PART I ANNEX

Annex I-1 Surveyers of Evaluation Team

Name	Attached to	Position or job title	Function of the project
Dr. Shigeo Ueki	Japan Consulting Institute	General Manager of Technical Dept.	Project Leader (General management)
Mr. Masayasu Sakanashi	UNICO International Corp.	Senior Techno-economist (Group Manager, Manager of Project Planning and Research)	Sub-leader, General economics (including the whole chemical industry), Policy for fertilizer market, management problems, financing plan, financial and economic evaluation of the project
Mr. Tetsuo Inooka	UNICO International Corp.	Agro-economist (Expert on fertilizer market research)	Research on agriculture and fertilizer market in ASEAN countries, supply/demand forecast and sales plan for nitrogenous fertilizers
Mr. Shohei Maeno	UNICO International Corp.	Senior Project Engineer	Examination of ammonia and urea plant, site survey, construction planning, organization · staff planning
Mr. Shozo Inakazu	UNICO International Corp.	Senior Project Engineer	Site survey, examination of utility facilities and auxiliary facilities, and estimation of total construction cost of the project
Mr. Yoshiharu Nishida	UNICO International Corp. (Non-regular employee)	Project Engineer	Examination of gas intake facilities and estimation of construction cost
Mr. Kazuo Hayata	Japan Consulting Institute (Non-regular employee)	Civil Engineer	Survey on soil and geographical conditions of plant site and land infrastructure, civil engineering and construction design, design and cost estimation of land infrastructure facilities
Mr. Kennosuke Watanabe	Japan Consulting Institute (Non-regular employee)	Civil Engineer	Survey on coastal conditions of plant site, harbor facilities and estimation of construction cost
Mr. Tsuneo Miyauchi	Mitsui Ocean Development & Engineering Co., Ltd.	Civil Engineer	Survey on oceanographic meteorological and oceanographic conditions, design and estimation of harbor facilities
Mr. Daishiro Kasahara	Japan Oil Engineering Co., Ltd.	Senior Petroleum Engineer	Study on gas suppliability
Mr. Tomotoshi Kamita	Japan Consulting Institute	Project Engineer	Study and analysis of factors for construction cost estimate
Mr. Kohsuke Irie	UNICO International Corp.	Financial Analyst	Study and analysis of financial analysis factors and laws concerned with the project

Annex I-2 List of Attendants of Indonesian Counterpart Team

INDONESIAN COUNTERPART TEAM

1.	Chairman:	-	Ir. Hartarto Director of Fertilizer and Petrochemical Industries Directorate General of Chemical Industries
2.	Deputy Chairman:	-	Mr. Ilchaidi Elias S.E. Chief of Finance Bureau Ministry of Industries
3.	Secretary:	-	Ir. M. Pulungan Secretary Directorate General of Chemical Industries Ministry of Industries
4.	Sub Market Team:	-	Drs. Dalil Hasan Director, P.T. PUSRI
		-	Mr. Wardoyo Assistant Secretary of Intensification Program (BIMAS), Ministry of Agriculture
		-	Ir. Nico Kansil Directorate General of Chemical Industries
		-	Mr. M. Saubari Directorate General of Foodcrops Ministry of Agriculture
		-	Drs. Bachrum S. Harahap Directorate General of Chemical Industries

- Ir. Sudharyono Mustafa
  Marketing Manager
  P.T. PUSRI

- Mr. Lusri
  P.T. PUSRI

- Mr. Wahab
  P.T. PUSRI

5. Sub Technical Team:

- Ir. Supratignyo
  Directorate General of Chemical Industries

- Dr. Ibrahim Hasan
  Chief, Aceh Regional Planning Agency (BAPPEDA)

- Ir. Kotan Pasaman
  Director
  P.T. PUSRI

- Dr. Entol Suparman
  Chief of Planning and Development Bureau
  P.T. PUSRI

- Ir. Rahman Subandhi
  Directorate General of Chemical Industries

- Drs. Ir. M. Sunyoto
  Directorate General of Sea Communication
  Ministry of Communication

- Ir. Sukapto
  Directorate General of Chemical Industries

- Mr. Darmasto
  Ministry of Public Works and Electrical Power

- Ir. Kusmono
  Directorate of Chemical Industries

- Ir. Sugito
  Ministry of Public Works and Electrical Power

6. Sub Gas Team:

- Ir. Sumbarjono
  Directorate General of Oil and Gas
  Ministry of Mining

- Ir. Pandjaitan
  Directorate General of Oil and Gas

- Ir. Effendi Daud
  P.T. PUSRI

7. Sub Finance and Economic Team:

- Drs. Sofyan Djajawinata
  Director
  Directorate General of Monetary Affairs
  Ministry of Finance

- Drs. Astar Siregar
  Director
  Ministry of Finance

- Mr. Djasril Djarib
  Ministry of Finance

- Mr. Kudri
  Ministry of Finance

- Mr. Yanda Muhanmad
  Bank Indonesia

- Drs. Abdaoe
  Director
  P.T. PUSRI

- Mr. Tjahjono
  Directorate General of Chemical Industries

- Mr. Bruce Heim
  Consultant
  P.T. PUSRI

- Drs. Sueb
  P.T. PUSRI

Annex I-3 On-the-Spot Survey Schedule

In conducting the below-mentioned surveys, the survey team was divided into four groups:

1. Market research (market research group)
2. Survey related to natural gas supply (gas survey group)
3. Research on technological problems (technological group)
4. Financial and economic appraisals (financial and economic survey group)

The market research group conducted research on chemical fertilizer markets centering on urea in Malaysia, Thailand and the Philippines from February 16 through March 5, and the technological problems research group made a survey on this project's support capability in Singapore on March 6 and 7.

The outline of the on-the-spot surveys was as follows:

February 5	(Sunday)	Arrangements on the schedule.
February 6	(Monday)	Arrangements at the Embassy. Plenary meeting and sub-committee meetings at the Ministry of Industry.
February 7	(Tuesday)	Plenary session and sub-committee meetings.
February 8	(Wednesday)	Sub-committee meetings.
February 9	(Thursday)	Sub-committee meetings.

February 10	(Friday)	Sub-committee meetings. Arrangements at MIGAS.
February 11	(Saturday)	Visit to P.T. PUSRI. Plenary session and sub-committee meetings.
February 12	(Sunday)	Return to Jakarta.
February 13	(Monday)	Sub-committee meetings.
February 14	(Tuesday)	Plenary session. Sub-committee meetings. Arrangements with local consultants.
February 15	(Wednesday)	Sub-committee meetings.
February 16	(Thursday)	Nine members move to Lhokseumawe; on-the-spot survey. Two members move to Malaysia (market research group).
February 17	(Friday)	On-the-spot survey and arrangements. Research on the fertilizer market in Malaysia (market research group).
February 18	(Saturday)	On-the-spot survey; surveys on LNG plants and the Arun gas field. Two members go to Banda Aceh. A courtesy call on the Governor. Research on the fertilizer market in Malaysia (market research group).
February 19	(Sunday)	On-the-spot survey (four members). Four members move from Lhokseumawe to Medan. Two members move from Banda Aceh to Medan. The market research group moves from Kuala Lumpur to Bangkok.

February 20	(Monday)	(National holiday) Four members move from Lhokseumawe to Medan. Research on the fertilizer market in Thailand (market research group).
February 21	(Tuesday)	Visit to the Consulate in Medan. Visit to P.T. Indonesia Asahan Aluminum. Visit to PERTAMINA Unit 1. Research on the fertilizer market in Thailand (market research group).
February 22	(Wednesday)	Visit to the urea terminal of P.T. PUSRI. Move from Medan to Jakarta. Research on the fertilizer market in Thailand (market research group).
February 23	(Thursday)	Internal arrangements. The market research group moves from Bangkok to Manila.
February 24	(Friday)	Visit ot the P.T. PUPUK Kujang fertilizer plant. Research on the fertilizer market in the Philippines (market research group).
February 25	(Saturday)	Arrangements with those concerned of the Water Resources Department, the Geological Survey Department and the Public Works Ministry. Arrangements with MIGAS. Research on the fertilizer market in the Philippines (market research group).
February 26	(Sunday)	One member of the market research group moves from Manila to Jakarta.
February 27	(Monday)	Arrangements with MIGAS. Research on the fertilizer market in the Philippines (market research group).

February 28	(Tuesday)	Sub-committee meetings. Research on the fertilizer market in the Philippines (market research group).
March 1	(Wednesday)	Plenary session. Arrangements with MIGAS. Research on the fertilizer market in the Philippines (market research group).
March 2	(Thursday)	Plenary session Preparation of an interim report. Research on the fertilizer market in the Philippines (market research group).
March 3	(Friday)	Report the survey results to the Ambassador. Arrangements with the counterpart on the contents of the interim report. Research on the fertilizer market in the Philippines (market research group).
March 4	(Saturday)	Plenary session. Submit the interim report. Research on the fertilizer market in the Philippines (market research group).
March 5	(Sunday)	Eight members leave Jakarta for home. One member leaves Manila for home. Three members move from Jakarta to Singapore.
March 6	(Monday)	Visit to Jurong Shipyard Ltd., Jurong Engineering (Pte.) Ltd. and Mitsui Toatsu Bulk Urea Terminal; arrangements (technological group).
March 7	(Tuesday)	Visit to South Eastern Development & Engineering Services (Pte.) Ltd.; arrangements (technological group).
March 8	(Wednesday)	Three members leave Singapore for home.

Annex I-4-1 Answers to the Questionnaire Submitted by the JICA Team on ASEAN Urea Project (Indonesia)

I. New Company (ASEAN Urea Project (Indonesia)).

1. Time schedule for incorporation of the project company will be as follows:

   a. It is proposed to convene a meeting of shareholding entities in Jakarta on 24-28 July 1978 to finalize the Draft Joint Venture Agreement and the Draft Articles of Association.

   b. The final draft of the Joint Venture Agreement and the Articles of Association will be submitted for approval by COIME at its next meeting scheduled to be convened in Manila in August 1978.
   The COIME has been authorized by the ASEAN Economic Ministers to approve the aforesaid documents on their behalf.

   c. Upon approval of the aforesaid documents by COIME, the Project company can be incorporated.

   Besides the above time schedule pertaining to the incorporation of the Project Company it is also important that the loan negotiation shall be conducted as soon as possible so that the contract with the General Contractor shall become effective at the latest on January 1, 1979.

2. The debt/equity ratio for financing of the Project will be 70/30. Out of the 30% equity capital the host country originally was to take up 60% and the balance of 40% to be shared equally by the other ASEAN member countries.

   The equity participation for this project, however, has been changed in view of Singapore intention of having only a nominal participation of 1% of the total equity capital in this Project and consequently the projected equity participation for this Project will therefore be as follows:

Indonesia (host country)	60%
Malaysia	13%
Philippines	13%
Singapore	1%
Thailand	13%
Total:	100%

3. The mode of subscription and payment of shares will be stipulated in the Joint Venture Agreement and payments will be done in installments on a quarterly basis and in proportion to the equity share of the shareholding entities of the ASEAN member countries.

   The draw down schedule for the equity and loan is based on the financial requirements for the construction and commissioning of the Project.

4. The sources of finance for the equity capital will be the responsibility of the individual ASEAN member countries to decide. In the case of Indonesia it will be by Government equity finance extended directly to P.T. PUSRI which is the Indonesian shareholding entity in the Project Company.

II. As P.T. PUSRI will be the shareholding entity representing Indonesia in the Project Company, its execution will be realized with the full assistance of P.T. PUSRI especially in relation to the recruitment and training of plant operating personnel. P.T. PUSRI will also be assigned as the marketing agent for the product from this Project Company. This condition, however, will be subject to the approval of the shareholders of the Project Company.

III. The selection of Technical Advisor will be at the discretion of the Management of the Project Company.

We fell, however, that Technical Advisor will be needed and should be selected on an objective basis taking into account the qualification, experience, etc. of the candidates.

IV. The Project Company will take the form of a P.T. (Limited Liability Company) based on Indonesian law and as such the Board of Management will comprise a Board of Managing Directors (Direksi) under the supervision of a Borad of Supervisors (Dewan Komisaris) which shall be responsible for running of the Project Company.

It is agreed that the Project Company shall be managed by a Board of Managing Directors consisting of a President Director to be nominated by the Indonesian Party assisted by at the most four Managing Directors, one of whom shall be jointly appointed by the Parties other than the Indonesian Party. The Board of Managing Directors will be under the supervision of a Board of Supervisors. The Board of Supervisors consist of maximum ten (10) members including one (1) from each shareholding entity other than the Indonesian Shareholding entity. One of the members of the Board of Supervisors shall be appointed as the President of the Board of Supervisors by the Shareholders' Meeting.

V. Financing Arrangements

1. Foreign currency

a. The foreign currency portion is expected to be obtained entirely as loan capital.
Indonesia as the host country has been authorized to negotiate the terms and conditions of the loan capital on behalf of the ASEAN member countries and to report the results of such loan negotiation to them.

b. This matter will be discussed during the loan negotiation.

c. Responsibility for additional loans.
The (draft) Joint Venture Agreement contains a provision that the Project Company shall be responsible for the raising of additional loan to cover any cost overrun.

2. Local currency portion

a. The financing of local currency portion will as far as possible be covered by the equity capital.

b. Raising of additional funds, if required, will be the responsibility of the Project Company.

VI. At the Sixth Meeting of the ASEAN Economic Ministers held in Jakarta on 5-7 June 1978 the following agreements, among others, have been reached pertaining to the legal framework on ASEAN Industrial Projects:

1. Basic Agreement on ASEAN Industrial Projects which covers the following aspects:

    1. Purposes and principles.
    2. Equity.
    3. Board of Directors.
    4. Financing.
    5. Preferential Trading Arrangements (PTA).
    6. Taxation.
    7. Incentives.
    8. Repatriation of foreign exchange.
    9. Protection of minority shareholders.
    10. Pricing principles.
    11. Project scope.
    12. Institutional arrangements.
    13. Consultation.
    14. Bankruptcy.
    15. Special provision.
    16. Entry into force.
    17. Amendments.

2. Supplementary Agreement to the Basic Agreement on ASEAN Urea Project (Indonesia) which covers the following aspects:

    1. Joint Venture Agreement.
    2. Gas price.
    3. Market support.
    4. Pricing.
    5. Firmly planned projects.
    6. Amendments.

3. It was agreed that at the latest within one (1) month after the approval by the ASEAN Economic Ministers of the Basic Agreement on ASEAN Industrial Projects and the Supplementary Agreement pertaining to the ASEAN Urea Project (Indonesia), ASEAN countries shall nominate their respective shareholding entities

so that the Joint Venture Agreement can be finalized and signed by the entities concerned and the Project Company incorporated.

Jakarta, July 7, 1978

Indonesian Team

Annex I-4-2 The Management of P.T. ASEAN Aceh Fertilizer

1. The company shall be managed by a Board of Managing Directors and will work under the supervision of a Board of Supervisors.

2. The Board of Managing Directors consist of a President Director who shall be nominated by the Indonesian party and assisted by at the most four Managing Director one of whom shall be jointly appointed by the Parties other than the Indonesian Party.

3. The Board of Supervisors consist of at least 6 (six) members and not more than 10 (ten) members, including one from each shareholder entity, other than the Indonesian shareholder entity of which amongst them one shall be appointed as President Supervisor by the shareholder meeting.

4. The quorum and votes necessary in the meetings of the Board of Supervisors shall be at least 2/3 votes except in major issues which would need 3/4 votes.

5. For the following transactions, approval of the Board of Supervisors is required by the Board of Managing Directors:

   a) to bind the company as guarantors

   b) to borrow money on behalf of the company if the amount is in excess of US$50,000.

   c) to lend money entrusted to the company if the amount is in excess of US$50,000.

   d) to enter into any contract involving on expenditure by the company in excess of US$50,000.

   e) to acquire, alienate or encumber real properties of or on behalf of the company.

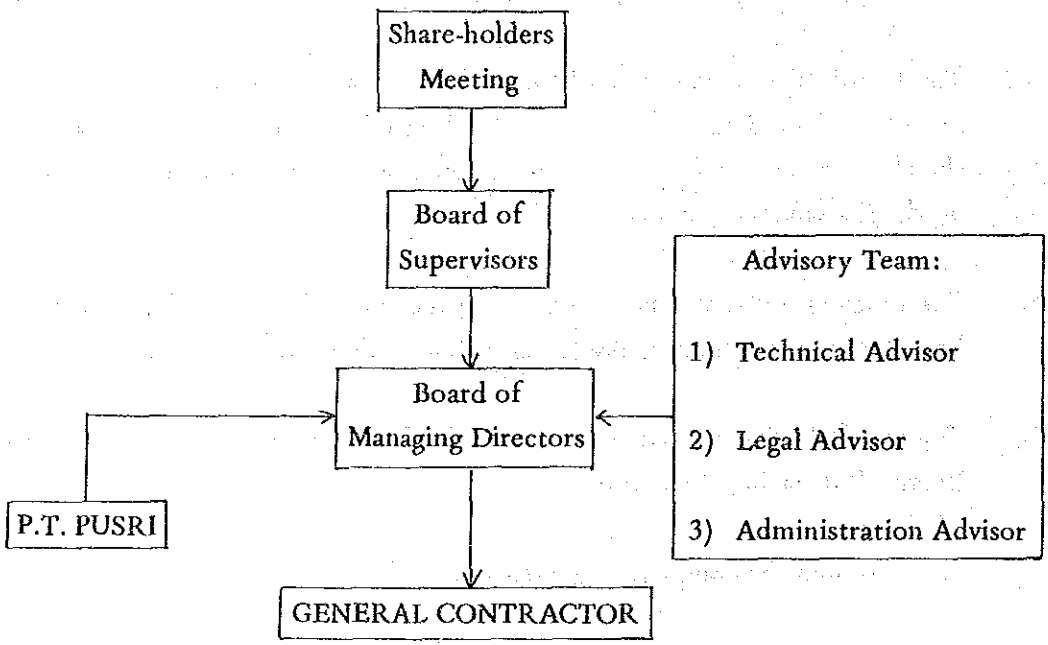
   f) to grant general powers of attorney.

   g) to submit disputes to the judgement or arbitrators.

h) to engage in legal proceedings as plaintiff to enter into out-of-court settlements of claims brought against the company with the exception, however, of taking conservatory and urgent measures.

i) sales allocations, pricing policies and other terms of sale particularly sales to ASEAN members.

6. The structure of the Management is as follows:



PART II ANNEX

Annex II-1 Present Status and Future Prospect of Supply/Demand Balance of Nitrogenous Fertilizers (Particularly Urea) in the ASEAN Countries

1-1 Indonesia

1-1-1 Features and trend of Indonesian agriculture

(1) Natural environment and agriculture

1) Agricultural land

The total land area of the Republic of Indonesia is 190,457 thousand ha., and the country consists of 13,667 islands. Of these, only 931 islands are presently inhabited. The Island of Kalimantan occupies 28% of the total land area of Indonesia, while Sumatra occupies 25%, Irian Jaya 22%, Sulawesi 10%, and Jawa and Madura together 7%.

As shown in Annex II/Table 1-1-1*), the agricultural land area (including agricultural residential area) accounts for 16,393 thousand ha. (according to 1973 census) which corresponds to only 8.6% of the total land area, while 64.2% of the total land of the nation is covered by forest. Except for Jawa and Bali-Nusa Tenggara, all the islands of Indonesia contain 50% to 80% of forest area.

Of the total agricultural land of Indonesia, 37.7% is located in Jawa. The total land area of Jawa, Sumatra, and Bali-Nusa Tenggara accounts for only 35.7% of the total national land area; however, these islands alone occupy 76.4% of the total Indonesian agricultural land area.

It is commonly accepted that the necessary extent of forest reservation is about 30% of the total land area of a country. From this viewpoint, it is obvious that Jawa and Bali-Nusa Tenggara have already been overdeveloped, while all the rest of the islands of Indonesia still are largely under developed agriculturally. Owing to the above reason, intensified agricultural cultivation with intense labor on the limited agricultural land area is observed in Jawa, whereas the

Note: *: Table numbers and Figure numbers referred to hereafter are those numbers in Annex II, otherwise specified.

extensive agricultural cultivation such as that on burnt field is observed on other islands.

2) Natural conditions

Indonesia has two seasons in a year; the east monsoon season (dry season) from June to September and west monsoon season (wet season) from December to March. April/May and October/November are transient periods from one season to the other. During the east monsoon season, the land is exposed to easterly or southeasterly wind, and is covered by continental air. During the west monsoon season, the wind blows from the west or northwest, placing the whole country under wet oceanic air.

Except for some areas, the annual precipitation runs from 1,500mm to 2,500mm. Over 40% (over 60% in some areas) of the annual precipitation is during the wet season.

The climate ranges from 21°C to 33°C except in some mountainous regions, but generally speaking, the annual average temperature is about 30°C without showing any significant fluctuation. Humidity averages between 60% to as high as 100%.

As seen in the foregoing, Indonesia enjoys favourable conditions for agriculture throughout the year as far as the climatic conditions are concerned. Despite this condition, the multiple cropping ratio in Indonesia is not so high as expected. It can be attributed to the lack of irrigation water required for the multicropping.

(2) Structural features of the Indonesian national economy, and the position of agriculture in the economy

In the period before independence of Indonesia, about 30% of the total national income of Indonesia was dependent upon exportation. (The export dependency of national income was 34.7% during 1920-24, and 28.4% during 1935-39.) The rate occupied by agricultural products in the exportation was extremely high. Of the agricultural export products, the estate products took up an importantly large portion.

As depicted by Table 1-1-2, the exportation which has traditionally been the main support of the Indonesian national economy has remained on a rapid downward trend since 1957.

From 1966 onwards, the export ratio as opposed to GDP began to increase. The ratio attained a level of 21% as of 1973. (Owing to the increase in the oil price, the ratio in 1974 was further improved to 29%). During this period, the importance of mineral products in the total exportation had increased. And particularly after the Oil Crisis in 1973, the significance of the mineral products as export items became increasing high owing to the oil price hike. Since the Oil Crisis, the rate occupied by mineral products in the total Indonesian exportation has been over 50%. As a result of this growth, the share of agricultural products in the total exportation has been diminished. Within the agricultural export items, the forest products have been showing an increase, while the portion of estate products and small-holding agricultural products is continually declining.

In view of the portion of agricultural production in GDP, the situation during this period presents a somewhat different story. Table 1-1-3 shows the past trend of changes took place in the industrial-sector-wise structure of GDP. During pre-1965 years, the agricultural sector kept occupying about 50% while showing little change in its importance. The importance in the structure as well as the production in value by agricultural sub-sectors did not show any significant change, either.

Since 1966, the GDP growth has particularly been conspicuous in the mining sector. At the same time, secondary and tertiary industries began to show a gradual growth. Consequently, the relative importance of the agricultural sector, in spite of its own growth, has been suppressed. Within the agricultural sector, the growth achieved by the food crop sub-sector was highest of all in this respect.

Nevertheless, even if the relative position of agriculture has thus been lowered, the agricultural production in 1975 still occupied as much as 36.8% of the total GDP of Indonesia. In view of labour structure of the country, about 60% of the labour force in the country is still engaged in agricultural production. In view of these facts, it is obvious that agriculture in Indonesia is still occupying an important position within the framework of the national economy.

Further, along with the progress in the industrialization, Indonesia has also been experiencing the concentration of population in urban areas. The securing of food

supply in these areas has therefore become an important problem. Consequently, the government is trying hard to promote intensive agricultural production as will be explained in detail later.

(3) Agricultural structure

The agriculture of Indonesia consists of estate agriculture and small-holding agriculture. The estate agriculture concentrates on the production of export crops such as rubber, coconuts, coffee, sugar, etc., while the small-holding agriculture engages mainly in food crops such as rice, maize, cassava. Along with the penetration of the system of monetary economy into rural areas, the small-holding agricultural sector also began to engage in the production of export crops on a small scale. Today, the large portion of rubber and coffee is produced by small-holdings.

In the case of Indonesia, the estate agriculture has its origin in the large-scaled agricultural operation established during the first half of 19th century. At present, 353 estates are owned by the government. These are divided into 28 groups on the basis of geographic location and types of crop products, thereby forming 28 enterprises.

On the other hand, the land ownership in the case of the small-holding agriculture is quite small in scale when compared to the estate agricultural operation as shown by Tables 1-1-4 and 1-1-5. About 70% of the total small holder farmers own individually less than 1 ha. of agricultural land. The percentage of those farmers possessing an agricultural land area of more than 3 ha. accounts for only about 6%. In order for Indonesia to attain the increase in food production, it is essential to promote fertilizer application among these small-scale farmers, and therefore, a pertinent credit system for fertilizer purchase and a suitable extension system for technical assistance on fertilizer application for these farmers is a must for any success in this venture.

The trend of the crop-wise cropping area is shown in Figure 1-1-1. Figures 1-1-2 and 1-1-3 give the structural ratio of the cropping areas. Of the food crops, the maize growing area has been falling, while the rice cropping area has been increasing. In the case of estate crops, the cropping of coconuts has been showing an increase. Further details concerning the trend of cropping will be given in Paragraph 1-1-3.

(4) Past trend and future direction of agricultural policies

The Indonesian live mainly on rice with maize and cassava filling in due to a shortage. The potential demad for rice has been increasing along with the increase in the income of people. Also, the concentration of population in urban areas has constantly been generating additional demand for rice. In addition to these economic factors, the Indonesian population has been growing at an annual rate of about 2.3%, thereby necessitating a rice production increase by at least 2.3% every year in order to cope with the growing population.

On the other hand, until 1965, almost no increase had been made in terms of per hectare yield of rice. Consequently, the per capita rice production has been showing a downtrend as shown in Table 1-1-6. In order to cope with such a situation, the Government of Indonesia has continually been placing an emphasis upon the food crop production increase. These governmental efforts have so far been embodied in the village training center program of 1950, the three-year rice production increase plan of 1959 centering on the rice cultivation centers, the DEMAS program of 1963, and also the BIMAS program series which have been under way since 1964.

These programs are all based on the reinforcement and extension of utilization of high yield varieties, fertilizers and agricultural chemicals, etc. combined with provision of loans for farming activities. The BIMAS and INMAS programs began to show the effects gradually, thereby materializing increase in per hectare yield. At the same time, the agricultural land area covered by these programs increased to as much as 62% of the total rice cultivation area of the country as of 1976. In addition, these projects which originally covered rice production alone have been expanded to secondary food crops.

Another approach to the food crop production increase is the expansion of the agricultural lands. Except for Jawa, the many islands have potentiality to expand their agricultural area. In order to implement this plan, the government is encouraging an immigration program to disperse the population to islands outside Jawa. Immigration from Jawa Island to the other islands is being carried out with the highest rate of population shift from Central Jawa to the other islands, followed by the population emigration from East Jawa and West Jawa. Lampung Province is receiving the highest number of these immigrants from Jawa Island. Lampung is receiving about 50% of all the population outflow from Jawa, followed by South Sumatra and Kalimantan States.

Inside Jawa Island on the other hand, there is no land left for further agricultural land development. Therefore, in Jawa instead of physical expansion of the lands, the development of multiple cropping has been set at a goal to be attained through expansion of irrigation systems. Along this line, a number of projects on expansion of irrigation systems are being implemented under financial support by the World Bank, etc.; however, the pace of expansion so far has not been high.

As discussed in the above, the major emphasis of Indonesian agricultural policy is placed on food production increase, and the production growth is intended to be geared by the promotion of intensive cultivation. Within this framework, the extension of high yield rice varieties is one of the key points of the project. Since high yield rice varieties require a higher level of fertilizer application, the extension of fertilizer application on the part of the farmers is one of the most important points in the Indonesian agricultural policy.

1-1-2 Past trend and present status of fertilizer supply/demand balance in Indonesia

(1) Fertilizer demand and governmental policies concerning the promotion of demand for fertilizers

1) Prior to 1972

Statistics on national fertilizer demand in Indonesia were not available in the past. The national demand was estimated in National Fertilizer Study conducted in 1971, and the actual data on demand began to be accumulated thereafter as given in Table 1-1-7. The data on demand up until 1966 is not available, and therefore, it can only be estimated from the data on import and domestic production.

From 1968 until 1973, the fertilizer consumption had begun to grow significantly. The growth in the fertilizer consumption was particularly conspicuous in food crop sector. It is possible to enumerate the following points as the reasons for such a progress:

1. The government placed a particular emphasis on the production of food crops.

2. The fertilizer distribution system was significantly improved.

3. The fertilizer importation became comparatively easy due mainly to the reduction in the import prices.

The introduction of the INMAS Program in 1967 also contributed to the growth in the consumption of the fertilizers. The INMAS Program was implemented as a back-up to the BIMAS Program. Within the framework of the INMAS Program, the payment by the farmers for the purchase of the fertilizers has to be made in cash; however, the farmers are allowed to utilize subsidized fertilizers.

Since 1968, the high yielding varieties (HYVs) of rice have been introduced. Because the application of fertilizers on HYVs is more advantageous than in the case of conventional varieties, the introduction of HYVs also may have been one of the factors contributing to the outstanding growth in the fertilizer consumption.

2) After 1973

The fertilizer demand which showed a rapid increase up to 1973 started to stagnate during a period from 1973 to 1976. One of the causes for the stagnation was a hike in the import prices of fertilizers. Another cause was a consequential strict prohibition of application of subsidized fertilizers to crops other than rice. However, during 1977, the demand again showed an outstandingly high rate of increase which amounted to 23% over the previous year's level. The following paragraphs will give a historical and chronological account concerning the governmental policies for the promotion of fertilizer demand undertaken during this period. These various governmental policies are most likely to be the basic elements which caused such a fluctuation trend in the demand for fertilizers.

a) Limitation on the use of subsidized fertilizers

Even prior to 1973, the subsidized fertilizers were permitted to be applied only to the paddy. In practice, however, paddy farmers after purchasing the subsidized fertilizers often resold the fertilizers to estate farmers, etc.

However, in 1973 the government began to strictly control the re-selling practice of the subsidized fertilizers. The purchase and utilization of the subsidized fertilizers were strictly limited to paddy farmers. Governmental control

in this respect was so strict that those who did not cultivate a paddy could not even go near fertilizer distribution stations. This governmental restriction was relaxed in early 1974 to include the secondary food crops as the subject crops for subsidized fertilizer application. Near the end of 1975, the application of the subsidized fertilizers was allowed to horticultural farmers participating in the BIMAS/INMAS Programs. In October of 1973, the governmental restriction concerning the use of the subsidized fertilizers was completely abolished because of the relaxation in the supply/demand balance of fertilizers, and the application of the subsidized fertilizers was extended to include the estate crops. At present, the government is positively encouraging the promotion of fertilizer consumption for all types of crops.

b) Loans as fund for purchasing fertilizers

The governmental loans to the farmers for providing the fund for purchasing fertilizers have been made within the framework of the BIMAS Program. However, one of the problems in this system was that those farmers who failed to repay the loans were excluded from the BIMAS Program in the following year so that the increasing number of failing farmers began to form a great obstacle in further promotion of the BIMAS Program. In order to improve the repayment problems, the government introduced a new repayment system in 1971. The new system counts two seasons as one cycle as far as the repayment is concerned. That is, the former system required that all the loans extended, say, for the dry season be repaid by the end of the dry season. On the other hand, in the new system, the repayment could be deferred until the end of the rainy season which follows the dry season. This system prevents the creation of insolvent farmers because of the unexpected failure in cropping for the season upon which the governmental loan was provided. Thus, the farmers under the new system have another chance of meeting the repayment obligations by the cropping in the following season.

In 1973, the government further improved the system to solve the repayment problems. In addition to the above-mentioned two-season one-cycle system, farmers suffering from crop failure are now entirely relieved from the repayment obligations or will be given further deferment. If a farmer should fail to harvest more than 15% of an average yeild he will be released from the repayment obligations. Those farmers whose harvest ranged from 15% to 85% of their average yield level will be entitled to receive deferment in repayment

beyond the two-season one-cycle obligations. The extent of deferment would depend upon the severeness of the failure.

c) Policies to secure necessary supply of fertilizers

In view of a bitter experience in a price hike of fertilizers in the international market causing a supply shortage, the Government of Indonesia implemented fertilizer stockpiling policy during 1974-1975 period. As a result, fertilizer import rapidly grew these two years, and the fertilizer inventory also increased to a great extent. During 1977 with the acute increase in the inventory of fertilizers and the stagnation in the domestic demand resulted in fertilizer exportation from Indonesia.

d) Governmental policies concerning the fertilizer prices and fertilizer subsidy

The government controls the establishment of official prices for urea, TSP, DAP, and complex fertilizer with NPK nutrient of 15-15-15. The government fixes the importer's or fertilizer manufacturers' sales prices on one hand, and the retail prices on the other. It follows that the distribution cost and the commission for the fertilizer distributors are fixed to a certain level.

Concerning the subsidy, no subsidy payment is made directly to the farmers. The subsidy is made to the fertilizer manufacturers and/or fertilizer importers in the form of compensation for the difference between the actual import prices/production cost and the governmentally fixed prices.

e) Reinforcement of fertilizer distribution system

In the case of Indonesia, the fertilizer consuming points are widely scattered among a number of islands. Therefore, it is highly important for the country to improve distribution system so that the necessary amount of fertilizers will be delivered to the farmers as and when it is necessary with a reasonable distribution cost. In order to cope with this problem, the Indonesian Government has been trying to reinforce the fertilizer distribution channels and to improve the fertilizer distributing system under the financial assistnce extended by the World Bank. Table 1-1-8 shows an outline of the existing fertilizer distribution system in Indonesia.

(2) History and present status of the fertilizer industry in Indonesia

1) Past trend of fertilizer importation and fertilizer supply

Until 1963 when PUSRI I began the production of urea, the supply of nitrogenous fertilizers in Indonesia was entirely dependent upon importation. Even after the commencement of the production by PUSRI I, Indonesia had to continue importing a vast amount of fertilizer in order to catch up with a rapid expansion in the demand for fertilizers. The second fertilizer manufacturing plant in Indonesia after PUSRI I was constructed by Petrokimia in 1972, eight years after the onstream of PUSRI I. However, the growth in the demand for fertilizers in the meantime was enormous, thereby compelling Indonesia to continue a large amount of importation.

Thereafter, PUSRI II, III and IV were completed in 1974, 1977 and also in 1977 respectively. Since the start of operation of these plants, stable sources of supply of nitrogenous fertilizers were made available inside Indonesia. The trend of fertilizer production and importation during these years are shown in Table 1-1-7. In Indonesia, production of fertilizers is exclusively undertaken by state-operated fertilizer companies.

2) Past trend of production

The production capacity and corresponding actual production of these fertilizer manufacturing plants in Indonesia are shown in Table 1-1-9. As shown in this table, the level of operational rate at these plants has been maintained at an exceptionally high level as opposed to the other developing countries in the world. The reasons for such a remarkable high operational rate are as follows:

1. Thorough training of the operators was conducted during the initial period of urea plant operations in Indonesia. Thereafter, new plants were placed onstream one after another by these highly trained engineers acting as directors.

2. The maintenance and repair parts has been secured circumspectly. Further, the same types of plants were constructed one after another so that the securing of maintenance/repair parts would be comparatively easy and stable.

1-1-3 Future outlook on the fertilizer supply/demand balance in Indonesia

(1) Outlook on fertilizer demand

1) Past trend and future outlook on factors affecting the level of fertilizer consumption

a) Forecasts formulated in the past upon the fertilizer supply/demand balance in Indonesia

Tables 1-1-10 and 1-1-11 are representative forecasts formulated so far on the subject of fertilizer demand concerning Indonesia. Figures 1-1-4 and 1-1-5 graphically illustrate the results of these forecasts in a form of comparison.

The 'National Fertilizer Study, Indonesia (NFS)' conducted in 1972 served as the basis for various fertilizer demand forecasts on Indonesia. However, already at the time of estimating actual achievements for the year 1971, which was the year employed as the base year for the NFS forecast, the actual figures exceeded the forecast figures. Thereafter until 1974, the actual achievements continued to exceed the forecast figures. Because of the abnormal hike in prices of fertilizers which have taken place since 1974, the demand preceeded to stagnate. Consequently, the actual figures and the forecast figures began to come closer. However, in 1977 when the demand started to recover, the actual figures again began to exceed the forecast. Therefore, the forecast made in the NFS seems to too conservative in reflecting the status of fertilizer consumption in Indonesia.

The forecast made in the 'Next Fertilizer Plant in Indonesia' was compiled on the basis of the estimated actual achievements for the year 1972. The forecast figures have constantly been higher than the actually achieved figures for the forecast period because of the above-mentioned demand stagnation which began to appear since 1974.

Nevertheless, as soon as the demand showed the recovery in its grwoth during 1977, the actual achievements made at the time caught up with the low case figure in this forecast in spite of the continued stagnation during a three year period prior to 1977.

In this connection, the future growth in the demand is expected to be higher than that projected and therefore, the estimation made on the future growth of demand in this forecast seems rather conservative.

A forecast made in the recently conducted 'National Fertilizer and Pesticide Distribution Study (NFPDS)' shows vastly lower actual achievement figures than the forecast figures concerning the first year of the forecast period. This trend of lower actually achieved figures than the forecast figures is still persistent even in 1977 when the demand actually recovered. (This NFPDS forecast was adopted in the 'Fertilizer Marketing Study, ASEAN Region' which was employed as the basis for the market evaluation in the Project Proposal made by the Indonesian Government.)

In the following paragraphs, an independent demand forecast will be conducted. This new forecast will be made by reviewing and reexamining the various factors affecting the trend of fertilizer consumption which were studied in the above-mentioned various forecasts taking into account the descrepancy described above. The proposed forecast will also incorporate new data and information made available since the compilation of these previous forecasts.

In formulating this new demand forecast, it is maintained that full incorporation of the following two points among others are indispensable in arriving at the validity of the forecast figures:

1. The demand during 1974-1975 period stagnated as a result of the acute hike in the fertilizer prices. Thereafter, particularly in 1977, a rapid recovery in the fertilizer demand took place.

2. It is likely that the Government of Indonesia will undertake fertilizer demand promotion policies much more positively than before as a result of the attainment of self-sufficiency in the supply of fertilizers within the country.

b) Outlook on the land use and the trend of cultivated areas by crop

As shown in Table 1-1-12, of all the agricultural land in Indonesia, paddy land accounted for 35 percent in 1963, and 42 percent in 1973, increasing the percentage gradually.

However, the agricultural land area in Indonesia decreased by 144 thousand hectares during ten years from 1963 to 1973, according to the agricultural censuses. Among the reduction, upland area occupied 1,393 thousand hectares of reduction, whereas the paddy land and land for perennial crops increased 765 thousand hectares and 484 thousand hectares respectively. The above changes in the land use, that is, increase in paddy land and decrease in upland, are especially conspicuous in the islands other than Jawa.

Increase in the paddy land has stimulated by the government's policy on increase in the food production, and as shown in Figure 1-1-1 the cropped area of paddy has increased steadily. The increase in the paddy land has been secured both by converting upland to paddy land and by developing uncultivated land. Since the possibility to raise double cropping ratio of existing paddy land has already been approaching its upper limit, there will be few possibilities to increase the cropped area of paddy by intensifying double cropping.

As for the perennial-crop area, as shown in Figure 1-1-1, the area cultivated by estates has shown no change in its area, with rubber cropped area being converted into oil palm cropped area, whereas the area cultivated by small holdings has increased due to the increase in rubber and coconut cropped area.

As far as the upland area is concerned, corn cropped area, which occupies the largest share in the total upland area, has shown a slight down trend in its cultivated area, fluctuating substantially year by year. The cassava cropped area, which occupies the largest share next to corn, has also shown a slight decrease. It is obvious that the above descrived trend in the change in the cropped area has resulted in the decrease in total upland area.

c) Analysis of crop-wise nitrogenous fertilizer consumption factors and future outlook

1. BIMAS/INMAS paddy cultivation

Historically, nearly all the nitrogenous fertilizer consumption in Indonesia has been made in the paddy cultivation. Among all the paddy growing farmers, it is safe to assume that the fertilizer application has so far been undertaken only by those farmers who have been participating in the

BIMAS/INMAS Programs. However, it is likely in the future that, along with the intensification of the fertilizer demand promotion policies on the part of the government, the fertilizer application practice will be extended gradually beyond the limitation of the BIMAS/INMAS farmers to include upland rice growing farmers and rain-fed paddy farmers. The nitrogenous fertilizer consumption by the paddy farmers other than BIMAS/INMAS farmers will be discussed later.

Estimation of the cropping area:

As shown in Table 1-1-12, the total paddy area in Indonesia has been growing slightly year after year. During a decade from 1963 to 1973, the paddy area grew at an annual rate of 1.7%. However, in the case of Jawa Island alone, the growth rate is only 0.4% per year. On the other hand, the growth in areas other than Jawa Island has been registered at an annual rate of 3.6%. This implies that Jawa Island has no more room for further expansion of paddy cultivation land except for slight conversion from upland to paddy land. Reflecting this situation, the emphasis of policy to promote the increase in food production in Jawa island is on the increase in per hectare yield. On the other hand, in areas outside Jawa Island, it is possible to assume that there are still uncultivated lands and also a potential switchover from the upland cultivation practice. However, in order for these regions to actually achieve the paddy area expansion, it is necessary to undertake the immigration of farmers into these areas. As one can imagine from 3.6% of the past annual growth rate of paddy land in these islands, in order to implement the immigration, Indonesia faces a number of difficult problems that must be solved beforehand. This being the circumstance, it has been assumed in this forecast that the expansion of the paddy area in Indonesia as a whole will not show any drastic uptrend in the future. The assumption here is that the future pace of paddy field expansion will be comparable to the trend registered in the past up to the present.

Two other important elements contributing to the increase in the cropping area are the increase in the irrigation area and the increase in the double-cropping rate. (Refer to Table 1-1-13.) Concerning the irrigation area rate, there has been a sound growth from 68% in 1973 to 76% in 1976. However, along with the increase in the irrigation area rate, the

necessity for expanding the irrigation to less favorable areas will become more and more necessary. Therefore, it is forecast that the growth of the irrigation rate will soon or later be suppressed. The upper limit of the future growth in the irrigation area rate is said to be at around 90%.

The double-cropping rate in the irrigated fields at present is 47%. This rate has been kept unchanged since 1973. In order to improve the double-cropping rate, it is necessary to secure an ample supply of water during dry seasons. In view of the fact that the above irrigated area includes the area irrigated by pump using the following water, and also in view of the fact that in these pump-up irrigated areas are not necessarily equipped with water storage facilities, it is likely that the securing of the water during the dry season has already been nearing the limit. Of the irrigated paddy area, those receiving fertilizer were limited to the fields owned by the farmers participating in the BIMAS/INMAS Programs. The rate of the land area covered by the Programs as against the irrigated field area varies depending on the season being dry or wet. The rate is higher during the dry season than during the rainy season. This is due to the fact that the fields in which the cropping can be undertaken during the dry season are those which are comparatively well located fields for securing water even during the dry season. By being owners of such well situated fields, the farmers are likely to show a high rate of participation in the BIMAS/INMAS Programs.

The area rate of the coverage by the BIMAS/INMAS Programs during the rainy season began to drop from the 82% achieved in 1973 to 76% in 1976. However, in 1977 the rate began to pick up to 90%. A similar trend is also noted concerning dry seasons. The rate for the dry season dropped from 91% to 79%. Thereafter, it went up to 93% in 1977. This has been due to the fact that the fertilizer application incentive had been declining because of a rapid deterioration of the product price/fertilizer price ratio. This slowed down the increase rate of the participating farmers, and the participation at one time even showing an actual decrease. As a result of the lowering of the fertilizer prices effected in 1977, the area coverage rate of the Programs began to show an uptrend. This deterioration of the product price/fertilizer price ratio was due to the heavy dependence of Indonesian agriculture upon the imported fertilizers. Upon gaining the self-sufficiency in the supply of fertilizers by use of the

indigenous natural gas as the raw material in the future, it is likely that such a vulnerability will be removed. Therefore, it is likely that the area coverage rate will further increase and that all the irrigated fields will be finally covered by the Programs.

Among the Programs, the importance of BIMAS kept reducing as compared to the INMAS until 1973 both for rainy and dry seasons. However, during 1974-1976, the importance of BIMAS continued to show a high level of importance. Then, in 1977, the BIMAS/INMAS field ratio returned almost comparable to that prevailing in 1973. The INMAS Program was established with an intention that those farmer who belonging to BIMAS Program have become able to purchase fertilizers with their own fund should shift to INMAS Program under which they are entitled to receive technical guidance. In view of this objective, it is a natural outcome that the rate of BIMAS coverage should gradually decrease. It is likely therefore that this downtrend will persist in the future. The BIMAS participation increase which took place during 1974-1976 could be regarded merely as a temporary phenomenon caused mainly by the farmers' fertilizer procurement fund shortage due to a hike in fertilizer prices.

Diffusion of HYVs is one of the major factors influencing the nitrogenous fertilizer consumption increase until 1973. The consumption rate has been steadily moving upward for both rainy and dry seasons. However, during 1974-1976, the incentive for planting high-fertilizer-consuming HYVs was suppressed due to the hike in the price of fertilizers, thereby causing a slump in the extension of HYVs. In the future, however, it is likely that the extension rate will keep increasing, as implied by a re-appearance of an uptrend in 1977, so that nearly all the irrigated lands will be eventually planted with HYVs.

Table 1-1-13 shows a forecast on the paddy and upland rice cropping area in Indonesia formulated on the basis of projections made in the above paragraphs.

Estimation of per hectare fertilizer dosage:

It was assumed here that all the farmers participating in the Programs have

so far been carrying out proper fertilizer application. The fertilizer dosage recommended by the 'BIMAS Package Program' is as follows:

For HYV (Maximum dosage for certain area):	115 kg N/ha.
For HYV:	92 kg N/ha.
For LV:	46 kg N/ha.

As shown in D of Table 1-1-14, the actual dosage levels as against those recommended levels are extremely satisfactory, with an exception of the INMAS during the rainy seasons, the recommended-dosage fulfillment rate being from 95% to 100% as of 1977. This high fertilizer dosage level which exceeds 90 kg N/ha. is outstanding in comparison to paddy farmers of other Southeast Asian countries. Even in the case of Japan and Taiwan where high fertilization is coducted to paddy, the level of dosage is approximately 100 to 120 kg N per hectare of fertilized area.

The following are the results of the field survey conducted for analyzing the fertilizer response of paddies. These results correspond well with the estimated fertilizer dosage amount and paddy cropping results of 1975 and 1976. It is therefore considered here that these survey results are truely representing the actual status of fertilizer response in paddy cultivation on the farmers' level.

Where no phosphate fertilizer was applied:

$$Y = 33.00 + 185.76X - 852.86X^2$$

Where 30kg P_2O_5/ha. was applied:

$$Y = 33.11 + 222.84X - 804.14X^2$$

(Notes):
Y = Paddy yield at 100kg/ha., X = nitrogenous fertilizer dosage tN/ha.

In the food-crop sector, the amount of phosphate fertilizer consumption has been equivalent to approximately one third of that of nitrogen fertilizers. At the same time, the BIMAS program package recommends phosphate fertilizer dosage at the level of around one third of the nitrogen-

ous fertilizer recommended level. In this connection, it is reasonable to employ the fertilizer response with 30 kg of phosphate fertilizer application in order to examine the optimum fertilizer application level in Indonesia. At present, the urea price is Rp 70/kg, while the price of rice is Rp 54/kg. The urea/rice price ratio at 1.3 is employed as one of the indexes by the Indonesian Government for establishing official prices of urea and rice, and it is expected that the official prices of these two commodities will be based on this index also in the future.

It is generally known that farmers will normally increase fertilizer dosage until the value/cost ratio of rice/fertilizers reaches down to 2.0. With the urea/rice price ratio being 1.3, and if the fertilizer dosage level is increased to a level at which the value cost ratio becomes 2.0, the maximum level of dosage will be 103.5 kg N/ha. when phosphate dosage = 30 kg P_2O_5/ha.

In the case that 30 kg P_2O_5/ha. is applied as the maximum fertilizer dosage level of 115 kg N/ha., calls for a urea/rice price ratio of 0.87 for such a level of dosage to become economically viable. It is therefore impractical to expect that all the paddies will receive a dosage of fertilizer at a level of 115 kg N/ha. It is however possible to attain this level in the case of well conditioned paddy fields. No further improvement beyond this level seems possible.

It is consequently out of question that the current recommended dosage level should be revised upward, unless some new varieties which call for a higher level of dosage for a higher advantage are introduced. It is however feasible that the actual application level is enhanced to the recommended level.

The potential dosage shown in Table 1-1-14 was calculated by weighted averaging of the recommended dosages on the basis of the variety-wise cropping area rate.

High Case and Low Case of projection on cropping area and per hectare fertilizer dosage:

In the foregoing paragraphs, assumptions were made as to the most likely projections on several factors which are deemed to give influence on the

demand for nitrogenous fertilizers applied to paddy cropping in Indonesia. The following paragraphs will discuss the extent of possible variation likely to take place in each of these factors.

Of these factors, the double cropping ratio over the irrigated area was estimated to be almost approaching the expected upper limit, in view of the difficulty to secure the necessary irrigation water. The actual trend of the ratio in the past has been fluctuating within a range from 44.9% to 47.5%, thereby showing a comparatively stable move. The standard deviation of the ratio is only approximately 1% in this case, so that the effects of change in the double cropping ratio upon the demand projection is estimated to be slight.

The expected upper limit of irrigation area ratio over the paddy fields is said to be at the level around 90% on the basis of the trend of past growth. In practice, it is almost impossible to assume the upper limit higher than 90%. In the Low Case, the upper limit has been set on an assumption that the present irrigation area ratio has already been nearing a physical limit.

The diffusion ratio of HYVs over the total irrigated area was assumed to attain a level of nearly 100% by 1990 for both wet and dry seasons. This assumption seems valid in view of the past trend of the diffusion of HYVs and also in view of the fact that the extension of HYVs is the point of emphasis within the framework of the governmental food production promotion programs. However, it is also possible that the diffusion of HYVs may be on a pace slower than the assumption made here. Such a case is incorporated in the 'Low Case'.

The analysis of the ratio occupied by the BIMAS and INMAS Programs within the governmental intensification program may be summarized as follows: So far, the ratio occupied by the BIMAS Program stayed within a range from 51% to 65% during wet seasons and from 33% to 44% for dry seasons except for a period from1974 to 1976. This ratio has been showing a long-term decline. This trend is likely to persist in the future if the fertilizer price is stabilized and the fluctuation of paddy yield does not show any abnormality. However, when taking into account the possible instability of the paddy yield, it is probable that the BIMAS ratio

will fluctuate by about 10% both upwards and downwards centering on the level of the Moderate Case. In view of this possibility, a case involving a fluctuation by +10% was incorporated in the High Case, and one involving -10% fluctuation was put in the Low Case.

Table 1-1-15 shows a forecast on the cropping area for High and Low Cases, while Table 1-1-16 gives the corresponding demand forecast.

2. Secondary Food Crops in the BIMAS/INMAS Programs

Supplementary crops to rice, maize, cassava, etc. have been considered to be important secondary food crops. Since 1974, the government approved of applying the subsidized fertilizers to these crops. At the same time, the BIMAS/INMAS Programs had also been introduced to the cropping operations of these secondary food crops.

Up to 1976, the nitrogenous fertilizer consumption by the secondary food crops has been insignificant. However, it is considered highly likely that nitrogenous fertilizer consumption by these crops will rapidly increase in the future as a result of further intensification of the production boost of these crops by the government, and also as a result of the intensification of fertilizer application to a wider range of crops along with the attainment of the self-sufficiency in fertilizer supply within Indonesia. The demand forecast concerning nitrogenous fertilizers by these crops in the future has been made on the basis of the following prerequisite conditions:

1 The BIMAS Program will be further expanded to these secondary food crops in the future, so that the number of farmers participating in this Program will increase year after year. Also, all these participating farmers will carry out fertilizer application to the crops.

2 The per-hectare fertilizer dosage will gradually increase, so that the dosage level will year after year approach the recommended dosage level set forth within the framework of this Program.

The prerequisite conditions concerning the estimation of the fertilized area and per-hectare dosage for each of the subject crops are as follows:

Maize:

The farmers with less than 1 ha. of land size of operational fields are carrying out the self-sustaining agriculture so that these farmers will not be expected to participate in the intensification programs.

Therefore, although it has been assumed that the coverage area of the BIMAS Program will gradually increase, and the upper limit of the fertilizer application area ratio will be within the range of area excluded by these farmers' area. The ratio of the area of these farmers accounts for 23% of total maize cropped area, remaining unchanged in recent years.

Concerning per-hectare dosage, the NFS estimated that the level was 37.9kg per hectare of fertilized area as of 1970, whereas, 'the Next Plant in Indonesia' forecast that the amount was 41.6kg as of 1972. It is deemed here that these data represent the actual status of the fertilizer application made in the past. The future per-hectare dosage is expected to gradually approach the BIMAS recommended dosage level of 92kgN/ha. year after year.

Soybeans:

As in the case of maize, it has been assumed that the upper limit of the fertilized area ratio will be 58%. This 58% ratio stands for a ratio occupied by the major soybeans producing districts selected in view of the past trend and the scale of the cropping area in respective districts in the total soybean cropping area in Indonesia.

As far as per-hectare fertilizer dosage is concerned, it has been estimated that a 50% level of the BIMAS recommended dosage have been fulfilled in the past, and that the dosage will hereafter approach the recommended dosage level of 23kgN/ha. year after year.

Groundnuts:

The upper limit of the fertilized area rate in the case of groundnuts has been estimated in line with the same consideration made for the

case of soybeans. The per-hectare dosage was estimated to be 23kgN/ha. for both past and future. This 23kgN/ha. is the recommended dosage set forth in the BIMAS Program.

Cassava:

It is assumed that the present level of fertilizer application to cassava is negligibly small. However, along with the further penetration of the BIMAS activities in cassava cultivation, it is expected that a certain extention of fertilizer application to cassava will be eventually made. Even so, the actual dosage will still be extremely low. It is estimated here that the potential fertilized area will be limited to the cultivated area where the cassava will be cultivated as a cash crop. The actual fertilizer application ratio in the case of cassava as against the recommended fertilizer dosage set forth for cassava is estimated here to less than that in the case of maize in view of the fact that the cassava cultivation is more of a self-sustenance oriented cultivation compared with that of maize.

The results of a forecast formulated on the basis of the above assumptions are as shown in Table 1-1-17.

The trend of the cropping area of maize has been showing a great fluctuation from year to year. In this forecast, it has been deemed that the maize cropping area figure will be stable in a long-term perspective, and an average figure for a period from 1971 to 1977 was employed as the maize cropping area figure in the future. In the High Case and the Low Case of forecast, the cropped area of maize was projected by deviating the area upward and downward respectively from the area projected in the Moderate Case by the amount equivalent to the standard deviation of the average past cropped area. The result is given in Table 1-1-18.

3. Other food crops

Vegetables

Recently, the government permitted the application of subsidized fertilizers to vegetables. Further, the INMAS Program has been expanded

to include vegetables as well. As no actual data is available concerning the past records of fertilizer consumption made in vegetable cultivation, it was assumed here that a balance between the total fertilizer consumption estimated for all the food crops and the total of fertilizer consumption estimated for those crops discussed so far is the amount of fertilizer consumption made in the vegetable cultivation sector. According to this estimation, the consumption in vegetable cultivation showed a stagnation until 1973 with a temporary uptrend in 1974. The consumption sharply dropped during 1975, and again increased in 1976 and 1977. This fertilizer consumption trend roughly coincides with the governmental approval of subsidized fertilizer application to vegetables and the involvement of vegetables in the INMAS Program, except for the acute consumption increase shown during 1974.

In this study, the cropping area increase rate is assumed to be analogous to the population increase rate which is estimated at 2.4% per year. Regarding the per-hectare fertilizer dosage, the average level of the recommended dosage in INMAS program, i.e., 120kg/ha. has been set as the maximum dosage level, although the per-hectare dosage will vary actually depending upon the kinds of the vegetables. It has also been assumed that the fertilizer dosage will increase year after year to come eventually closer to this maximum level. The results of this forecast are as shown in Table 1-1-19.

Paddy and upland rice outside the coverage of BIMAS/INMAS Programs

It is likely that the almost no fertilizer application is being carried out to either paddy or upland rice cropping outside the coverage area of the BIMAS/INMAS Programs. Although these areas will eventually receive a certain extent of fertilizers along with the promotion of fertilizer application practice among the farmers in general, no significant growth in nitrogenous fertilizer consumption is expected in these cultivations in view of the following reasons:

1 Nearly all the paddy rice cropping is expected to shift to be covered under the BIMAS/INMAS Programs.

2 In view of the poor profitability of operation in these cultivation, the

expansion of fertilizer application seems highly difficult.

The future demand for nitrogenous fertilizers in these cultivations was projected on the basis of the following points:

1 The projected cropping areas employed in this forecast are shown in Table 1-1-17. (Refer to paragraphs pertaining to the cropping area of paddy rice under BIMAS/INMAS Programs regarding the estimations shown in this table).

2 The per-hectare fertilizer dosage has been calculated by the following formula:

$$\text{(Recommended dosage)} \times \text{(Actual fertilizer application ratio over the recommended dosage)}$$

The actual fertilizer application ratio in these cultivations is deemed to be far less than that in maize. In the case of maize, the fertilizer application has already been carried out to some extent, while in the case of these rice cultivations, no fertilizer application has been observed so far.

The results of the projection are given in Table 1-1-19.

4. Estate crops

The history of nitrogenous fertilizer consumption by estate crop sector is rather long; however, there has been no significant change in terms of the fertilizer consumption amount. Since there is no available data as to the crop-wise consumption of fertilizers in this sector, the past consumption by individual crops will be estimated using various data and informations.

According to the NFS forecast, it was estimated that the nitrogenous fertilizer consumption by the estate crops by 1974 would be 69 thousand tons N. However, the actual records of consumption remained at the level of 26 thousand tons N. According to a forecast made in 'the Next Fertilizer Plant Study', the 1972 nitrogenous fertilizer consumption would be 53 thousand tons N. However, here again, the actual consump-

tion achieved during the same year was only 27 thousand tons N. Forecasts made in the past concerning the nitrogenous fertilizer consumption by estate crops have often been excessively optimistic. The major reason for such a tendency is the fact that many of these forecasts are based on the crop-wise fertilizer requirements.

In this study, the past crop-wise fertilizer consumption was estimated on the following basis:

1 The ammonium sulphate consumed in estate crop sector is estimated to have been consumed entirely by sugarcane cropping.

2 It is estimated that, other than sugarcane cropping, all the rest of the fertilizer application was made to rubber cropping, thereby deeming that all the other estate crops consumed almost no fertilizers. The fertilizer dosage to rubber is estimated to be 40kg for mature trees and 12kg for immature trees.

3 Regarding the rubber cropping pointed out in the above, it is estimated further that fertilizer application was made only to those rubber trees which were grown by estate management farmers, thereby deeming that rubber trees cultivated by small-holding farmers received almost no fertilizer.

4 The fertilizer dosage to sugarcane cropped by small-holding farmers has been deemed to be a half of that by estate farmers. (This assumption corresponds with the survey results revealed by "the Next Fertilizer Plant Study".)

The result of the above estimation on the past consumption by crop is roughly in line with the actual achievement in estate crop sector as a whole, and therefore, it is reasonable conjecture that the above estimation is successfully reflecting the status of practical fertilizer application in this sector.

On the basis of these facts, a demand forecast was made as shown in Tables 1-1-20 through 1-1-22. The future fertilized area and per-hectare fertilizer dosage projected on individual crops will be discussed in the

following paragraphs.

Rubber:

1 The rubber cropping area by estates has been declining along with the shift of operation from rubber to oil palm. The area coverage is reasonably assured to continue to decline in the future. The rate of immature tree planting area as against the total rubber cropping area has been also declining, and the rate was as low as 5% as of 1976. However, this rate is thought to remain unchanged from now on.

The rubber cropping area by small-holding farmers has shown almost no change since 1972. This has been due to the stagnation in the market price of rubber. It has therefore assumed here that no change will take place in this respect in the future. The immature tree area is also expected to remain unchanged in the future.

2 It is likely that fertilizer application has so far been carried out only by estates. According to 'the Next Fertilizer Plant Study', per-hectare dosage in this case is 40kg for mature trees and 12kg for immature trees. These dosage levels will be maintained also in the future.

In future the fertilizer application conducted to rubber trees by small-holding farmers is estimated to be lower than that by estates.

Sugar cane

1 In the case of both estates and small-holdings, the sugar cane cropping area has been increasing. However, the cropping area coverage in Indonesia so far is not very large. In view of this fact, it is assumed here that the cropping area increase trend will continue also in the future, and that the increase trend shown in the past will carry on into the future.

2 The fertilizer application to sugarcane is being conducted by both estates and small-holding farmers. The per-hectare dosage in this case is estimated to be 120kg in the case of estate farmers and 60kg

by small-holding farmers according to the survey made in 'the Next Fertlizer Plant Study'. These estimated figures roughly coincides with the ammonium sulphate consumption amounts recorded by the estate crop sector.

3 Concerning the future per-hectare dosage, the 120kg level in the case of the estate farmers seems to be almost a maximum level when taking into account the cases of other countries. Therefore, it is assumed that fertilizer dosage at this level will be kept unchanged in the future. Concerning small-holding farmers on the other hand, it is expected that the dosage will increase in the future, eventually approaching the same application level as in the case of estates.

Other estate crops

1 All the other estate crops are assumed to show a continuation of the past trend of the growth in the cropping area.

2 Concerning the per-hectare dosage, the following formula was employed to obtain the dosage figures for each crop for estate farmers and small-holding farmers separately:

$$\text{(Per hectare dosage)} = \frac{\text{(Recommended dosage) x (Actual fertilizer application rate)}}{}$$

The actual fertilizer application rate in each crop was obtained by multiplying the actual fertilizer application rate, in the case of maize by a respective coefficient assigned to each of the estate crops, i.e.:

(Actual fertilizer application rate of the subject crop) = (Actual fertilizer application rate of maize) x (Coefficient assigned to the subject estate crop)

The figures employed to formulate these estimations are shown in Table 1-1-23. The coefficients employed here have been established on the basis of the profitability and the type of agricultural management pertaining to each of the subject crops.

The results of forecasts made on the basis of the above-discussed factors are summarized in Tables 1-1-20 through 1-1-22. It should be noted here that these forecasts are still subject to some danger of the shortcomings suffered by many of the demand forecasts made in the past. The shortcoming in question is the danger of excessive or optimistic forecasting because of the use of employing as the basis the fertilizer requirements of each of the subject crops. The present forecast still involves some elements of this danger because of the fact that the actual status of fertilizer application conducted in the past has not thoroughly been clarified during the process of this study. Nevertheless, it is likely that the present forecast achieves a much higher realism than the past endeavours in view of the following points:

1 It is expected that the promotion of fertilizer application to various types of crops will be further intensified in Indonesia as clearly shown by the fact that the self-sufficiency in the supply of fertilizers has already been achieved in Indonesia, and the governmental approval for the application of subsidized fertilizers has already been expanded to various types of crops.

2 In this forecast, the 'Actual fertilizer application rate' as against the 'Standard dosage' was introduced, and this 'actual fertilizer application rate' has been set to best represent the actual status, thereby providing a safeguard to prevent the forecast figures from deviating towards excess because of the 'fertilizer requirements' element.

It is still possible that the promotion of fertilizer application activities in the estate crop sector may be delayed. In order to cover such a case, the Low Case was established in addition by reducing the above-mentioned coefficient for each subject crop by 1/2 (the coefficients being those in relation to the actual fertilizer application level of maize). On the other hand, another case is assumed in which the fertilizer application promotion is made on the same level as the promotion of fertilizer application to food crops. In such a case, the above-mentioned coefficients are deemed to be uniformly 1.0 for all the subject estate crops. This case is called the High Case. Table 1-1-24 shows the results of forecasts made for High and Low Cases.

2) Result of the nitrogenous fertilizer demand forecast and a demand forecast concerning urea

Table 1-1-25 gives the results of a demand forecast made on a crop-wise basis on the basis of the discussions described in the foregoing. Table 1-1-26 gives the results for High Case and the Low Case. Figure 1-1-4 illustrates a comparison between the demand forecasts formulated in the past and the present forecast made as a result of this Study.

As a result of the fertilizer application promotion policies covering various types of crops, the demand for fertilizers is expected to rapidly expand until about 1980. However, fertilizer application to paddy (in view both of fertilized area and per-hectare dosage) will attain a considerably high level by 1980. Therefore, the expansion pace of demand for fertilizers thereafter concerning paddy will show a stagnation.

Of the demand for nitrogenous fertilizers, the following paragraphs will discuss the demand for urea in particular. Table 1-1-27 gives the actual records of urea consumption by each agricultural sub-sector of crops in the past. As shown by this table, the BIMAS/INMAS farmers of the food crop sector almost exclusively employed urea. On the other hand, non-BIMAS/INMAS farmers did not use urea because of the prohibition by the government of applying subsidized fertilizer to their crops. However, after the abolishment of the regulation as to the subsidized fertilizers, the employment of urea rapidly grew. Concerning the ammonium sulphate consumption by those non-BIMAS/INMAS farmers, a series of fluctuation from year to year has been conspicuous. On the other hand, the level of consumption of compound fertilizers including ammonium phosphate has been on a stable level of 3,500 TN/y on an average. This seems to be due to the fact that the compound fertilizer utilizing farmers tend to adhere to the use of compound fertilizer in contrast to ammonium sulphate consuming farmers who are more prone to shift to the use of other types of fertilizers.

In the case of the estate crop sector, the utilization rate of ammonium sulphate is high. Most of the ammonium sulphate used in this sector is destined to sugarcane. In the case of sugarcane cropping, the farmers seem to adhere to the use of ammonium sulphate. However, in the case

of other estate crops, it is possible that the farmers will switch to urea if it is proven that the application of urea is more advantageous economically. The utilization of compound fertilizers has been showing a continuous fluctuation both in terms of quantity and utilization rate.

In view of the above conditions, the utilization rate of urea has been estimated as follows in the present study:

1 The BIMAS/INMAS farmers will entirely employ urea in the future.

2 The non-BIMAS/INMAS farmers will keep showing a demand level of 3,500 TN/y for compound fertilzers; however, all the other fertilizer requirements beyond this level by these farmers will be met by the application of urea.

3 Among the estate crops, sugarcane will entirely receive ammonium sulphate. Regarding estate crops other than sugarcane, the utilization of compound fertilizers will increase gradually; however, all the additional requirements beyond this level will be fulfilled by the utilization of urea.

The result of forecast on the demand for urea are given in Table 1-1-28.

(2) Demand forecast concerning industrial-use urea

Tables 1-1-29 and 1-1-30 respectively give the actual records of consumption of industrial-use ammonia and currently possible consumption of industrial-use urea in Indonesia.

It is likely that nearly all the consumption of industrial-use ammonia has been destined to the refrigeration industry. The past trend of consumption of ammonia has been showing a slight downtrend. In the present forecast, it has been deemed that there will be no drastic change in the trend of demand.

As for the consumption of industrial-use ammonia in the synthetic fiber raw material sector, nothing has been clarified in Indonesia concerning new construction projects regarding the plants manufacturing synthetic fiber raw materials. At present, no synthetic fiber raw material plant is in operation in Indonesia.

Therefore, the present forecast does not include any demand for ammonia which may be generated some time in the future from the synthetic fiber raw material industry.

If all the adhesives manufacturing factories should enter into full operation in Indonesia, the demand for urea as the raw material for producing urea-formaldehyde resin adhesives would amount to 9,600 T/y. According to relative statistics, the present level of plywood production is still extremely low. Therefore, it is not likely that the adhesives manufacturing factories are carrying out their full-capacity production. The operational rate of these adhesives plants as of 1978 is estimated to be 80%. On the basis of this operational rate, the present demand for urea as a raw material for these adhesives is estimated on one hand. On the other hand, future plywood production has been projected on the basis of the past records of plywood output in Indonesia. On an assumption that the adhesive production will also grow along with the growth of plywood production, the future extent of demand for raw material urea has been estimated.

Concerning the extent of demand for urea as a raw material for producing sodium glutamate and other products, it has been assumed that the operational rate of these production facilities as of 1977 shall be 75%, and the growth rate of the demand for these products shall be equivalent to the growth rate of real GDP of the country for a period from 1970 to 1975. Table 1-1-28 shows the results of the forecast made on the basis of the above assumptions.

(3) Prospect on the production of nitrogenous fertilizers and urea in Indonesia

Tables 1-1-31 and 1-1-32 respectively show a prospect on the domestic production of nitrogenous fertilizers and that of urea.

In order to avoid double counting, the outlook on the domestic production of nitrogenous fertilizers has been calcualted on the basis of the ammonia production amount. The existing ammonia manufacturing plants in Indonesia are four PUSRI plants from I to IV and one plant operated by Petrokimia. The future operational rates of these plants have been estimated on the basis of the past records; however, regarding PUSRI III and IV which are still young in operational history, the estimated operational rate figures for a new plant explained later has been applied for their second year of operation onwards.

There are three new plants to be constructed in the future. They are Aceh, Kujang, and Kaltim plants. The expected onstream month of these plants are respectively January/1982, August/1978 and October/1980. Concerning the operational rates of these new plants, the estimated levels are 75% for the first year, 80% for the second, and 90% for the third year onward. These operation levels have been estimated on the past actual records of operational rates achieved by PUSRI.

In the case of urea, both the onstream timing and the expected operational rates have been set in the same manner as for the case of ammonia. Concerning PUSRI I, it has been assumed that this plant will stop producing urea after 1982, based on the information provided by the GOI.

(4) Supply/demand balance outlook on nitrogenous fertilizers and urea

Tables 1-1-31 and 1-1-32 respectively show an outlook and the supply/demand balance of nitrogenous fertilizers and urea in Indonesia formulated on the basis of the demand forecast and supply forecast discussed in the foregoing section.

The supply capability of nitrogenous fertilizers and urea for agricultural use was calculated by first obtaining a produceable amount of both nitrogenous fertilizers and urea, and then by subtracting from it the amount which is to be allocated for industrial-use consumption.

Regarding the supply/demand balance of nitrogenous fertilizers, the supply capability is forecast to exceed the demand beginning in 1978. Thereafter, the gap (i.e., oversupply) began to grow year after year. The extent of oversupply is expected to exceed 700 thousand tons in 1982 when all the new plants will start production. From 1982 onwards, it is likely that the gap will begin to diminish along with a gradual expansion in the demand.

Concerning the supply/demand balance of urea, oversupply will begin to be felt from 1978 onward, and will attain a level of about 1,200 thousand tons from 1982 onward. Thereafter, the amount of oversupply will gradually drop along with the expansion in the demand.

If the changes in the inventory is excluded from the account for the sake of discussion here, Indonesia will have to export the urea beginning 1978. Such urea export requirements will increase and amount up to 1,200 thousand tons from 1982

onward. As for the ammonia, of the produced ammonia in Indonesia, 44 thousand tons N turned out by PUSRI I and 117 thousand tons N by Kaltim will not be coverted into urea, whereas all the ammonia produced by Petrokimia will be used for the production of ammonium sulphate, as of 1984. The export reauirements of nitrogen other than urea in the same year 1984 will be approximately 100 thousand tons N with a loss by 3% taken into account.

1-2 The Philippines

1-2-1 Features and trend of the Philippine agriculture

(1) Natural environment and agriculture

1) Agricultural land

The Philippines consists of 7,100 islands which altogether cover a land area of about 30,000 thousand ha. These islands have a number of ranges which form watershed ridges so that each island is further divided into several small parts. On the whole, the availability of cultivatable lands is limited because of such a topographic condition. It is estimated that the area of the land suited for agricultural cultivation amounts to approximately 1/3 of the total land area of the country. As shown by Table 1-2-1, the 1960 census revealed that the extent of the agriculturally used land amounted to 28% of the total land area, thereby implying that the physical expansion of the agricultural land has been already approaching to its limit.

2) Natural conditions

The features of the climatic conditions of the Philippines are; the atmospheric temperature shows only slight change either by season or by the locality, the precipitation varies from place to place, the humidity stays within a range from 70% to 85% throughout year, and the sunshine time is relatively short.

Precipitation varies from region to region with the Philippines. The country may be categorized into the following four types in terms of precipitation conditions. On the whole, the average amount of annual rainfall is on a high side of the above 2,500 mm:

1. Type I: In regions of this group there are distinct two seasons, i.e., the dry season from November to April, and wet season during the rest of the months. The average annual precipitation exceeds 2,500 mm. West Luzon and West Visaya fall under this category.

2. Type II: These regions have no distinct dry season; however, the period from

November to January involves a particularly high extent of precipitation, so that an average annual rainfall exceeds 3,200 mm. From Bicol to East Visaya and Mindanao belong to this type.

3. Type III: Although no seasonal change is apparent in these areas, a comparatively dry climate prevails from November to April. During the rest of the year, the climate is generally wet. The annual precipitation is about 2,000 mm. The areas falling under this category are from the eastern part of Luzon to South Cebu and North Mindanao.

4. Type IV: In these places, the precipitation is evenly distributed throughout the year amounting to 2,500 mm approximately per year. The areas outside the above three types belong to this category. This type of areas can be found in various places from Northern Luzon to Central Mindanao.

Another problem pertaining to the climatic conditions of the Philippines is the frequent typhoons which travel through the northern part of the country from July to November every year.

(2) Features of the structure of the Philippine national economy and the position of agriculture in the economy.

As in the case of other Southeast Asian countries, the Philippines also have a dual structure in agriculture. However, in the case of this country, the growth of the industrial sector showed a comparatively high pace, so that the share of the industrial sector in the total GDP at present already exceeds 33%. (Table 1-2-3) Even so, the national economy on the whole is still heavily dependent upon exportation as shown by Table 1-2-3. The export dependency rate has been showing a trend of increasing. Among the export product items, the importance of agricultural products centering on coconuts and sugar is still high.

The history of growth of the national economy of the Philippines may be divided into three stages, i.e., the rehabilitation stage up to 1950, rapid growth stage up to 1957, and the recent stage up to the present time. During the rapid growth stage until 1957, the manufacturing industry kept growing at annual average rate of 12% to 13%. Thereafter, the growth rate has been stabilized on a low rate of 5% to 6%. Concerning agriculture, the growth rate has constantly been below that of

GDP. (Table 1-2-4.)

In order to accelerate the growth and the structural change of the national economy and also to distribute the gain more equally to all the population, it is necessary for the Philippine agricultural sector to solve the following fundamental problems within the framework of the national economy:

Firstly, the agricultural sector has to secure the food crop production required in this country. Historically, the expansion of agricultural production in this country was compelled by the economic rehabilitation and the population growth, and was persued through the expansion of agricultural land while still depending on the traditional agricultural techniques. Consequently, when such an expansion of agricultural land approached the limitation, the agricultural production itself began to stagnate. Thus, agricultural production began to fall behind the population growth. In order to cope with this problem, it was strongly intended by the authorities to promote an intensive agricultural operation.

Secondly, the agricultural sector has to play a role as a supplement market to the urban market for industrial products. As mentioned earlier, the industry of the Philippines has been comparatively soundly developing in the course of import substitution. However, the lack of purchasing power in the rural market has become the impediment for the further development of the industry. Therefore, the modernization of this agricultural sector is deemed to be essential for the industrial development, creating higher purchasing power on the part of the rural market.

Thirdly, the agricultural sector is required to modernize itself from the standpoint of securing the export of agricultural products. As discussed earlier, the importance of exports within the framework of the Philippine national economy is significantly high. Among the export products, agricultural products centering on coconuts and sugar still occupy an extremely important position. For the country, earning in foreign currency is indispensable for further stabilization of the foundation for future development. For the purpose of earning foreign exchange, the role played by the export crop sector must be further reinforced. However, these major export crops are not necessarily produced by large-scaled plantations alone. An important portion of the output of sugar and coconuts is still carried out by a traditional agricultural sector. From this viewpoint, the modernization of the traditional agri-

culture is an indispensable prerequistite for future progress of the Philippine national economy.

(3) Agricultural structure

The agriculture of the Philippines may be categorized into two sectors, i.e., the food crop sector and the export crop sector. The former sector occupies an overwhelmingly important position over the latter in view both of the cropping area and the number of farms. The food crop sector occupies over 70% of the total cropping area and the total number of the farms. However, in terms of the agricultural value added ratio, the food crop production versus export crop production currently present a ratio of 6:4. This means that the food crop production shows a lower land productivity than the export crop production, and that the farmers' income in the food crop sector is generally lower than that of export crop sector.

The scale of farm operation in the export crop sector is generally larger than the case of food crop sector with the average scale of farm operation being 14 ha. in the case of sugar cane growing farmers, 4 to 5 ha. in the case of coconuts in export crop sector, while as small as 3 ha. in the case of rice and 2.5 ha. in the case of corn in the food crop sector. The scale-wise number of farms reveals that most of the farms in the case of rice and maize occupy an area less than 10 ha. However, in the case of sugar cane, although the small-scaled sugar cane farms individually possess less than 10 ha. of land this accounts for 85% of the number of sugar cane farms. These altogether occupy only about 19% of the total sugar cane cropping area. On the contrary, the large-scaled sugar cane farms, each possessing more than 5 ha. constitute only 5.0% of the total number of the farms; however, the land ownership by these large-scaled farms is as high as 65.7% of the total.

The great discrepancy between the positions of the food crop sector and the export crop sector is the above described combination of the difference in the operation scale and the land productivity. Even within the export crop sector itself, however, there is a large variation among the farmers with different scale of operation, and the modernization in this respect is one of the most important issues in this respect.

The total cropping area is still growing. In the food crop sector, the maize cropping area is particularly increasing, while in the export crop sector, the coconut cropping area is still growing. Details concerning the trend of the cropping area by each

crop are shown in Table 1-2-5 and Figure 1-2-1.

(4) Past trend and future direction of agricultural policies

As has been mentioned earlier, the modernization of the traditional agricultural sector is an important issue not only for the promotion of the agricultural production but also for the future development of the national economy of the Philippines at large. In order to materialize this modernization, much closer attention should be paid to the productivity not only of the food crop sector farmers but also to the small-holding farmers in the export crop sector. However, the present agricultural policies undertaken by the government are for the most part directed to a food crop increase.

The food crop production which is the major objective of the agricultural policies in the Philippines has already suffered from the physical limitation in the expansion of cultivable land. A more intensified utilization of land has been set up as a new policy following the construction of irrigation facilities.

The intensification of the agricultural production has recently been further enhanced by the introduction of new high yield varieties of the food crops started during 1966. In order to further promote the diffusion of high yeild varieties, the Masagana 99 program and the Masagana Maisan program were implemented in 1973 and 1974. These programs evisage the encouragement of the farmers to employ and apply a package system of new agricultural techniques and necessary agricultural input materials supported by governmental loans of the funds necessary for procuring the modern agricultural materials. The Masagana 99 is a program for rice cropping, while the Masagana Maisan program covers maize. In addition, the Gulayan sa Halusugan program is prepared to involve the vegetable farmers.

In order to also cover the farmers who live in remote localities and are therefore excluded so far from the benefits of these governmental programs, a new project for the assistance on fertilizer application has been implemented since 1973 in the form of a joint project between the Philippine Government and FAO.

1-2-2 Past trend and present status of nitrogenous fertilizer supply/demand balance in the Philippines

(1) Demand for nitrogenous fertilizers and governmental policies regarding fertilizer demand promotion.

Consumption of fertilizers started comparatively early in the Philippines. A sizeable amount of fertilizers began to be consumed already during the 1950s. Nearly all the fertilizers are estimated to have been consumed in sugar cane cropping in those days.

Since 1966 a full scale fertilizer input into paddy cropping began along with the introduction of HYVs. Although the government started a system of subsidizing 50% of the necessary funds for fertilizer purchase as part of rice/corn production promotion policies since 1956, a greater portion of the procured fertilizers seems to have been applied to sugar cane cultivation rather than to paddy.

The national economy of the Philippines has traditionally been steered by the private sector rather than by the public sector. Also in the case of fertilizer industry, the government had little to do with the distribution of fertilizers among the farmers. Fertilizers imported from Japan within the framework of the war reparation and fertilizers imported by the SPCMA (Sugar Producer Cooperative Marketing Association) without import duty imposition were naturally much cheaper than domestically manufactured fertilizers. This being the circumstance, the domestic fertilizer manufacturing industry of the country has been compelled to stagnate as will be explained in more detail later, and the Philippines for a long time had to depend on imported fertilizers. Consequently, the fertilizer prices in the country have been directly subject to the effects of the changes in the international market prices of fertilizers.

From the standpoint of a stable fertilizer supply in order to cope with the promotion of food production, the government established the Fertilizer Industry Authority (FAI) in 1972, thereby taking the initiative in leading the fertilizer industry.

The function of the FIA cover a wide range of duties from quota allocation of domestic production to fertilizer manufacturing companies, control over the distribution of fertilizer, establishment of retail prices, determination of import quantity, assurance of import licenses, etc. Thus the operations concerning fertilizers became centralized by the authority.

In 1973, the government established a dual price system for fertilizers, i.e., a different set of prices for fertilizers to be used for food crop cultivation and those to be applied to export crops. For the fertilizers of food crops, a subsidy was granted to the manufacturers of fertilizers, thereby making the price different from the fertilizers for export crops.

However, this system was revised in 1976 to be a single price system. This single price is determined on the basis of the average import price of fertilizers and the production cost of efficient domestic manufacturers. The balance, if any, is compensated for in the form of payment of the difference by the government to either the manufacturers or the importers.

Governmental programs for food production increase were started in 1973 and 1974 as mentioned earlier, and the program to provide aid for those farmers who were not covered by the main programs in their fertilizer use was also implemented in succession. As a result of these policies, the demand for fertilizers rapidly expanded during 1973 and 1974. Although the actual fertilizer dosage level is still below the recommended level, it is now apparent that fertilizer application has become a common practice among food crop growing farmers except those farmers possessing very small scale operational holdings, and are engaged in self-sustenant scale of agricultural operations.

However, as shown in Table 1-2-6, the trend of fertilizer consumption since 1974 displayed a demand recession due to the hike in the import prices of fertilizers. Even as of 1977, the consumption level was still below the 1974 level. This is one of the manifestations of the vulnerability of the fertilizer supply system in the Philippines which is still significantly dependent upon importation.

(2) History and present status of the fertilizer industry of the Philippines

1) Past trend of import and domestic supply of nitrogenous fertilizers

As shown in Table 1-2-6, the fertilizer supply of the country is highly dependent on imported fertilizers. Even after the commencement of domestic production, the dependency persisted to a significant degree. This has been due to several problems pertaining to production technology as will be explained later and the incapability of domestic production cost in effectively competing

with the import prices, rather than due to absolute shortage of domestic production capacity.

The governmental fertilizer policy basically places emphasis on the securing of low-cost supply of fertilizers rather than on the protection and fostering of the domestic fertilizer industry. This governmental attitude, rather rare among developing countries, has been a result of the requests made by the export crop industry in general and by the sugar industry in particular which is the mainstay of the national economy of the Philippines. The major objective of this policy has been the reduction of sugar production cost. As long as the international price of fertilizers kept stagnating, no particular problem was caused by this policy in the actual availability of fertilizers.

However, once the oil crisis took place and the fertilizer supply shortage became apparent in the world, the Philippine fertilizer supply structure quickly gave in, thereby demonstrating its fragile character because of heavy import dependence. The wave of fertilizer price hikes soon shook the foundation of the fertilizer supply system in this country. All the governmental countermeasures of pushing fertilizer subsidy could not control the abnormal price increase.

Because of such an unstable market, speculative hoarding of fertilizers took place in 1974, thereby boosting the importation up to about 250,000 tons. In order to cope with the excessive stocks caused by the above importation, the authorities prohibited fertilizer importation for a period of about one year from 1975 onward. At present, the Fertilizer and Pesticide Authority (FPA), an agency formed by revising the FIA controls the fertilizer import quota allocation to six importers.

Since 1976, the import prices of fertilizers have been declining. The government is now setting forth an official price level on the basis of both the domestic production cost and the import prices of fertilizers. Therefore, the authorities are compelled to extend subsidies in any case to either the importers or to the manufacturers whichever is suffering from higher cost. This being the circumstance, the FPA is requesting suspension of urea production to the domestic manufacturers whose production cost is fairly higher than the price of imported urea.

2) Past trend of production

Table 1-2-7 shows the production capacity and actual production figures of domestic fertilizer manufacturers. The generally low level of operational rate is highly conspicuous. The reasons for such a poor standard of operation are the result of failure in effectively coping with imported fertilizers on one hand, and problems in operational technology on the other. The most prevalent problems in the operation technology are production loss due to power failure and the obsolescence of plant facilities, accompanied by a shortage of maintenance and repair parts. The low operational rate consequently pushes the production cost upward, and the manufacturers have so far been forced often enough to suspend production because of consequential failure in competing with imported fertilizers.

Since 1972, the government has been taking into account the production cost of the domestic manufacturers and the import prices of fertilizers when deciding upon the official price of fertilizers. Under this provision, the party suffering from the higher cost could receive subsidy from the government, thereby seemingly providing a protective measure for the domestic fertilizer industry. In practice, however, the gap between the production cost and the import prices was too vast, so that the government became unable to grant the subsidy. This is the reason why the authorities are now compelled to request production suspension to the domestic fertilizer manufacturers.

It is therefore impossible to expect that the implementation of such a policy alone will result in future stabilization of the domestic fertilizer production in the Philippines.

1-2-3 Future outlook on the fertilizer supply/demand balance in the Philippines

(1) Outlook on the fertilizer demand

1) Past trend and future outlook on the factors affecting the fertilizer consumption

a) Forecasts formulated in the past on the fertilizer demand in the Philippines

Table 1-2-8 and Figures 1-2-2 and 1-2-3 show a comparison of major forecasts conducted so far on the nitrogenous fertilizer demand in the Philippines.

The forecast conducted by TVA in 1971 under the title of "Fertilizer Industry in the Philippines" is estimated on the basis of the crop-wise fertilizer areas and per-hectare dosages. This TVA forecast has been employed often as a reference for demand forecasts made thereafter. However, it is necessary to pay attention to the difference between the forecast data shown in this forecast and the actually achieved records registered since the compilation of the TVA forecast. The following are major points of difference between the TVA forecast and the actual achievements:

1. During a period from 1972 to 1977, except for 1973 and 1974, the actual figures were lower than the forecast figures. Concerning the 1973-1974 period, the actual figures were above the forecast figures. However, during 1973-1974, a vast amount of apparent demand prevailed because of the abnormal hike in the international fertilizer prices. In other words, the inventory piled on the distribution stage of fertilizers during this period was enormous. Therefore, when adequate modification was made to this apparent demand, the actual level of fertilizer dosage must have been lower than the forecast level all through those years.

2. The crop-wise accumulated estimation on the achievements of 1970 which was used as the basis for the TVA forecast exceeded the actual achievement values. In other words, the estimations made by TVA concerning the fertilized area and per-hectare dosage on the base-year 1970 seems to have been on a higher side than the actual status.

3. In comparison to the actual values for the period from 1973 to 1974, the TVA forecast value on the food crop sector turned out to be higher by approximately 20% than the actual value, while on the contrary, the TVA forecast figure concerning the export crop sector was much lower than the actual achievement, being only approximately 60% of the actual achievement.

In short, the TVA forecast turned out to be highly optimistic concerning the

food crop sector, while very pessimistic concerning the export crop sector. In total, it is safe to evaluate that the TVA forecast was generally higher than the acutal achievement.

A forecast compiled in 1976 by FPA was based on calculations by assuming that the annual growth rate of demand for nitrogenous fertilizers will be 10%. Particularly in the case of the Philippines, the demand growth rate in the past has been fluctuating along with the changes in the prices of the fertilizers. The demand for fertilizers was also affected greatly by the changes taking place in the governmental policies for promoting fertilizer demand. Therefore, the average annual growth rate significantly has varied depending upon the selection of a certain period from which the demand growth rate is to be obtained. It is also difficult to forecast which will be stable during the years to come, the annual growth rate or the annual growth extent of demand. For reference, the annual average growth rate of demand for nitrogenous fertilizers in the Philippines may be summarized as follows:

1970 – 1977:	7.7%
1972 – 1977:	8.8% (After the establishment of the FIA)
1970 – 1974:	13.9% (Period during which the demand showed a comparatively steady growth)
1975 – 1977:	15.5% (Demand recovery period after a hike in the fertilizer prices)

In addition to the above forecast, estimations were made by the FPA for the years 1972 and 1975 on a single-year basis concerning the crop-wise fertilized areas and per-hectare dosages. Also, the FPA conducted a summary of estimates on the crop-wise fertilized areas and per-hectare dosages made by fertilizer manufacturers and fertilizer distributors during the year 1975. However, the latter survey revealed a result that the estimated value greatly exceeded the actual achievement.

In the following paragraphs, a new demand forecast will be conducted as part of this study while taking into consideration the difference between the figures

of the forecast made so far and the figures achieved as actual demand. The present study will also incorporate new data and information since collected.

b) Outlook on the land use and the trend of crop-wise cropping area

As shown in Table 1-2-1, the land area devoted to agriculture in the Philippines has shown a slight increase, with the average annual increase rate being 0.8% during a peirod 1960 through 1971. On the other hand, the gross cropping area has increased by the average annual rate of 1.7% during a decade from 1960 to 1970. The increase rate of the gross cropping area was especially conspicuous during five years from 1970 through 1975, with the rate being around 5% annually, as shown in Table 1-2-5. With respect to the increase in the crop-wise cropping areas, coconut cropping area has grown steadily in the case of the cash crop sector. In the case of food crop sector, the cropping area in the sector as a whole was slow until 1970, and then turned up rapidly thereafter.

Among the crops cropped in the Philippines, cropped areas of palay, corn, and coconut occupy a large share in the total cropped area, with the share being 31%, 28% and 22% respectively as of 1975. Whereas the share of sugar cane, which is the most important crop in this country in terms of export, was no more than 4.7% as of 1975 despite of gradual increase in the share.

According to the target in 1977/1982 five year plan and 1977/1987 ten year plan of the Philippines, the emphasis of agricultural production is on rice and corn production in the food crop sector, whereas in the cash crop sector, on coconut production

The target of increase in rice production is to achieve self-sufficiency in the rice supply, and further to secure the necessary buffer stock of rice. The increase in the rice production is intended to be achieved by the increase in yeild through further diffusion of HYVs in irrigated fields. In the case of corn, the increase in the production of yellow variety corn as feedstock is emphasized, and for this purpose, the expansion of cultivated area of the yellow variety is intended especially for in the regions oriented to livestock industry.

The increase in the coconut production is intended to attain through conver-

sion of conventional varieties into HYVs, and further diffusion of dense palnting. In the case of sugar cane, the emphasis of policy is on the improvement of export competitiveness in sugar products, and improvement of productivity as well as conversion of the cropping area into other crops in the case of unfavorable regions will be persued.

c) Analysis and future outlook on the factors affecting fertilizer consumption by crop

1. Paddy

Cropping area:

It was impossible to find any significant correlation between the changes in the paddy cropping area and the changes in the rice price as well as the prices of agricultural products competing with rice. This seems to be due to the fact that rice has a definite position as the major food crop of the country, thereby having a possibility of cropping area expansion whenever possible regardless of the effects of the prices on the market. Also, farmers are well versed in growting paddy, and also they have a basic philosophy that the harvested rice will serve as their own food even in the worst case.

However, as is generally known that the expansion possibility for paddy area in the Philippines is almost nil, the annual average growth rate of net cropping area of paddy from 1970 to 1977 was as low as 1.7%. Particularly since 1974, the average annual growth rate was only 0.2%.

The irrigated area ratio over the paddy cropping area has long been stagnating on a level of 40% up. In a long run, some increase may be expected; however, there is no immediate plans for enhancing the rate of irrigated area in a significant degree.

Concerning the double-cropping ratio, a level as high as over 70% has been shown in irrigated fields; however, the ratio itself has been fluctuating within a range from 65% to 80%, thereby showing no significant changes. This seems to be due to the fact that, even if there are irrigation

facilities installed, there have been changes in the available amount of irrigation water during the dry season resulting in the fluctuation in the area devoted to double cropping. Therefore, it is likely that the double cropping rate has already attained the maximum possible level at present. If certain improvements are expected in this respect the possiblility is that the double cropping rate will be stabilized on a high level due to the reduction of the adverse effects of weather conditions. Concerning the double cropping rate in rain-fed fields, the rate has long been stagnating within a range from 35% to 50%. In this case also, the current status and the outlook on the future status are highly similar to the case of the irrigated fields as discussed above.

Regarding the extension of HYVs, the development made so far has been remarkable. In the case of irrigated fields, the HYV extension rate steadily grew from 61% in 1970 to over 80% in 1976. Even in the case of rain-fed fields, the rate grew from 39% in 1970 to 65% in 1976. Both in the irrigated and rain-fed fields, the per-hectare yield of HYVs was much better than that of conventional varieties. It is therefore expected that the extension of HYVs will keep increasing in the future.

In view of the above points, the cropping area for paddies has been estimated on the basis of the figures and other factors enumerated below. The past actual figures and the estimated figures concerning the cropping area are shown in Table 1-2-9.

1 The net cropping area has remained almost unchanged since 1974. In view of the fact that the expansion of the area is thought to be approaching its limit, this trend is expected to persist in the future.

2 Concerning the irrigated area rate, the slight increase trend shown in the past is expected to continue in the future.

3 Although no improvement will be expected in the double cropping rate itself, it will be reasonable to assume that the fluctuation which took place so far in the double cropping rate will be stabilized in the future.

4 It is expected that the extension rate of the HYVs will gradually increase, thereby steadily approaching the 100% level.

Per-hectare fertilizer dosage:

During a period from 1973 to 1975, along with the enforcement of dual price system of fertilizers, the statistics on fertilizer demand was collected by crop-sector-wise.

However, these statistics do not clarify the quantity of nitrogenous fertilizers consumed by each of the subject crops. In the following paragraphs, a new estimation will be made concerning crop-wise per-hectare dosage by revising the estimation data formulated in the past, while incorporating the acutal achivements since made.

The following table shows estimation data on the fertilizer application to paddy revealed by various estimates made in the past as mentioned earlier:

	TVA (1970)	FIA (1972)	FIA (1975)
Per-hectare fertilizer dosage	Recommended dosage: 60 kg/ha. Actual application rate: 75%	35 kg/ha.	Farmers under programs: 43 kg/ha. Farmers outside programs: 14 kg/ha.
Fertilized area rate	33% (1,022 thousand ha. out of 3,113 thousand ha.)	37.5% (1,200 thousand ha. out of 3,200 thousand ha.)	87% (Farmers under programs: 1,200 ha. Farmers outside programs: 1,900 ha.)

As has been discussed earlier, the TVA's forecast seems to be too optimistic in view of the actual achievements made thereafter. When taking into account this factor, the actual dosage as of 1970 is estimated to have been 36 kg/ha. of fertilized area, but the actual achievement of the demand in this year was approximately 80% of the demand forecast by TVA with the assumption that TVA's projection overestimated all the crop-wise demand by same rate. In other words, TVA estimated the per-hectare dosage as follows: (Recommended dosage 60 kg/ha.) x

(Actual fertilized ratio 75%) = (Actual per-hectare dosage as of 1970 45 kg/ha.). Therefore, the actual dosage was estimated to be 36 kg/ha. in this study by reducing the actual dosage projected by TVA by 20%. As far as the fertilized area is concerned, TVA projected the fertilized area as of 1970 to be 1 million ha. On the other hand, all of the irrigated area grown by HYVs are reasonably estimated to have been fertilized because of the major objective of Masagana 99 Program. That was to promote the fertilizer application on the irrigated area grown by HYVs. Therefore, if the TVAs projection on the fertilized area is assumed correct, 200 thousand ha. of area other than the irrigated area grown by HYVs was fertilized as of 1970. In view of the fact that per hectare yield of LVs in irrigated fields have been higher than that of HYVs in rain-fed fields, it is likely that the fertilized area of 200 thousand ha. was on the irrigated area grown by LVs rather than on the rain-fed area grown by HYVs.

It is estimated that the per-hectare dosage on the LV grown rain-fed area was no more than 1 bag of urea (23 kg N)/ha. of fertilized area.

The FIA forecast maintains that the fertilizer dosage as of 1972 was 35 kg N) ha., thereby implying that the level of fertilizer dosage is almost similar to that in 1970 as mentioned above. On the other hand, the fertilized area is estimated to have increased by about 200 thousand ha. compared with that in 1970. Of this fertilized area increment, about 150 thousand ha. is estimated due to the increase in the HYV cropping area in irrigated fields, while the remaining approximately 50 thousand ha. implies an expansion in the fertilized area for other paddies including the LVs in irrigated fields.

Direct calculation based on the FIA forecast for the year 1975 reveals that the nitrogenous fertilizer consumption by paddy alone amounting to 78 thousand tons N. This amount corresponds to 98% of the nitrogenous fertilizer consumption by food crops, thereby implying that this FIA estimation is too high. The fertilizer dosage for LVs in irrigated fields is estimated to be on a level lower than this figure.

Table 1-2-10 summarizes the results of forecast made on the basis of the

foregoing discussion.

The following paragraphs will examine the extent of possible enhancement of per-hectare dosage and fertilized area rate.

The fertilizer response compiled through experiments conducted by agricultural laboratories in various localities demonstrate a considerable extent of irregularity. Therefore, it was impossible to determine the economically optimum fertilizer dosage level simply on the basis of these experimental results. The following shows the economical optimum dosage level figures on an assumption that the farmers will keep increasing the dosage until the marginal cost/benefit ratio reaches 2:

HYV in irrigated fields:	100.8 kg N/ha.
HYV in non-irrigated fields:	75.7 kg N/ha.
LV irrigated fields:	74.4 kg N/ha.
LV non-irrigated fields:	88.8 kg N/ha.

The recommended standard dosage set forth in the Msagana 99 Program stays within a range from 60 to 70 kg N/ha. Therefore, it is possible to assume that the dosage will eventually improve to attain this level as far as the HYVs in irrigated fields are concerned. However, regarding the per-hectare dosage on other paddies, since the expected yield obtained from the above response is fairly higher than that prevailed in practice, it was impossible to estimate the reasonable potential level of dosage from the above fertilizer response alone.

Regarding the fertilized area ratio, there seems to be some improvement possibilities. In the case of irrigated area, all the area is expected to be fertilized in near future. However, in other cases, some areas will be left unfertilized, because the effects of fertilizer application is expected to be unsignificant on one hand, and such farmers as self-sustenant oriented farmers lack of incentive for fertilizer application on the other hand.

The demand for nitrogenous fertilizers will be forecast on the basis of the assumptions made on the actual status of the fertilizer application

as mentioned above. It should be noted here, however, that this forecast does not take into account the possible changes in dosage level or fertilizer application area caused by short-term change in the economic conditions. The demand for nitrogenous fertilizers from 1975 to 1977 was, however, largely affected by a short-term change in the economic conditions, i.e., an abnormal and sudden hike in the fertilizer prices. It is possible to interprete the trend took place during this particular period as involving a recession in the fertilizer application rate and per-hectare dosage which up till then showed a gradual increase. This recession was a direct result of the abnormal increase in the fertilizer prices. It is reasonably estimated that the fertilizer application area and per-hectare dosage concerning paddies, except for HYVs in irrigated fields, recessed to the 1973 level in 1975, and thereafter started to recover gradually so that the 1975 level was regained in 1977.

Table 1-2-11 shows the nitrogenous fertilizer demand forecast on the basis of the above discussions.

The following paragraphs are devoted to the discussions on tentative analysis of the effects of the projected changes in the nitrogenous fertilizer consumption on future rice production in this country. The factors affecting the production of the paddy are versatile in practice, and the increase in the level of fertilizer dosage is only one of the numerous factors contributed to the yield increase. Table 1-2-12 ocmpares the outlook on future paddy production on the basis of the above-mentioned forecast values and the target figures set forth in the Five Year and Ten Year Plans while taking into full consideration the risk of errors occasioned by the fact that the fertilizer application factor is only one of the numerous factors.

According to the paddy production figures based on this forecast, it is revealed that the self-sufficiency in the supply of paddy will not be attained. According to the target figures for the Five Year and Ten Year Plans on the other hand, it is envisaged that the irrigated area rate will be 57% in 1982, and will improve to 68% by 1987. The per-hectare yield projected in the plans shows a level higher than the present forecast level by 20% to 30%. It implies that the expansion of the irrigated area and

the intensification of cultivation activities must be positively and strongly implemented in order to attain the goals envisaged in the plans.

It is highly possible that new governmental policies will be enforced and strongly implemented in the future expansion of irrigated area and the promotion of fertilizer application with the attainment of self-sufficiency in food crops as the ultimate objectives. In view of such a possibility, the High Case was established by assuming the following points:

1 The expansion of the irrigated area will attain a level halfway between the target of the Five/Ten Year Plans and the level estimated by the present forecast.

2 The intensification of fertilizer application promotion programs will be enforced, and as a result, the trend of dosage level increase shown in the past will continue in the future.

In the Moderate Case, the embodiment possibility is high concerning the projected irrigated area rate, HYV extension rate, and fertilizer dosage level. However, regarding the assumption on the possible change in the double cropping rate in the Moderate Case, i.e., an assumption that the double cropping rate will attain a stabilized level in the future, still necessitates as a prerequisite condition that the necessary water will be secured during the dry season and full efforts will be exerted in improving the cultivation technology. In the light of this point, the Low Case was established as a case in which the double cropping rate will still fluctuate around the presently prevailing level. Table 1-2-13 shows the projected demand for nitrogenous fertilizers in the High Case and the Low Case calculated on the basis of these discussions.

2. Maize

Cropping area:

The change in the cropping area and yield of maize vary greatly from district to district. This is due to the fact that the expansion of corn cropped area is persued especially in the districts oriented to livestock

industry, as mentioned earlier. No significant correlation was found between the change in the maize cropping area and maize price or between the maize cropping area change and the fluctuation in the price of sugar cane which is deemed to be a competing crop for maize. This seems to be due to the fact that, in some districts in the Philippines maize is consumed as a main food crop in place of rice, thereby involving a possibility that the expansion of cropping area will be carried out year after year as long as arable land is available.

Concerning the future cropping area for maize, an estimation is made on the basis of the past trend of cropping area for each district of the country.

Per-hectare dosage:

The following table shows the fertilized area and per-hectare dosage estimated in various forecasts made in the past as mentioned earlier:

	TVA (1970)	FIA (1972)	FIA (1975)
Fertilized area ratio	27%	21% (500 ha. out of total cultivated area of 2,350 ha.)	64%
Per-hectare dosage	Recommended dosage: 56 kg N/ha. Actual application ratio: 75%	20.0 kg N	Program farmers: 47 kg N Non-program farmers: 23 kg N

As discussed earlier, the TVA forecast must be discounted by 20% in view of the evolution of the actual achievements made since. According to the FIA forecast for 1975, the actual dosage was about two bags of urea per farmer under the program and approximately one bag of urea per farmer outside the program. These estimations seem to be representing the actual status of fertilizer dosage; however, if the forecast fertilized area rate of 64% is accepted, the nitrogen consumption by maize alone

will amount to 55,000 tons N. In view of the actual total nitrogen consumption of 80,000 tons N in the food crop sector, this estimation by the FIA seems too excessive. The per-hectare dosage estimation made by the FIA for the year 1972 roughly corresponds to the fertilizer dosage for the farmers outside the program estimated by the FIA for the year 1975. As of 1972, the maize production increase program was not yet started. Therefore, these two estimation figures may be considered as being analogous with respect to the dosage of non-program farmers.

The discrepancy between the actual results and the forecast figures in the case of the TVA estimation for the year 1970 seems to be due mainly to the difference between the estimated and actual per-hectare dosage in view of the points made in the foregoing. Therefore, concerning the fertilized area rate an estimated rate of 27% seems to be representing the actual status.

In addition to the above review on the estimations conducted in the past, the following points were incorporated into the projection of this study.

The rate of the cropping area owned by the farmers under the program as against the total cropping area was estimated to have increased annually by 1%, and this rate is expected to persist in the future. The per-hectare dosage by the program farmers will remain unchanged at the level of 47 kg/ha. in the future which is the level attained as of 1975. On the other hand, the fertilized area ratio as against the cropped area by non-program farmers is estimated to stagnate at a maximum rate of about 65% after showing a gradual increase towards this level. This 65% level represents a rate of major cropping district as against the nationwide cropping area. In these major cropping districts, the cropping area has been showing an uptrend, thereby implying that these major cropping districts have a potential for further expanding the fertilizer application in the future. Also, the per-hectare dosage of no-program farmers has been estimated to be 23 kg N/ha.

Table 1-2-14 shows a nitrogenous fertilizer demand forecast regarding maize.

3. Vegetables

The nitrogenous fertilizer consumption by vegetables was estimated at 1,500 tons N in 1970 by the TVA, 3,000 tons N in 1972 by the FIA, and 7,950 tons N in 1975 by the FPA. The consumption in 1975 was on an unusually low level due to the abnormally high fertilizer prices. Therefore, the above estimated consumption during 1975 is not likely to be really reflecting the actual demand level in this year, because the projection was conducted on the basis of expected normal fertilizer application practice. If the estimated 1975 consumption is regarded as 1974 consumption and when the estimated fertilizer consumption by food crops other than vegetables in 1974 is added to this vegetable fertilizer consumption, the total consumption figure in 1974 roughly corresponds to the actual fertilizer consumption achieved by the food crop sector as a whole. Therefore, this figure is reflecting the consumption figure achieved in vegetable in 1974 rather than that in 1975.

Concerning the future trend of fertilizer consumption by vegetables, it is estimated that the growth rate of nitrogenous fertilizer consumption rate to be achieved by the vegetable sector is equivalent to the average annual vegetable consumption growth rate envisaged in the Ten Year Plan. This assumption is based on the expectation that the vegetable production growth will be achieved by the growth in the vegetable cropping area.

4. Sugar cane

Cropping area:

Sugar cane is one of the most important export crops of the Philippines. The government controls the cropping area coverage, thus trying to maintain the sugar export price. Therefore, it is not possible to forecast the future trend of the cropping area coverage merely on the basis of the past trend. This being the case, the forecast was based on calculations made on the production target figures set forth in the Five/Ten Year Plan. It was assumed for these calculations that the future per-hectare yield will be on the present level in view of the fact that no signi-

ficant change has been made for a long time in the per-hectare yield and also that there is no prospect of new varieties of sugar cane which will change the yield rate in the future.

Per-hectare fertilizer dosage:

It is acknowledged that the sugar cane growing farmers are the most modernized farmers of the Philippines. Therefore, it is likely that nearly all of them are applying fertilizers to their crops. The TVA forecast for 1970 assumes that all the sugar cane farmers are fertilizer users. However, in view of the scale and form of management for the cropping operation conducted by sugar cane farmers, 66% of the total cropping area is occupied by farmers each having over 50 hectare of cropping area. On the othr hand, 5.2% of the total cropping area is owned by farmers each possessing less than 3 hectares. These farmers are assumed to be crop-sharing farmers and the fertilizer application incentive among them is likely to be low. In the present forecast, the fertilizer application area has been calcualted on an assumption that all the farmers except these small holders are carrying out fertilizer application.

The actual per-hectare dosage according to 1977 survey by the FPA is estimated to be 113 kg as against the recommended dosage prescribed as 150 kg. The estimated levels in the past surveys show a fluctuation, i.e., 120 kg in 1970, 150 kg in 1972, and 118 kg in 1975. As has been stated before, the TVA's 1970 estimate is lower than the actual level. On the other hand, the 1972 FIA estimate appears to be the recommended dosage level rather than an estimated figure. In short, it is likely that the dosage level for sugarcane has been fluctuating within a range from 110 kg to 135 kg depending upon the current level of prices of agricultural products and fertilizers.

The estimation and forecast on yearly level of per-hectare dosage was obtained by regression of the past trend of dosages on logarithmic function of the sugar export price/fertilizer price. This estimation by the above regression can be justified from the fact that although the sugar cane farmers are coducting commercial farming and their fertilizer application level depends on the current price level of the product and

that of fertilizers, the correlation between the fertilizer application level and the price is not very high. As to the price ratio in this forecast, the average ratio of that in 1970 to 1974 period was employed as the ratio in the Moderate Case. The average ratio of the higher four years in terms of dosages was interpolated in the High Case, and the lower four years in the Low Case. Table 1-2-15 shows the result of the forecast, while Table I-2-16 gives the results obtained for the High and Low Cases.

5. Coconut

Fertilizer consumption level by coconut is extremely low. It is likely that almost no coconut farmers are applying fertilizers. The fertilized area rate is estimated at 2.0% in 1970 by the TVA and 4.0% in 1972 by the FIA. The reasons for such a low level of application are as follows:

1 Fertilizers if applied overlap the fertilizer already applied on companion crops.

2 The farmers are still largely ignorant about fertilizer effects. They are rather against the use of fertilizers. They insist that, if top dressing of fertilizers is carried out, the roots of coconuts will grow towards the surface of the ground, thereby making the coconut trees apt to fall.

Along with the diffusion of HYVs of coconut and extension of dense planting, the future extent of fertilizer demand in this sector is expected to increase gradually.

6. Other crops

In addition to various crops discussed so far, there are other crops to be included such as pineapples, tobacco, bananas, etc. Regarding fertilizer past demands generated by these items, the estimated figures by the TVA and FPA for the years 1972 and 1975 respectively were employed for the purpose of this study. Concerning the future growth rate of the demand, the production growth targets envisaged in the Five/Ten Year Plans was used as the future growth rate of demand for fertilizers. The growth rate for tobacco is 2.45% per year, and that of fruit crops is 4.89% per year.

2) Results of nitrogenous fertilizer demand forecast and forecast on demand for urea

Of the resutls of forecasts discussed so far on the demand for nitrogenous fertilizers, the estimated figures for a period from 1975 to 1977 were revised by taking into account a demand recession due to the abnormally high fertilizer price hike. The per-hectare dosage by crops other than HYVs in irrigated fields and sugar cane for this three-year period was arbitrarily deemed to be on the same level as that of a period from 1972 to 1974. This is based on the fact that the demand sharply dropped during 1975 and then gradually began to pick up until 1977 when the 1974 demand level was recovered. In the case of HYVs in irrigated fields, they have been supported by the Masagana Program, so that there seems to have been no significant drop in the fertilizer demand. Concerning the forecast on sugar cane, the factor of such a periodical slump in the demand for fertilizers has already been taken into account in the projection of the product/fertilizer price ratio on fertilizer application level.

Table 1-2-17 summarizes the forecast results, while Table 1-2-18 gives the results for the High and Low Cases.

When comparing the estimation made in this Study on the past demand level and the actual achievements of the demand level, the following points must be taken into consideration:

1. The estimations for 1973 and 1974 are lower than the actual figure, while the estimations for 1974 onward are higher. This may be attributable to the fact that an import drive was apparent druing 1973 and 1974 due to the fertilizer price hike, thereby generating an apparent demand (i.e., increase in stock on distributors' level), and that 1975 saw a release of the stocked fertilizers as a reaction.

2. As the actual price could not be ascertained, the estimation on the demand for fertilizers by sugar cane during 1977 was calculated on an assumption that sugar cane price has been restored to a normal level by 1977. However, it is likely that the actual price during 1977 stagnaged on a considerably low level, thereby making it more likely that the actual level of demand for fertilizers was below the estimated level.

Regarding urea, the rates occupied by urea in the past years in the total nitrogenous fertilizer demand were as shown in Table 1-2-19.

This table implies that urea has been used for both export crops and food crops at a rate of about 50%. In the case of the Philippines, there has been no notable preference shown to urea by the type of crops. The urea application rate as against the total nitrogenous fertilizer application has so far demonstrated no uptrend or downtrend, although some fluctuation has been apparent.

It is assumed that this trend will also persist in the future. It is at the same time likely that the domestic production cost of ammonium sulphate will be relatively higher than the future international price of urea, thereby presenting a possibility of reduction of ammonium sulphate production in the Philippines. The fertilizer trade in the future will center around urea rather than ammonium sulphate. In view of these factors, it is probable that the urea application rate in the Philippines will show a slight increase.

As a result, the estimated demand for urea has been calculated as shown in Table 1-2-20.

(2) Outlook on the demand for industrial-use urea

The major source of demand for industrial-use urea is the urea-formaldehyde adhesives industry. Two adhesives factories are in operation in the Philippines at present. One plant has an adhesives production capacity of 1,700 tons per month, while the capacity figure of the other plant is unknown. The operational rate of the former is estimated to be some 60%. If it is assumed that the latter is also of the same capacity and operational rate, the demand for urea as a raw material for adhesives production will be about 10,800 tons.

However, on the basis of the actual production of plywood, the raw material urea requirement is calculated to be about 4,500 tons. When taking into account the other fields of adhesives consumption such as the wood craft industry, 6,300 tons or 40% over 4,500 tons is deemed to be the industrial-use urea demand in 1975.

Regarding synthetic fiber raw materials, no production is being carried out in the Philippines. At present, no project is being formulated for the construction of new

production facilities for this industry. It is also likely that urea and ammonia are being used for refrigeration and for the production of sodium gultamate; however, no detail has been made available.

As to the future trend of demand, calculations have been made on the basis of the possible future trend of plywood production which was based on the past trend. The results of this forecast are as shown in Table 1-2-20.

(3) Outlook on the domestic production of nitrogenous fertilizers and urea

Tables 1-2-21 and 1-2-22 respectively show the outlook on domestic production of nitrogenous fertilizers and urea. It has already been mentioned in relation to the production of ammonia that the operational rate of the existing plants, one owned by Planters Products Inc. and the other by Maria Christina Inc. is rather low. In formulating the future outlook on the production by these manufacturers, it has been assumed that such a low level of operational rate will also persist in the future.

In addition to these, a project is being contemplated concerning the construction of a new plant having an ammonia producing capacity of 600 t/d. This plant is envisaged to be based on indigenous natural gas and is targeted to be onstream during 1982. However, it is understood that the project will have to be delayed by one year at least due to the delay in the natural gas development project. In view of the present status of this Project, it has been assumed in this forecast that the commencement of production by this projected plant will be made in July of 1984 at the earliest. Concerning the operational rate of this new plant, it is estimated that the level will be lower by 10% than the case of Indonesia judging from the fact that the operational rate of the existing plants has been stagnating at a low level and also in view of the fact that the Philippines have no past experience in operating such a large plant. Therefore, the assumed operational rate figures are 65% for the first year, 70% for the second, and 80% from the third year onward.

Regarding urea, there is one existing plant operated by Planters Products Inc. In the case of this plant, the production cost is relatively higher than the price of imported urea, so that the operation is now compelled to be suspended. It is assumed here that the resumption of the operation will not be made in the foreseeable future, so that urea production by this plant has been excluded from the calculations. As a new plant, a project is being contemplated for a urea plant

having a capacity of 1,000 t/d to be constructed in conjuction with the above-mentioned ammonia plant. Concerning the onstream target and the operational rate levels, the assumption made here is the same as that made for the ammonia plant.

(4) Outlook on the supply/demand balance of nitrogenous fertilizers and urea

On the basis of the demand and supply outlook discussed so far, the supply/demand balance of nitrogenous fertilizers and urea is shown in Tables 1-2-21 and 1-2-22 respectively.

As a total nitrogenous fertilizers, a supply shortage by about 170 thousand tons N is estimated to take place in 1978. This shortage is estimated to grow gradually along with the expansion in the demand, so that the shortage level is estimated to attain a level of 233 thousand TN/Y by the year 1983. Thereafter, the supply will increase as a result of the commencement of the operation by the new plant; however, a shortage in supply of about 160 thousand TN/Y is estimated to persist in spite of the increase in the supply.

Regarding urea, the supply shortage estimated to be about 250 thousand tons as of 1978 is expected to grow gradually, so that by 1983, the shortage will exceed a level of 300 thousand T/Y. Thereafter, although the absolute shortage amount will be reduced as a result of the commencement of the operation by the new plant, a shortage of about 130 thousand T/Y is expected to still persist.

Therefore, if it is assumed that there would be no change in the level of stock, importation of urea becomes necessary in the amount of about 300 thousand T/Y before the commencement of operation of the new plant, and about 130 thousand tons after the start-up. In addition, as the import requirements of nitrogenous fertilizers other than urea, about 90 thousand TN/Y will be necessary prior to the new plant start-up, and about 100 thousand TN/Y after the start-up. Part of these nitrogenous fertilizer requirements will be met by importation in the form of anhydrous ammonia or aqua ammonia both of which will be used as raw materials for manufacturing ammonium sulphate or compound fertilizers. Some other part will be imported in the form of ammonium sulphate and compound fertilizers. The import requirements of anhydrous and aqua ammonia estimated on the present level of production of ammonium sulphate and compound fertilizers is about 15 - 20

thousand tons N. (Note: It is assumed here that the production of ammonia by the existing facilities in the Philippines will be continued in the future.)

1-3 Thailand

1-3-1 Features and trend of Thai agriculture

(1) Natural environment and agriculture

1) Agricultural land

Thailand may be divided into four parts, i.e., northern, northeastern, central, and southern regions. The northeastern and southern regions are different from the rest of the part in both topography and to a certain extent in climatic conditions. The northern and central regions are comparatively homogenous in terms of natural environment.

The distribution profile of agricultural lands is as shown in Table 1-3-1. More than 40% of the total agricultural lands of Thailand exists in the northeastern region. The central region is a monoculture area of rice with some exception being fruit and vegetable cultivation carried out in the outskirt areas of cities and the fruit/pepper cultivation carried out in the Chantaburi area. In recent years, the production of maize and sugar cane has increased centering on this region and the cropped area of these crops has since been extended into the other region. Generally, in this region, organic components in the soil are in shortage, so that the soil itself is acidified.

The northern region is the major agricultural production centers of rice cultivation; however, the availability of lands suitable for rice cropping is rather limited because of the mountainous topography of the area. In addition, the organic contents of the sandy soil of this region is hindering the production.

The northeastern region is mostly situated on a high land, and the soil is sandy. This area is basically more suited for dry field cultivation rather than for wet rice paddies in view of the nature of the soil. In spite of this condition, the major cropping here has traditionally been centering around rice cultivation.

The southern region is highly mountainous except for the coastal areas, and the soil is also sandy. Commercial agriculture such as rubber, coconuts, etc. has been fairly well developed here on one hand, but the importance of the self-

sustaining agriculture based on rice cropping is still high on the other.

2) Natural conditions

Except for the coastal bay area of the southern and the central region, the general climate is comparatively similar, threby showing no drastic regional differences. From April to May and also from October to early November are the rainy seasons with the southwesterly monsoon. In the northern and northeastern regions, the highest extent of precipitation is experienced from August to September, while from September to October in the central region. The dry season which runs from November to April has northeasterly monsoon with occasional rainfalls. The temperature is also high during the dry season, so that the summer crops can also be grown during this period. The annual precipitation in these regions range from 1,200 mm to 1,600 mm, and the amount of rainfall is higher in the areas closer to the mountains.

In the southern region, the wet season is quite long running generally from March/April to the next January. During this rainy season, owing to both southwesterly and northeasterly monsoons, the region has the heavy rainfalls amounting to 2,100 mm to 2,700 mm. In the bay/coastal area of the central region the climatic conditions are similar to those of the southern region, and the precipitation is as high as 3,600 mm on average.

(2) Features of the structure of Thai national economy and the position of agriculture in the economy

Traditionally, the national economy of Thailand has been featured by a monoculture of rice. However, along with the recent progress in the industrialization, the importance occupied in GDP by the agriculture/forestry/fishery industry has been lowered from 38% in 1960 to 20% in 1975. On the other hand, the manufacturing industry grew from 13% in 1960 to 20% in 1975. (Table 1-3-2)

Exportation of rice has been occupying an extremely important position within the framework of the Thai national economy. Particularly in years prior to 1960, about 40% to 60% of the total rice production was destined to exportation, and since the exportation of rice was the almost sole source of foreign exchange for Thailand, the fluctuation in the extent of rice exportation every year was directly related to the scale of the Thai national economic activities. The rice premium which forms

another important source of fund for industrialization was enacted by the Thai Government in 1956 in the form of an imposition upon rice exportation in addition to the export duty. During the initial stage of enactment, this rice premium served as one of the sources for securing the governmental financial income. As one of the features of economic construction during the decade of 1960s, the government undertook a sizeable investment into the infrastructural construction such as roads, etc. The rice premium played an important role in securing the source of the governmental investment. Around then, about 16% to 17% of the total governmental revenue was supported by the rice premium. During the first half of the 1960s, the importance of the rice premium fell to slightly over 10%, and during the last half, the percentage began to fall. Since 1971, the share of the rice premium in the total governmental revenue has been stagnating on a level of approximately 1%. In other words, the role of the rice premium system has since been changing from the originally intended source of governmental revenue to a buffer against the effects of the fluctuation in the international rice price affecting the domestic level of rice price in Thailand.

At the same time, the rice premium played a role, in the process of the industrialization, by controlling the general level of the wage on a low standard, thereby giving a boost to the promotion of the industrialization. In other words, the domestic level of rice price in Thailand was generally decided by subtracting the rice premium and the exporter's profit margin from the international rice price level. Therefore, the decided domestic rice price which was on a level much lower than that of the international rice price contributed to suppress the increase in the cost of living for people especially in urban areas.

Thus, the agricultural sector served as a source of capital formation necessary for the industrialization of Thailand. However, the importance of the agricultural sector within the framework of theThai national economy has, as mentioned earlier, been reduced to approximately 27%.

Nevertheless, it is true that the agricultural sector of the country is still occupying an important position within the national economy. The importance of the agricultural sector may be explained first by its capacity to absorb the labour force. As shown in Table 1-3-3, the agricultural sector is still involving about 80% of the total labour force of Thailand.

The second point which proves the importance of the agricultural sector is its ever important position occupied in the exportation. So far, the agricultural product exportation consisted mostly of rice. However, the agricultural export items have since been gradually diversified. At present, the rate occupied by the agricultural products including maize, tapioca products, and sugar account for about 70% of the total exportation from the country. (Table 1-3-4)

This being the situation, the following points may be raised as some of the most important issues to be expected on an agricultural sector from the stand point of the Thai economy:

1. To continue to maintain necessary export competitiveness for the acquirement of foreign exchange necessary for further industrialization

2. To check the inflow of farmers from rural areas into urban areas which is caused by the insufficiency of agricultural productivity, thereby increasing the number of unemployment in the city areas

In order to cope with these problems, it is acknowledged that the improvement in the productivity in the agricultural sector is a prerequisite for future development of the Thai national economy.

(3) Agricultural structure

A remarkable feature of the structure of Thai agriculture is the lack of the dual structure consisting of the plantation agriculture and small-holding agriculture. In this respect, Thailand is quite different from many other Southeast Asian countries. The nature of the agriculture in this country is basically of the so-called small-holding agriculture. Since independence in 1855, commercial rice cropping agriculture began to develop independently from the traditional self-sufficiency agriculture. Until the decade of 1950s, the agriculture of Thailand presented a strong feature of being a mono-culture based on rice cultivation. Even the rubber cultivation which traditionally developed in the southern part of the country is based on the small-holding system. The land tenant system which is observed in the rice growing operations did not originated from the past feudal land system, but this system has been formed within the process of commercial rice cropping development.

There is a certain difference in the pace of commercial development of rice cropping

depending upon the locality. Surrounding the central highland area, the commercial rice cropping has been well developed. On the other hand, there are several regions in the northeastern and southern parts of the country where the self-sufficiency rice cropping is still carried on. In the northern part, there is a burgeoning of commercial rice cropping by taking off the traditional stage of self-sufficiency operation.

Along with such a change in the structure of rice cropping agriculture, another significant change in the agricultural sector of this country began with the decade of 1950. This was the diversification of crops which developed greatly during the decades of 1960s and 1970s. As shown in Table 1-3-4, maize, tapioca, and sugar products closely followed rice in export in value of 1975. In terms of the exportation in value, these top four crops now show almost no difference.

One of the factors which gave impetus to such a rapid advancement in diversification of the crop items was an internal factor which had been fostered within the structure of the Thai agriculture. Another important factor which gave rise to the diversification expansion is an external factor which influenced the Thai agriculture.

The internal factor is twofold. One is a rapid change in the environment surrounding the agriculture, i.e., the industrialization, and the other is the change within the agriculture itself in the form of the further development of the commercial rice cropping. These internal factors were sufficiently fostered by the beginning of the 1950s to such a degree that the environment was attractive enough for the farmers to commercialize the agricultural products.

The external factor is an active expansion of demand for maize, tapioca, and other feed products in Japan and EC member countries.

The maize growing farmers in Thailand are cropping in fields where almost no irrigation facilities are available. Therefore, the cultivation is a complete rain-fed operation. This being the circumstance,the production is severely affected by the weather condition. The types of maize farmers range from the primitive type to the very modernized type. The most primitive farmers are moving year by year to seek suitable area for cultivation and carrying out the burnt field cultivation.

Some farmers possess their own fields along with highways from where their products can be transported to the market conveniently. Further, some farmers are conducting more modernized operation, being supported by the supply of capital

for operation from the urban investers and utilizing large scale agricultural machineries.

As a result of rapid increase in the demand for tapioca, the cultivation of cassava has also been expanded. Cassava can be grown in poor soil without abundant rainfall. Stable output of cassava can be expected even under these conditions. Further, this crop strongly withstands insects, and can be cultivated throughout the year. The cultivation of cassava does not call for a special technique. Therefore, the cassava growing is now expanding even in the northeastern part of the country where the agricultural production has strongly been oriented to self-sufficient production.

As has been discussed earlier, nearly all the rubber growers in Thailand are small-scaled farmers. The average size of the land for growing rubber plants owned by these farmers is less than 3 ha. This has been the impediment for the re-planting of the old rubber trees, thereby implying a danger of future drop in the productivity. In order to improve this situation, the government has prepared a special fund to assist the financing of rubber re-planting operation.

The past trend of the cropping area figures by the types of crops is as shown in Figure 1-3-1. Details concerning the trend of cropping of each of the these types will be described later.

(4) Past trend and future direction of agricultural policies

Within the framework of the economic policy formulated by the Thai Government, the agricultural policies were originally formulated on a basic intention of securing the government revenue from agriculture which is an important export industry. The implementation of the rice premium system is the major embodiment of such a nature of agricultural policies.

However, in recent years, two factors have been compelling the government to modify such a passive nature of the agricultural policies. The first factor is the gradual decline in the export surplus capacity in the production of rice. As shown by Table 1-3-5, the growth rate of rice production is lower when comapred to the growth rate of rice consumption, thereby inevitably reducing the amount of exportable rice. The other factor is the limitation to the physical expansion of agricultural lands. Particularly, the expansion of rice paddy land has become almost impossible.

The cause of these factors is attributable to the fact that the expansion in the

agricultural production in Thailand has traditionally been met by physical expansion of the arable lands alone without implementing the improvements in the agricultural technology and consequential enhancement of per-hectare yield.

This being the circumstance, the present direction of Thai agricultural policies is geared to the intensification of agricultural production. One manifestation of this policy is the substantialization of irrigation facilities. The irrigation construction projects envisages to enable the rice cropping during dry seasons. Although large-scaled irrigation facilities have so far been constructed, the project covered only the main water ways, leaving the branch water way networks uncompleted. Because of this delay, no effective irrigation has so far been possible. Within the scope of the Third Five Year Plan (1972 – 1976), the emphasis is being placed upon the construction of branch water way networks. So far, irrigation facilities to cover 1.2 million ha. have been constructed. However, the consolidation of the field itself fell behind the schedule this time, so that the irrigation water cannot be introduced into the fields.

Another manifestation of the intensification of the agricultural production is the encouragement of intensified cultivation technology. In the case of rice, Thailand has been falling behind in the introduction of high yield varieties when compared to other neighbouring Southeast Asian countries. The reason for hesitation for introducing high yield varieties on the part of the Thai Government was a deep concern about the deterioration in the quality of Thai's export rice for which the reputation has already been established in the international market. Therefore, the authorities were not quite willing to introduce and popularize the so-called high yield varieties. However, with the difficulties in physical expansion of the agricultural land becoming so serious, the government is finally promoting the utilization of the high yield varieties in order to increase the per-hectare yield. In the case or rubber tree growing, the government is encouraging the re-planting of high yield varieties as well.

The third manifestation is the agricultural land reform which is intended to prevent the inflow of population from the rural areas to the urban areas. The major point of this land reform is to narrow the income level gap existing between the rural and urban areas in Thailand.

1-3-2 Past trend and present status of supply/demand balance of nitrogenous fertilizers in Thailand

(1) Demand for nitrogenous fertilizers and governmental policies regarding fertilizer demand promotion

In general, the extent of demand for nitrogenous fertilizers in Thailand is not great. Prior to 1960, the annual demand was below 10,000 tons N. From 1960 to 1965, the demand stagnated within a range from 10,000 tons to 20,000 tons. In 1966 and 1967, the demand picked up sharply at a rate of 171% and 183% respectively over the previous year's level. However, the years thereafter saw a fluctuation, so that the average annual growth rate for an eight-year period from 1967 to 1975 was only 4%. (Table 1-3-6)

In the case of Thailand, nearly all the consumed nitrogenous fertilizers were used in the form of mixed or compound fertilizers. It is one of the features of the consumption pattern of this country that the rate of utilization of nitrogenous fertilizers in the form of straight fertilizer is quite low. It is also conspicuous that the utilization of urea is extremely low in contrast to the other Asian countries where urea is most popularly used. This fertilizer consumption pattern peculiar to Thailand may be explained as a reaction to the governmental policy of protecting domestic fertilizer industry, the details of which will be explained later. Further analysis of the past trend of fertilizer demand and the history of form of fertilizer utilization will also be explained later.

The distribution of fertilizers in Thailand has so far been undertaken for the most part by the private sector distributors and their distribution network. About 6% to 10% of the total fertilizer distributed are being handled by the cooperatives under the affiliation of the Agricultural Cooperative Federation of Thailand (ACFT). About 10% of the total is handled by governmental organizations (e.g., Rubber Replanting Aid Fund, etc.) which are directly selling the fertilizers to the farmers covered by the governmental organizations' programs.

In 1974, the government established the Marketing Organization for Farmers (MOF) for the purpose of sale of agricultural products and purchase of necessary agricultural input materials both at adequate prices. The government placed the MOF in charge of selling fertilizers to the farmers at a low cost with a support of governmental subsidy while the high level of international fertilizer prices prevailing in 1974. Prior to 1974, the basic policy of the Thai Government concerning the fertilizer distribution was to refrain from governmental injunction in the distribution of fertilizer commodities. For the first time in 1974, the government actually

provided the fertilizer subsidy although the scale was small. The fertilizers distributed by MOF are sold to the farmers through the cooperatives. In addition, the subsidized fertilizers were also distributed through the ACFT organization or the governmental agencies. As a result, the share in the fertilizer distribution occupied by the governmental organizations and cooperatives which amounted from 15% to 20% of the total was increased to 36% in 1975. However, the fertilizer handling amount by the MOF began to drop in 1976 when the import prices of fertilizers began to stabilize. As a result, the share by the governmental agencies and cooperatives as of 1976 fell to 17%.

The fertilizer consumption promotion activities directed to the farmers are the functions of private sector fertilizer distributors. Although the government operates agricultural laboratories and fertilizer application extension organizations, the services rendered by these governmental institutes are limited to the members of the cooperatives. The private sector fertilizer distributors are covering the farmers who are not affiliated under the governmental services. In the case of Thailand, the major form of fertilizers are mixed and compound fertilizers. Therefore, the private distributors are exerting their own efforts in selling their mixtures.

The government and governmental agencies of Thailand never formulated any special programs in the past for the purpose of positively expanding the demand for fertilizers.

(2) History and present status of the fertilizer industry

1) Past trend of importation and supply

As shown in Table 1-3-6, the supply of fertilizers in Thailand in the past has been entirely dependent upon importation. In 1966, the first manufacturing plant of ammonia, urea, and ammonium sulphate was placed onstream. This plant (Chemical Fertilizer Company (CFC)) started off as a 50% – 50% joint venture between the government and private firms. Since the operation was not satisfactory after the start-up, the government increased its rate up to 94% to assist its management, thereby making CFC a government-owned public corporation.

In spite of the governmental support, the operation of this plant failed to improve, so that the dependency upon importation is still high.

As mentioned earlier, the government took a basic attitude of fostering free competition in the fertilizer market, thereby minimizing the official intervention into the industry. However, along with the nationalization of CFC, the government started to undertake a policy for protecting the domestic fertilizer industry against the pressure of low international fertilizer prices. For this purpose, CFC was nominated as the only fertilizer importing organization in 1968, and the government prohibited the importation of fertilizers by other private companies. However, in spite of such a measure, the operational status of CFC still stagnated on a low level so much so that CFC alone could not meet the demand generated from the domestic market. In 1971, the government changed the policy in order to cope with this problem in such a manner that CFC is authorized to import only ammonium sulphate and urea, and the importation of other fertilizers were released to private companies. As a result, the fertilizer importers began to concentrate their business on the importation of mixed and compound fertilizers. As of 1973, all the prohibitions concerning fertilizer importation were abolished.

Since then, no ammonia-based fertilizer plant has been built in Thailand; however, a large-scaled fertilizer mixing factory based on imported fertilizers was constructed by private enterprise in 1975. In addition, five small-scaled mixing factories are in operation at present. The production share taken up by these five small plants is, however, only 6% of the total at the most. The Government of Thailand acknowledges exemption of import duty (10%), and a five-year tax holiday for corporate tax (30%) for all the fertilizer plants including mixing factories.

The Thai authorities have been controlling the import duty as one of the means to normalize fertilizer distribution. For the purpose of protecting the domestic fertilizer industry, an import duty ranging from 25% to 30% has been imposed on urea. However, due to the rise in the international urea price, the high duty urea started to harm the welfare of the farmers. Consequently, the duty rates have since been reduced to 10% for industrial-use urea and 3% for fertilizer-use urea.

On the other hand, the government is now in the process of increasing import duty rates for the most popular mixture product brands for the purpose of protecting the domestic fertilizer factories.

2) Past trend of production

Table 1-3-7 shows the past trend of production capacity and actual production by Thai fertilizer manufacturers. CFC is Thailand's sole ammonia-based fertilizer plant. It is a government-owned concern, however, the operational rate of the facilities has been extremely low.

The most conspicuous problems are difficulties in general administration, malfunctioning of production facilities, and in particular, the low quality level of raw material lignite.

As a mixing factory, Thai Central Chemical Co., Ltd. (TCCC) began production in 1975 as a joint venture with a Japanese trading company, a Japanese fertilizer manufacturer, and a Thai party. This plant expanded its production capacity in 1976 and is further planning to expand the capacity in 1978. As mentioned earlier, five other mixing factories are in operation on a small scale.

1-3-3 Outlook on fertilizer supply/demand balance in Thailand

(1) Outlook on fertilizer demand

1) Past trend and future outlook on the factors affecting the fertilizer consumption

a) Forecasts formulated in the past on the subject of the fertilizer demand in Thailand

Table 1-3-8 compares the figures forecast by various studies made so far and actual achievements concerning the demand for nitrogenous fertilizers in Thailand. Figures 1-3-2 and 1-3-3 depict the relationships among the actual demand in the past and the results of projections on the basis of data given in Table 1-3-8.

No details have been made clear about the calculation basis for the forecasts made in the "Fertilizer Market Study, ASEAN Region". At least regarding urea, it seems likely that the data used as the basis for this forecast was incorrect in view of the actual achievements in the past.

The forecast formulated by the Division of Agriculture and Economy, Minsitry of Agriculture and Cooperatives (DAE) was based on an assumption that the future growth rate of demand for urea will be 20.68% per year.

Thus these forecasts do not clarify the fertilized area rates and per-hectare dosage levels in the future which are throught to be the critical factors affecting the fertilizer consumption. The following paragraphs will be devoted to the analyses of these factors and the estimation of future nitrogenous fertilizer demand on the basis of various agricultural and fertilizer-related statistics collected through the present study.

b) Outlook on the land use and the trend of crop-wise cropping area

As shown in Figure 1-3-1, the paddy has occupied the large part of total cropped area in Thailand. This is due to the fact that Thai economy has largely depended on the rice exportation, and that the agriculture of Thailand has developed along with the development of commercial rice production. The cropped area of the paddy had stagnated until 1972, and then, along with the development in the irrigation facilities, has shown a gradual increase. The extent of increase in the paddy cropped area varies by region due to the difference in the types of paddy farm management in respective regions. Possible arable land left for the further expansion of paddy field is estimated to be very scarce. Therefore, the growth of paddy cropped area is expected to begin to stagnate again.

The cropped area of maize, cassava, and sugar cane, which has still occupied comparatively small share in the total cropped area in Thailand, has increased steadily. This increase is attributable to the diversification in the kinds of crops cultivated in Thailand along with the increase in the export demand for these products. The growth in the cropped area of these crops is expected to continue in the future.

c) Analysis and future outlook on crop-wise factors influencing the fertilizer consumption

1. Paddy

The form of paddy cropping management by the farmers in Thailand presents a

wide variety from one region to another. The Central Plain Region has been developing commercial paddy cropping for a long time while the northeast region and south region show self-sustenant type of paddy cultivation. The north region is now in a transient stage of shifting from self-sustenant type to commercial paddy cropping management.

Because of these different forms of management, the cropping area coverage and fertilizer dosage factors have also been developing locally different characters.

In the past, the nitrogenous fertilizer consumption by paddy has been taken up over 50% of the total fertilizer consumption made in the country. In the future, the rate of nitrogenous fertilizer consumption in paddy cropping will relatively decrease along with a growth of nitrogenous fertilizer consumption by crops other than paddy.

Estimation of the cropping area:

Table 1-3-9 shows the past trend of the paddy cropping area coverage in Thailand. A great irregularity in the coverage figures is apparent from year to year concerning all the regions. While the south region has been showing an almost continuous stagnation, but the other three regions have been showing a growth over a long term. However, the coverage growth in these three regions is also showing a downtrend, thereby showing the fact that physical expansion of paddy cropping area in Thailand is approaching a satuation point.

The future development of cropping area has been estimated on the basis of the past trend for each of the subject regions. The Low and Moderate Cases were established on an assumption that there will be no significant increase in the cropping area in all the regions. The High Case assumes that the trend shown since 1960 will also be applicable in the future in the form of a linear regression. The High Case therefore signifies that the irrigation facility installation which has so far been showing a delay will progress steadily, and at the same time, the double cropping area will increase further from the present level.

Estimation of per-hectare dosage:

The following method was employed in estimating per-hectare dosage of nitro-

genous fertilizers in paddy cropping in Thailand:

1. The consumption amounts of those types of compound fertilizers used for paddy cropping (as shown in Table 1-3-10) were totaled*) for each subject region.

2. By dividing the region-wise consumption by the region-wise cropping area coverage, the average per-hectare dosage as against the cropping area (i.e., not as against the fertilized area) was obtained.

The results of the estimation by this study regarding the consumption of nitrogenous fertilizers in paddy by region are shown in Table 1-3-11 under column "Average Dosage". According to this table, the Central Region shows the highest level of approximately 10 kg N/ha., while the other regions show no more than 3 kg N/ha. It is obvious that these figures are drastically lower than the case of other countries. In addition, the per-hectare fertilizer dosages in all regions have been showing a slight fluctuation, yet demonstrating almost no uptrend.

There is no sign of factors which may cause a drastic change to this trend in the future. However, in view of the following points, it is expected that a certain extent of increase will be made in the future in per-hectare dosage of fertilizers:

1. Increase in the fertilized area coverage due to the expansion of commercial paddy cropping, and consequential increase in the average per-hectare fertilizer dosage as opposed to the total cropping area coverage.

2. Increase in the per-hectare dosage along with an increase in the cropping area under the HYV cultivation. Regarding this point, the 1973 actual

Note: *) The DAE conducted estimation on the crop-wise and region-wise fertilizer consumption for 1972. In the estimation, the consumption is estimated in terms of the amount of all types of fertilizer used for respective crops, but no data is available for fertilizer-nutrient-wise consumption. In this Study, the types of fertilizers which were assumed to have been applied to each of the subject crops have been estimated on the basis of these DAE data as well as on the basis of the interview made during the field survey.