achievement figures show that the national average of per-hectare dosage was 10.5 kg N in the case of HYVs and 5.4 kg N in the case of local varieties. This difference in the per-hectare dosage is not very conspicuous in the Northeast and South regions; however, the gap becomes more conspicuous in the Central Area where the commercial paddy cropping is mainly undertaken and also in the North Region where the paddy cropping operation is gradually shifting towards commercial cultivation.

In the present forecast, the per-hectare dosage was forecast by employing the following method. The obtained data are as shown in Table 1-3-11:

1. Generally, it has been assumed that the past trend in the fertilizer dosage will be maintained in the future. Therefore, the basis for this forecast is a linear extension of the trend value from 1970 to 1976 towards future years.

2. However, when selecting the trend value, attention must be paid to the fact that the agricultural product price/fertilizer price ratio in 1972 and 1974 was low. Therefore, the values for these two years have been excluded from the scope of calculation of the past trend value. The ratio figures of agricultural product price and fertilizer price are shown in Table 1-3-13.

3. A study was also made concerning the potential maximum level of per-hectare fertilizer dosage as will be explained later. However, because of the extremely low dosage level prevailing at present, it seems unlikely that the potential maximum dosage level will be a restriction on the fertilizer dosage level that is forecast for the subject forecast period.

High and Moderate Cases of the forecast are formulated on the bases of the foregoing points.

Above Clause 2 implies that the future ratio between agricultural product price and fertilizer price will not deteriorated easily to a level shown in 1972 and 1974. In practice, however, this ratio may temporarily be deteriorated to such a considerably low level because of a possible drop in the price of rice in the future.

The low case forecast is established on the assumption that such unfavorable conditions may occur in the future, too. In this Low Case projection, the consumption in the above described two years, i.e. in 1972 and in 1974, are not excluded from the scope of calculation of the past trend value.

The following paragraphs will discuss the maximum dosage level of nitrogenous fertilizer which can be expected in the paddy cropping in Thailand.

The result of analysis of fertilizer response to HYV paddies obtained from the DAE are as follows:

North Region:

$$Y = 483.73 + 4.390\,x - 0.018\,x^2$$

Northeast Region:

$$Y = 170.25 + 3.50\,x - 0.020\,x^2$$

Central Region:

$$Y = 464.15 + 8.538\,x - 0.045\,x^2$$

South Region:

$$Y = 357.29 + 2.654\,x - 0.009\,x^2$$

Where;

Y: Yield (kg/Rai), x: Dosage (kg/Rai)

the type of fertilizer used: N16-P20-K0

The above formulae represent the results obtained in agricultural laboratories. On the basis of the dosage and yield factors in all the subject regions for the years 1973/74, the expected yield calculated from the above formulae was compared with the actual yield in respective regions. As a result of such a comparison, the formulae were modified such that the yields calculated from the formulae are equivalent to the following yields:

North region:

94% of the yield expected from the above formula

Northeast region:

146% of the yield expected from the above formula

Central region:

72% of the yield expected from the above formula

South region:

74% of the yield expected from the above formula

On the other hand, it is generally acknowledged that farmers will keep increasing the fertilizer dosage until the marginal cost/benefit ratio reaches down to 2.0. On the basis of the modified formulae, the fertilizer dosage fingures at the level where the marginal cost/benefit ratio becomes 2.0 are obtained as follows. In other words, this data represent the economic optimum fertilizer dosage level obtained on the basis of the analysis of fertilizer response:

North Region:	34 kg N/ha.
Northeast Region:	26 kg N/ha.
Central Region:	30 kg N/ha.
South Region:	23 kg N/ha.

The above optimum dosage level figures are obviously much lower than the levels prevailing in other Southeast Asian countries. However, in the case of the soil conditions in Thailand, the nitrification is extremely quick, thereby lowering the fertilizer nutrient absorption rate by the crops. In view of these conditions, it has been established in this study that the above-obtained level figures are reasonable. As mentioned earlier, the currently prevailing fertilizer dosage level in Thailand is still on an extremely low level. Therefore, these optimum dosage levels will not be a restriction on the forecast fertilizer dosage levels in the near future.

On the basis of the above-mentioned forecast on the cropping area and also the forecast on the per-hectare fertilizer dosage, the nitrogenous fertilizer consumption for a paddy in respective subject regions has been forecast by employing the following formula:

(Demand) = (Cropping area) x (Fertilizer dosage per hectare of cropping area)

The obtained results are shown in Table 1-3-11. The results for the High Case and Low Case are shown in Table 1-3-12.

2. Other crops

Of all the crops other than paddy, sugar cane seems to be the most highly nitrogenous fertilizer consuming item. Along with consecutive construction of sugar mills in Thailand, the cropping area coverage for sugar cane has also been growing rapidly. However, as far as the fertilizer dosage level is concerned, the sugar cane in Thailand is receiving a dosage level ranging from 30 kg N to 50 kg N/ha. which is considerably lower than the case in other Southeast Asian countries where the cropping of sugar cane is generally carried out under the large-scaled farm operation with considerably high level of fertilizer dosage. In the case of Thailand, the sugar cane cropping is carried out by small-holding farmers. Another factor contributing to the low level of fertilizer dosage to sugar cane is the particularly low level of nitrogenous fertilizer absorption rate by crops in sugar cane fields in Thailand.

The nitrogenous fertilizer consumption by vegetables in Thailand also shows a considerably high per-hectare dosage level as in the case of other Southeast Asian countries. However, because of the fact that the cropping ara for vegetables is small, the total scale of demand for nitrogenous fertilizers is also considerably low.

Maize is one of the most important export agricultural crops of Thailand. Therefore, the cropping area coverage of maize is comparatively large. In spite of the fact, the fertilizer dosage level has so far been extremely low. This has been due to the fact that the maize growing farmers have grown maize in a primitive form such as burnt field cropping by utilizing lands of poor conditions on which no cropping of paddy or sugar cane is possible.

Rubber cultivation is one of the traditional agricultural activities of the country. However, the growth of cropping area coverage is currently stagnating, and the form of cultivation management shows almost no sign of further development.

Estimation of cropping area:

The cropping area coverage of respective crops was projected on the basis of the past trend. Regarding vegetables, the conventionally shown growth rate will also be achieved in the future along with the increase in the population and the improvements in the income. However, concerning other crops, it is likely that the pace of cropping area expansion in the future will show a gradual downtrend in view of the fact that the total cropping area for these crops is nearing a saturation point, and also in consideration of the fact that the pace of cropping area growth in the recent past has been falling. Concerning the cropping area of sugar cane, which is considered to have a possibility of giving the most significant influence on the future consumption level of nitrogenous fertilizers, two cases have been established, i.e., the High Case and the Low Case. In the High Case, the past trend of expansion in the cropping area has been linearly exterpolated, while in the Low Case, the assumptions made are that the expansion will rapidly attain a saturating point. Regarding other crops, the effects on the forecast is negligibly even if the actual achievement of the cropping area rate growth is different from the forecast value.

Estimation of per-hectare dosage:

As in the case of the study made on a paddy, the past level of nitrogenous fertilizer consumption of each of the subject crops was estimated on the basis of the total consumption of each of the fertilizer types as shown in Table 1-3-10 which are deemed to have been applied to these subject crops.

Regarding the future level of fertilizer dosage, the recommended dosage set forth by the Department of Agricultural Extension is deemed to be the optimum dosage level. It is assumed that the dosage level of each of the subject crops will gradually approach this optimum dosage level. However, the following points were taken into consideration when formulating this forecast:

1. In the case of vegetables, it is highly unlikely that all the vegetable items will receive fertilizer application at this optimum dosage level. Some vegetables may receive fertilizer application at this level, but others may not. Therefore, the average fertilizer application level per hectare of total vegetable cropped area will be lower than this optimum dosage level.

2. Some amount of sugar cane is used as food crops without being shipped to sugar mills. Of the sugar cane used as food, the sugar cane made into commercial commodity may receive fertilizers at a level approximately the

same as the amount of fertilizers given to the sugar cane grown to be delivered to sugar mill. However, the sugar cane consumed by the farmers themselves may have received no fertilizers in many cases. In view of these facts, the maximum dosage level for sugar cane is deemed to be lower than the above-mentioned optimum dosage level.

3. Concerning tobacco, no data was available concerning the recommended dosage. The actual dosage level for tobacco has been showing an annual fluctuation. In this Study, a level 25 kg N/ha. has been employed as the future dosage level in view of the past trend of the dosage applied. In view of the total nitrogenous fertilizer consumption made in Thailand, the fluctuation in the future demand for nitrogenous fertilizers in tobacco cropping is negligibly small.

4. In view of the past trend, no great extension of fertilizer application is likely in the case of maize. The per-hectare dosage in 1973 on a national average was 33 kg N, and the average for the North and Central Regions was slightly over 40 kg N. The fertilized area coverage will increase along with the growth in the cropping area coverage in the future. However, even if a dosage of 60 kg N per hectare is carried out throughout the total fertilized area as of 1973, the scale of demand will be only 180 tons N. Such an extent of consumption cannot cast any significant influence upon the future trend of total demand for nitrogenous fertilizers in Thailand.

Table 1-3-14 shows the results of crop-wise projection on the demand for nitrogenous fertilizers on the basis of the outlook on the future trend of cropping area and per-hectare dosage. Table 1-3-15 gives the results of demand forecast made for the High Case and the Low Case established for sugar cane.

Crops other than those discussed so far in terms of nitrogenous fertilizer consumption are fruit, cassava, coconut, kenaf, etc. During the course of the present study, no sufficient data were made available regarding the cropping area and fertilizer dosage concerning these crops. Therefore, the extent of future demand for nitrogenous fertilizers generated by these items was forecast by means of the following method:

1. On the basis of the standard dosage established by the Department of Agricultural Extension, the total nitrogenous fertilizer requirements were

calculated on an assumption that the fertilizer application were made throughout the cropping area. Concerning the future trend of cropping area, the fruit cropping area is deemed to increase at an annual rate of 1.9% in view of the past trend. Concerning all the other crops, it was assumed that the increase in the cropping area coverage will continue to grow linearly on the past trend.

2. The past achievements of each of these crops was analyzed in terms of the attainment rate as against thus obtained nitrogenous fertilizer requirements. The attainment rate is expected to increase gradually in the future, but the speed of the increase is unlikely to be rapid in view of past trend. On the basis of such an assumption, the yearly attainment rate for these crops was forecast.

3. On the basis of this attainment rate and the nitrogenous fertilizer requirements, the nitrogenous fertilizer consumption by these crops was calculated. The figures employed as the basis for this calculation as well as the results of this forecast are shown in Table 1-3-16.

2) Result of nitrogenous fertilizer demand forecast and demand forecast on urea

Table 1-3-17 summarizes the crop-wise nitrogenous fertilizer demand forecast as discussed so far. The High Case and the Low Case are shown in Table 1-3-18. According to these tables, the demand expansion by sugar cane and other crops centering on fruit is particularly conspicuous. Because of such a progress, the rate of paddy-destined nitrogenous fertilizer consumption, which in the past showed a level slightly over 50% of the total demand, is now forecast to fall to a level of approximately 35%.

The following paragraphs will discuss the forecast on demand for urea as one of the nitrogenous fertilizers.

Historically, the application of urea has been limited to some portion of vegetables. The history of urea application in this respect has already been mentioned in 1-3-2 (2). Up to the present moment, no particular sign of progress in urea application is noted. In the future, however, it is likely that the following trend will appear. It is likely that the oversupply in the international market of nitrogenous fertilizers will manifest itself in the form of surplus ammonia or urea. Therefore, importation and utilization in the form of urea or importation in the form of urea and utilization in the form of compound fertilizers will become more advantageous than importation in the form of compound fertilizers. The import duty on fertilizer-use urea has already been reduced. In view of these circumstances, it is likely that the general environment will be suitable and advantageous for urea to be further popularized.

However, some drawbacks are also present for the popularization of urea application. Firstly, nitrification of nitrogenous fertilizers under Thai soil is generally said to be quick, with urea being subject to much rapid denitrification than other types of nitrogenous fertilizers.

Secondly, Thailand is contemplating an ammonia production project. However, since no urea plant is planned to be constructed in the framework of this project, the produced ammonia will be converted into other types of fertilizers such as ammonium sulphate and ammonium nitrate. In such an event, the sales promotion of fertilizers will be more concentrated on indigenous products than on imported urea, thereby implying the possible stagnation in urea application.

In view of the above points, the following are projected concerning the future diffusion of urea application:

1. The application of urea will be popularized not only in the vegetable cropping field, but also for paddy and other types of crops as in the case of other Southeast Asian countries. Urea will be used not only as a straight fertilizer, but as a raw material for producing compound fertilizers.

2. However, the speed of penetration of urea application will not be high.

Table 1-3-19 shows the urea application penetration rate regarding the subject crops as estimated in the urea demand forecast. This table also shows the results of the forecast on the trend of demand for urea in the future.

(2) Demand forecast on industrial-use urea

The demand for industrial-use urea in Thailand is generated from the urea-formaldehyde resin adhesive manufacturing field and the sodium gultamate production field. Although the absolute amount of the demand for urea as a raw material for the production of these items was not great, the past achievement has shown a slight but steady increase.

One factory for manufacturing urea-formaline resin adhesives is now in operation in Thailand. If this plant carried out its full-capacity operation, the raw material urea requirements would be 6,600 T/Y. However, the demand for adhesives at present is not great, so that the current operational rate of this adhesives factory is estimated to be about 40%. On this basis, the estimated extent of demand for industrial-use urea in this field is 2,600 T/Y (1,200 T N/Y). However, in view of the urea requirements calculated on the basis of the production figures of plywood and particle board, it is likely that the demand for urea as a raw material for the adhesives as of 1975 is approximately 2,000 tons N. The remaining portion of the demand for industrial-use urea seems to be generated from the sodium glutamate manufacturing industry as a raw material.

The demand for industrial-use urea in the future has been forecast by means of the following method:

1) Regarding the demand as a raw material for adhesives, the future trend of production of plywood was first estimated on the basis of the past records of the production. The demand extent of urea was calculated, then, on the basis of the requirements derived from the estimated plywood production.

2) Regarding the demand as a raw material for manufacturing sodium glutamate, the extent calculated by subtracting the adhesive-use urea was deemed to be the past achievement of the consumption. The future trend was estimated by linearly extending the trend value of thus estimated past consumption level.

The results of these forecasts are shown in Table 1-3-20.

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

Table 1-3-21 shows the domestic production outlook of nitrogenous fertilizers, while Table 1-3-22 gives that of urea. CFC is the only manufacturing company of ammonia and urea in the country. The history of low operational rate of this plant has already been mentioned. Although efforts are being made to improve the operational rate, it has been assumed in this study that the past level of the rate will persist also in the future.

As to a new plant, a project is being formulated for a construction of a 1,000 t/d ammonia plant based on indigenous natural gas. Although no finalization has been made as of yet, the product ammonia is planned to be used as a raw material for ammonium sulphate and compound fertilizers. Taking into account the delay in the basic project for the development of natural gas, it has been assumed here that onstream of the operation of this plant will be made in July of 1985. The operational rate of the above-mentioned existing plant cannot serve as an index for the possible operational rate of the new plant because of the difference in the raw material. However, in view of the lack of experience in operating a large-capacity plant in Thailand, the operational rate level of the new plant has been assumed to be 10% below the Indonesian level, i.e., 65% for the first year, 70% for the second, and 80% from the third year onward. No project is being formulated for urea production.

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

Tables 1-3-21 and 1-3-22 give the supply/demand balance of nitrogenous fertilizer and urea formulated on the basis of the demand and supply forecast made so far.

Regarding supply/demand balance of nitrogenous fertilizers, the amount of short supply will increase until 1984. Along with the commencement of operation of the new plant in 1985, the supply shortage will be gradually related until 1987 when the supply and demand are expected to attain a balance.

Regarding the balance of urea, supply shortage will gradually increase, although the extent of shortage will be small. In 1982, the shortage will be 43,000 tons which is forecast to grow to 95,000 tons in 1987.

It is likely that the gap between the nitrogenous fertilizer supply shortage and urea supply shortage will be filled mainly by the importation of compound fertilizers.

1-4 Malaysia

1-4-1 Features and trend of Malaysian agriculture

(1) Natural environment and agriculture

As shown in Table 1-4-1, the total land area of Malaysia is 33,000 thousand ha. The land area of Malaysia is divided into two large parts, i.e., West Malaysia which consists of the Malaysian Peninsula and the East Malaysia which is composed of Sabah and Sarawak. West Malaysia takes up about 40% of the land area, and East Malaysia about 60% of the total land area of the country.

The agricultural land occupies only 11% of the total land area on an average throughout the country as of 1971. It should be noted here, however, that West Malaysia and East Malaysia differ from each other entirely in terms of the rate of the agricultural land as against the total land area of the region. The agricultural land rate in West Malaysia amounts to 22.4%, while in East Malaysia, Sarawak accounts for 3.6%, and Sabah only 3.3%. Although West Malaysia still has sufficient room for future development of agricultural land, East Malaysia may be therefore regarded as entirely undeveloped in terms of the agricultural land utilization.

In view of the geographic distribution profile of the agricultural lands, about 80% of the total Malaysian agricultural land exists in West Malaysia. In East Malaysia, Sarawak occupies 12% and Sabah only 7%.

In terms of climatic conditions, the country is in the tropical zone, and the prevailing climate is oceanic with comparatively stable and mild conditions. The precipitation is abundant, thereby making the land highly suitable for agricultural operation.

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

Since mid-19th century, rubber plantations and tin mines have been developed. The exportation of these two major products has traditionally been the major industry of Malaysia. The basic pattern is still persisting at present.

Table 1-4-2 gives the contribution rate of exportation to GNP. According to this table, the contribution rate of exportation has historically been staying on a level of approximately 50%. Although the contribution rate showed a downfall druing a certain period, the rate has again started to pick up since 1972.

For the most part, the export items consist of the primary industrial products. Until 1960, about 80% of the total exportation in value was accomplished by rubber and tin alone. Since then, the export rate of rubber began to fall along with a rapid development of the supply of synthetic rubber in the world market. However, the growth of oil palm exportation has been covering the decrease of rubber exportation. Outside the agricultural crop products, forestry products such as logs and lumber are also filling in the gap. In recent years, the importance of oil has been remarkably increasing in the exportation market. (Table 1-4-3)

Because of such an economical structure, the major source of governmental revenue is import/export duties which presently exceeds 50% of the current income of the government. Of these duties 20% of the total is received from the export duty.

In addition to the heavy dependence upon exportation, another feature of the national economy of Malaysia is the multi-class structure. Within the framework of the Second Five Year Plan, the Government of Malaysia divides the class structure into the following three major classes and five sub-classes as follows:

1. High-income class:

   Modern urban sector: Manufacturing, construction, commercial, service industries employing modern technology

2. Middle-income class:

   1) Modern agricultural sector:
   Large-scaled estate agricultural operation and small-holding farmers taking part in various governmental schemes

   2) Governmental sector

3. Low-income class:

   1) Traditional urban sector:
   Manufacturing industries without employing modern facilities

2) Traditional agricultural sector:

Farmers engaging in agricultural production by employing traditional techniques

The improvements in such a structural inequality is important both in view of the creation and generation of domestic demand, as well as for the betterment of the economic structure which is presently heavily dependent upon exportation. Table 1-4-4 shows the rate of poor households in rural areas in West Malaysia. This table is based on the data given in the Third Malaysian Plan. As shown here, about 60% to 70% of the villagers are classified as belonging to poor household. Particularly, the rate of poor households among rice growing farmers is as high as 88% in 1970 and 55% in 1975. For the improvement of such problems of poverty, the keypoint obviously is the modernization of the agricultural sector.

The effort on industrialization has increasingly been pressed in Malaysia. However, the rate occupied by the manufacturing and construction industries in the total GDP at present is still on a low level of approximately 20%, while agriculture/forestry/fishery sector still accounting for 30%. (Table 1-4-5) Further, in terms of the employment rate, the agriculture/forestry/fishery sector shows a rate as high as 49%, while the manufacturing/construction sector contributing to only 13% of the total. (Table 1-4-6)

Because of the insignificance in the scale of the domestic market, the industries depending on the domestic demand cannot expect to have any meaningful growth Therefore, if the industrialization of Malaysia is to be promoted, the modernization of the agricultural sector and consequent development of domestic market are the imperative prerequisites.

In the case of Malaysia, a great extent of foreign exchange has been expended to cover the importation of food in spite of the fact that the country has traditionally been showing a high exportation rate of agricultural products. The reason for such a contradictory status is the lack of proper attention on the rice cultivation operations carried out by the traditional agricultural sector, even though adequate countermeasures have been undertaken in protecting and promoting the profitable operations of export crop production. In recent years, however, the extension of double cropping and introduction of high yield varieties have been soundly progressing. Even so, the self-supply rate of rice as of 1976 amounted only to 86%. Concerning sugar, the self-supply rate has also been increasing; however, the present level is still approximately 90%. About 400 thousand tons of wheat is being imported every year. In order to cope with these problems of excessive foreign exchange expenditure, the government is now exerting its efforts to develop and modernize the agricultural sector.

As has been discussed so far, all the important issues for the future development of the Malaysian economy have close bearing upon the modernization of the agricultural sector. From this viewpoint, the major tasks for the Malaysian Government are as follows:

1. Maintenance of export competitiveness

2. Expansion of the domestic market in order to take off the unstable export-dependent economy

3. Elimination of the multiple-class structure of the national economy

4. Reduction of food importation

(3) Agricultural structure

The agricultural structure of Malaysia is similar to the other Southeast Asian countries in that the agricultural sector consists of two sub-sectors such as large-scaled estate agriculture on one hand and traditional small-holding agriculture on the other. However, in recent years, since the government has been promoting an immigration policy for the purpose of developing the untapped areas of the country, and also developing the small-holding agricultural sector, a new group of farmers are developing between the estate sector and the small-holding sector.

The estates mainly turn out rubber, oil palm, coconut, cocoa, tea, sugar cane, etc. Of these, rubber and oil palm take up a significantly important position.

Table 1-4-8 shows the number of rubber estates by size and by nationality of owner. Table 1-4-9 gives the estate rubber planted area by nationality of owner. The estate-oil-palm planted area by nationality of owner is as shown in Table 1-4-10.

Side by side with such large-scaled and modern-operation estate sector, there is a small-holding sector based on small-scale operation and traditional agricultural techniques. For the most part, these small-holding farmers are engaging in rubber cultivation, followed by rice, coconuts, etc. as shown in Table 1-4-11. The productivity in this sector is significantly low.

From among these small-holding sector, there have recently been a number of farmers who began to take part in various governmental programs, thereby enhancing their productivity. They are introducing high yield varieties in the case of paddy cultivation, and are re-planting high yield varieties in the case of rubber growing. Further, farmers who have been to grow oil palm are increasing because the oil palm is the major crop recommended by the government in its land development schemes. (The cultivation area figures owned by this type of farmers are included in the figures shown in Table 1-4-11.)

As shown in Table 1-4-12, the cropping area of rubber has been gradually decreasing. However, the area planted by the small-holding farmers has continually been increasing, while that planted by estates has been showing a decrease. The decrease in the case of estates is due to the progress in the shifting towards oil palm cultivation, and the increase in the case of the small-holding farmers reflects the results of the small-holding fostering policies undertaken by the government. In the case of oil palm, the cropping area shows a rapid increase. The land owned by the estates is increasing in terms of the coverage; however, the rate it occupies in the total oil palm growing area has been falling from 91% in 1964 to 63% in 1973. This is due to the expansion of the oil palm planting by small-holding farmers as the oil palm is the major crop for the immigration policies by the government and also for various land development projects promoted by the authorities. Concerning rice, the total cropping area has been increasing owing to the expansion of double-cropping area.

(4) Past trend and future direction of agricultural policies

As already discussed in (2) above, the modernization of the traditional agricultural sector, and the removal of poverty in rural area are inevitable issues for the Malaysian governmental agricultural policies. In order to cope with these problems, the government is now promoting several programs. These plans are classified into two broad categories, one pertaining to the development of the uncultivated land and the other to the promotion of double cropping of the paddy.

Within the framework of the Second Development Plan which started in 1961, priorities were given to the rice production increase and double-cropping promotion due partly to the stagnation of the demand for rubber because of the introduction of synthetic rubber into the world market. As a result, the investment for substantialization of irrigation and water drainage facilities began to increase, and double cropping became increasingly expanded, thereby enhancing the self-sufficiency rate of supply of rice.

Along with the physical improvements, the popularization of high-yield varieties greatly contributed to the increase in the rice production. Around 1964/65, new rice varieties began to be used in the fields. The government encouraged the introduction of HYVs by providing subsidy for the rice seed procurement, and also by setting the governmental purchase price of new varieties of the product higher than that of the conventional types.

The development scheme of land was mainly implemented in the export crop sector. During 1930s, the productivity of rubber plantations began to fall because of the aging of the rubber trees both in the case of large-scaled estates and small-holdings. However, no sufficient re-planting was conducted for a long time due to a great recession, international control activity for rubber growing, and confusion because of World War II, etc.

In accordance with such situation the government has implemented several re-planting programs. However, the project did not work well until the Federal Land Development Authority (FELDA) finally assumed complete administrative authorization concerning this project. In this system, the government provides the farmers with the necessary subsidy and loans for agricultural operations as well as household expenses until the immigrant farmers have begun to receive some income from their fields. At present, about 62% of the total farmers of this project are growing oil palm, while about 36% grow rubber and the remaining 2% either sugar cane or cocoa.

Similar programs are also being implemented by the Federal Land Consolidation and Rehabilitation Authority (FELCRA) and also by various state governmental agencies. In the case of the FELCRA, the main object of the project is to carry out the land development and land reform around the existing agricultural villages. Even so, the ultimate purpose of this project is identical to that of the FELDA project.

In 1973, the Rubber Industry Smallholders Development Authority (RISDA) was established, and all the conventional agencies dedicated to rubber re-planting and extension were united under this authority. The objective of the RISDA is to promote the modernization of the rubber cultivation by small-holding farmers. The fund for the activities to be undertaken by this authority is met by the surtax on the exported rubber, and subsidy provided by the governmental financial sources.

1-4-2 Past trend and present status of fertilizer supply/demand balance in Malaysia

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

No official data is available in Malaysia concerning the demand for fertilizers. Data collected from several sources are mutually different. Table 1-4-13 was based on an estimate made by C. Itoh Co. with some additions and modifications by subtracting the industrial-use portion and incorporating figures of import/export statistics for the years 1975 and 1976. According to this table, the demand for the nitrogenous fertilizers has been steadily growing with some stagnation during 1973 - 1975. In terms of type of nitrogenous fertilizers consumed, about 50% has been in the form of urea, followed by compound or mixed fertilizers.

In Malaysia almost no specially prescribed policy has been undertaken concerning fertilizer consumption except for some which will be described in the following. The distribution of fertilizer has been carried out solely by the private sector.

The expansion in the fertilizer demand in recent years is obviously a result of extension of governmental loans as fertilizer purchase funds. This is incorporated in governmental schemes for fostering small holder farmers such as land development schemes, double-cropping boosting programs, etc. The supply of fertilizers within the framework of these official programs is undertaken by respective governmental agencies. The transactions are conducted on the basis of bids.

In 1960, the government provided paddy farmers with a subsidy for fertilizers in connection with double-cropping promotion. This was merely used for the purpose of educating the farmers about the effects of fertilizers, and the subsidy program was implemented by covering a different district every year thereafter. The program was terminated in 1970.

During 1973 - 1974 when the international fertilizer price showed an abnormal hike, the government provided a subsidy on urea. This subsidy only covered paddy farmers and the farmers under the above described governmental schemes. This subsidy was also terminated when the international market price fell off.

(2) Past trend of imports and supply

Until the start-up of the ammonia plant of Esso Malaysia in 1966, all the supply was met by imports. After the onstream of the Esso plant, the import dependency fell about 55% as shown in Table 1-4-13. In 1975, the import was lower than other years and was due to the over imported stock of fertilizers during 1974.

(3) Past trend of domestic production

Production of ammonia has been conducted by Esso Malaysia since 1966. No other plant is manufacturing ammonia. By using this ammonia as a raw material, ammonium nitrate is produced by Chemical Company of Malaysia (CCM), and ammonium sulphate by Federal Fertilizer Company (FFC). Thus produced fertilizers are mostly used as components for producing mixed fertilizers. No urea production plant is in operation in Malaysia at present.

The trend of production by these plants is as shown in Table 1-4-14. The operational rate of FFC is low due to the insufficient supply of raw ammonia material.

1-4-3 Future outlook on the fertilizer supply/demand balance in Malaysia

(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 Malaysia

Table 1-4-15 shows a comparison of the results of several surveys conducted in the past on the future trend of nitrogenous fertilizer demand in Malaysia. The surveys shown in this table are the C. Itoh Study conducted in 1977, the actual achievements since made, the present study, and the "Fertilizer Market Study, ASEAN Region". Figures 1-4-1 and 1-4-2 were drawn on the basis of the data given in Table 1-4-15.

The C. Itoh Study accurately grasps the actual status of fertilizer consumption made in the past in Malaysia on the basis of the information collected through field surveys. The C. Itoh Study projected the fertilizer demand on the basis of the past status of consumption and crop-wise production forecasts. In this study, the actual status of fertilizer consumption in the past was grasped on the data and information collected through the field survey. The study can be highly evaluated as it is accurately representing the current status of the fertilizer facts of the country. Much of the bases employed in the C. Itoh study was directly quoted for the purpose of the present study.

However, there are some differences in the projected demand between this present study forecast and C. Itoh study forecast. It is especially on the subject of fertilizer consumption by paddy and there is a large difference between the two studies.

In the following paragraphs, an analysis will be conducted on each of the factors affecting fertilizer demand to formulate the bases for the projection in the present study. At the same time, mentions will be made as and when deemed necessary to those points which are the causes for resulting in discrepancies between the present study and the C. Itoh study.

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

The pattern of crop-wise cultivated area in Malaysia is different from those of other South Asian countries in that in Malaysia the rubber planted area occupies the largest portion of total cropped area. But in the case of other South Asian countries, paddy area occupies the largest total cropped area. The rubber planted area still occupies around 50% of the total planted area in Malaysia in spite of the fact that the share occupied by rubber planted area has been declining from 64% as of 1966. The decrease in the rubber planted area itself has been slight due to the fact that the rubber planted area by estates has declined on one hand because of conversion of the area into oil palm area. The rubber planted area by small-holdings has increased on the other, enhanced by the governmental land development schemes and thus the increase has almost compensated the decrease.

The oil palm planted area occupies only 16% of total planted area, but, as already mentioned, the area has increased rapidly due partly to the conversion from the rubber planted area, and partly to the government land development schemes.

The share of paddy planted area as opposed to the total planted area in Malaysia has been as low as 20%. In South Asian countries, this share is usually very high. However, the paddy planted area in Malaysia has increased only little by little.

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

1. Paddy

The agricultural and fertilizer data employed for the present study forecast on the fertilizer demand by paddy cultivation are the results of the "Crop Cutting Survey".

The "Crop Cutting Survey" classified Malaysia into three regions depending on the similarity in the form of paddy cropping management. The states covered by the respective regional categories are shown in Note to Table 1-4-16. The status of fertilizer application to paddy in Malaysia varies in accordance with the difference in the form of paddy cropping management from region to region.

Cropping area:

Table 1-4-16 shows the past trend and future outlook concerning the paddy cropping area coverage in Malaysia. Although the net cropping area has been fluctuating year by year, there has been no sign for the net paddy area to have increased in the past in the long run. However, in view of the gross cropping area, a gradual but steady increase has been achieved due mainly to a growth in the cropping area during off season. Two major factors contributing to this growth are expansion in irrigated area and consequent improvements in double-cropping rate.

The irrigated area coverage kept increasing from 31% in 1967 to 78% in 1974. The past trend and the actual rate of irrigated area coverage, however, varies considerably from region to region. Region I showed a rate as low as 28% as of 1967 but displayed a sharp rise so that the rate went up to over 90% in 1974. On the other hand, Region II already attained a level of 68% as of 1967, and thereafter climbed to 84%. However, the rate has been fluctuating in recent years, so that 1974 saw somewhere in the vicinity of 78%. This implies that Region II has already attained a saturation point of physical expansion of irrigated area. Region III showed about 30% before 1972, but thereafter increased the rate sharply to show a 1974 level of 57%.

The double-cropping area ratio as against the total irrigated area has also been showing a gradual growth, so that the rate attained a level of 95% in 1972. However, a sharp drop took place thereafter, and the double-cropping rate in 1974 was 75%. Therefore, it is likely that the double-cropping rate also attained a saturating point at around 95% level.

The following points were taken into consideration in the forecast on the future trend of the cropping area coverage:

1. Since the possibility of expansion on net cropping area seems very little due to the limit on the further development of new paddy field, the net cropping area of the paddy will show almost no change in the future.

2. Regarding Regions I and II, the irrigated area rate as against the total cropped area has already attained a saturation point, being 95% and 85% respectively. For Region III, there seems to be a possibility for a further rise in the irrigated area rate, but the rate achieved year by year will be lower than that achieved in other Regions.

3. The 1972 level of 95% seems to be around the maximum level to be achieved concerning the double-cropping area ratio in the irrigated area. So, the further expansion of the double-cropping area if possible is to be caused only by the expansion of the irrigated area.

Although any conditions better than the above assumed cannot be expected in the case of Malaysia, the High Case assumed that the irrigated area rate of Region III is more rapidly increasing than expected in the above assumptions.

The above points are taken into account in the Moderate projection to establish an assumption that the highest level achieved in the past will again be attained in the future. However, both the irrigated area rate and the double-cropping area rate have so far been showing fluctuation. If this instability is not to be eliminated in the future, the fluctuation of the rates will be inevitable. It is the Low Case assumption that this instability will continue to exist in the future.

Table 1-4-17 shows a result of forecast on the paddy cropping area trend in the future for the High and Low Cases.

Fertilized area and per-hectare dosage:

Table 1-4-16 gives the region-wise fertilized area and fertilizer dosage according to a sampling survey made in the "Crop Cutting Survey".

In the case of Region I, the fertilized area rate in irrigated fields has already attained a level of approximately 95%, whereas the rate in rain-fed fields, although drop took place during 1972 - 1973 the level attained 90% in 1974. It therefore implies that the fertilizer application practice in Region I has already progressed to a considerably high extent. The fertilized area rate in irrigated fields in the case of Region II kept rising from 48% in 1968 and attained a level of 84% in 1974. As for the rate in rain-fed fields in Region II, it exceeded 70% in 1969 and 1971; however, a drop began to set in since 1972 until 1974 when the level was as low as 38%. Concerning the irrigated fields in Region III, a conspicuous fluctuation in the fertilized area rate has been present with a highest point shown as 76% in 1971. In the case of rain-fed fields in Region III, the rate has been fluctuating between a range from 50% to slightly over 60% since 1970.

In all the regions, the fertilized area rate has been changing from year to year. On an average, however, Region I shows the highest level, followed by Regions II and III in this order. The fertilized area rate in irrigated fields has always been higher than that in rain-fed fields in all the regions; however, it is not possible to conclude that this trend will also be true in the future.

The data covering the per-hectare dosage have been collected by region and is not broken down into irrigated rain-fed fields in respective regions. Regionally, the per-hectare dosage rate in Region I is the highest of all, followed by Regions II and III in this order. Among these regions, Region III has displayed a growth in the average per-hectare dosage year by year; however, Regions I and II showed a peak in the dosage in 1972 and a fall thereafter. The highest dosage level shown so far in respective region is 48 kg by Region I, 40 kg by Region II, and 30 kg by Region III, thereby showing a difference by about 10 kg from region to region.

The drop in the fertilized area rate and per-hectare dosage in 1973 and 1974 seems to be due to the fertilizer price hike in the international market. Table 1-4-18 shows a forecast on the nitrogenous fertilizer demand by paddy on the basis of the projections on the fertilized area rate and per-hectare dosage. Table 1-4-19 gives the results of forecast for the High and Low Cases formulated in the same manner.

Following are some points taken into account in the forecast, regarding the assumption and calculation method employed.

1. The per-hectare dosage rates were projected by region regardless of the irrigated/rain-fed fields in all the subject regions. There must be some difference in this respect; however, because there was no available data upon which any valid estimation could be made regarding the difference. However, since there will be further improvement in the irrigated area rate, the rate of rain-fed fields in the total cropping area will decrease negligibly in the future, reducing the error caused by deeming that there is no difference between the per-hectare dosage levels of irrigated fields and rain-fed fields.

2. In formulating the forecast, the fertilized area rate and the per-hectare dosage level in respective region have been classified into two groups, in view of the past trend, that is, the one which are already near to the saturate point, and the other which have the potentiality to increase in the future.

In the present survey, the most conspicuous discrepancy with the C. Itoh study was noted in the field of the paddy. Table 1-4-20 gives the difference between the results of the present survey and that of the C. Itoh study concerning the estimation on the actual achievements as well as the projection.

As evident in this table, there is no significant difference between the two studies concerning the forecast on the cropping area coverage. However, there is a conspicuous gap in the forecast on the per-hectare fertilizer dosage. In the C. Itoh study, the forecast on the per-hectare dosage was made for the main season and the off season. The present study, on the other hand, is based on the regional data and also on the classification into irrigated and rain-fed fields. As far as the past achievements are concerned, the present study is based on the results of a sampling survey conducted in the "Crop Cutting Survey". If the forecast figures of the fertilized area rate by the present survey, i.e., 87.9% for 1980 and 88.6% for 1985 both of which are on a national average, are taken as a basis, then, the per-hectare fertilizer dosage in accordance with the C. Itoh study will give 75 kg for 1980 and 104 kg for 1985. These dosage figures are almost comparable to the current level of Japan where the dosage rate is one of the highest in the world. Therefore, the C. Itoh study in this respect seems to be too optimistic. On the contrary in accordance with the results of the present study, the forecast per-hectare dosage in fertilized area is 45 kg for 1980 and 50 kg for 1985.

2. Rubber

Cropping area:

Because of recent trend in shifting to oil palm cropping, the mature tree cropping areas in estate farms in Malaysia has been showing an annual fall with a peak level shown during a period from 1969 to 1970. The drop rate has been on a stable level of 2.3% per year.

The immature tree cropping area rate in the total rubber cropping area has been reducing year after year, so that the level became 17.2% as of 1974. This has been due to the reduction in the areas of new planting because of the progress in shifting from rubber to oil palm. It is therefore likely that the immature tree cropping area will continue to fall along with a further increase in the oil palm planting area.

Rubber cropping area by small holder farmers has been slightly but steadily increasing under the governmental development program. The scale of such governmentally developed area is still small; however, the rate occupied by such area is gradually growing. The growth of the governmentally developed area is roughly in line in scale with the increase in total rubber planting area by the small holder farmers, thereby suggesting that the progress in the latter is due to the effects of the former. As for the immature tree cropping area by smallholdings, the area has been falling annually due to the fact that new planting area is declining.

The trend of future cropping area coverage has been estimated on the basis of *the following considerations:*

1. The mature tree cropping area by estates will keep reducing at the same annual drop rate as observed in the past.

2. Although the immature tree cropping area rate will fall year after year, the speed of reduction will gradually slow down.

3. The past trend of growth in the cropping area by the small holder farmers will probably continue to persist in the future.

4. The cropping area expansion achieved under the governmental land development schemes will occupy around 90% of the total growth in the cropping area as of 1980. This rate will continue to grow gradually thereafter, because the expansion of the area by estates is not expected in the future.

5. Although the immature tree cropping area rate will gradually fall in the total cropping area of the small holder farmers, the reduction rate itself will gradually slow down.

Per-hectare fertilizer dosage:

The fertilizer dosage in the estates in the past was estimated by the data pertaining to fertilizer consumption cited from "Rubber Statistical Handbook". According to the estimation, the per-hectare nitrogenous fertilizer dosage to a mature tree has shown a gradual growth in a long run. However, the dosage to an immature tree has remained on a steady level of approximately 20 kg/ha. The future per-hectare dosage in the case of mature trees is expected to gradually approach the recommended dosage level of 40 kg/ha. While in the case of immature trees, the present dosage level will continue to persist in the future. It is likely from the view of the fact that the fertilizer application on immature trees is fairly common among the estates.

No accurate data was available concerning the past dosage level to rubber trees grown by small holder farmers. It is likely that fertilizer application has been carried out for nearly all the cropping areas in the case of immature trees, but almost no fertilizer application seems to have been given to mature trees. The only mature trees receiving fertilizer application are those grown under the governmental land development schemes. Regarding the fertilizer dosage level, the dosage to mature trees by small holder farmers is estimated to be comparable to that in the case of the estate farmers, while the dosage to immature trees is estimated lower than the estate farmers' level.

The results of forecasts made on the basis of the above assumptions are as shown in Table 1-4-21.

3. Oil palm

The only available data on the total cropping area of oil palm concern themselves with the area figures of the estate farmers and those of small holder farmers under the governmental land development schemes. However, it is likely that farmers who are actually undertaking fertilizer application are limited to these types of farmers. Therefore, the present study took up only these farmers as the subject of the examination.

Cropping area:

The cropping area of oil palm has been increasing along with the cropping shift from rubber cultivation to oil palm cropping and the progress in the governmental land development schemes. Until 1974, the pace of cropping area expansion gradually accelerated; however, it became stagnant during 1975. Of the total oil palm cropping area, the ratio occupied by the immature tree area has declined. The slowdown in the growth rate of cropping area seems to be due to the decline in the rate of shifting from rubber to oil palm. The fall in the immature tree cropping area is related to the relatively short history of oil palm cropping in Malaysia.

In fact the immature tree rate has been high because increasingly the immature trees are maturing. It is likely that the future trend of cropping area coverage will see a gradual slowdown in the pace of expansion, accompanied by the fall in the rate of immature tree cropping area coverage.

Per-hectare fertilizer dosage:

The nitrogenous fertilizer consumption amount for oil palm has been estimated on the data of consumption in terms of monetary value as in the case of the C. Itoh study. However, because of the difference between this present study and the C. Itoh study in the composition rate of compound fertilizers applied to oil palm, the resultant consumption figures obtained by this present study became somewhat different from those of C. Itoh study accordingly.

According to the results, the fertilizer application to mature trees as of 1971 was 60 kg N/ha. which has stagnated around this level thereafter. This level is already higher than the 52 kg level prescribed as the recommended dosage. Regarding immature trees, the dosage level has been fluctuating within a range from 27 kg to 34 kg. It is likely that the dosage to both mature trees and immature trees has already attained an upper limit. Therefore, the past record highest, i.e., 60 kg for mature trees, and 35 kg for immature trees seems to be the estimated future level of dosage.

The results of the estimation are as shown in Table 1-4-22.

4. Other crops

The difference between the past nitrogenous fertilizer consumption estimate for the major crops discussed so far and the total nitrogenous fertilizer consumption represents the nitrogenous fertilizer consumed by other crops. However, almost no detail is known regarding both the cropping area and per-hectare dosage when it comes to the crops other than the major crops. In the present study, the following method was employed to estimate the future trend of nitrogenous fertilizer consumption by these "Other Crops".

1. Regarding the nitrogenous fertilizer demand by the "Other Crops" West Malaysia, the past achievements of the consumption was linearly exterpolated in order to obtain the forecast value. According to this result, the estimated nitrogenous fertilizer consumption by these crops as of 1990 will be 14.3 thousand tons N. The subject crops in this respect are vegetables, fruits, sugar cane, pineapple, etc.

   On the other hand, the fertilizer requirements by the major crops estimated on the basis of the cropping area by the Department of Agriculture and also on the basis of the recommended dosage was 19.2 thousand tons N for the year 1975.

The above forecast demand is within such reasonable range from the estimated fertilizer requirement that the forecast is assumed comparatively true one.

2. The nitrogenous fertilizer consumption in Sabah and Sarawak seems to have been made mostly for rubber and oil palm cropping. However, it is extremely difficult to estimate the actually effected fertilizer application level. If it is assumed that the per-hectare fertilizer dosage to rubber and oil palm in Sabah and Sarawak is comparable to that of West Malaysia, the consumption level of the nitrogenous fertilizer thus calculated in the case of Sabah is only 60% to 70% of the estimated consumption obtained on the basis of the fertilizer import/export data. In the case of Sarawak, the result showed a level of only 3% to 10%. Therefore, a method of estimation on the basis of the dosage level involves a great danger of resulting in a considerable error.

However, the total consumption of nitrogenous fertilizers in these regions as against the total Malaysian consumption amounts only slightly below 10%. In this connection, in the present survey, the future demand by these crops were projected by the linear exterpolation of the past consumption trend.

2) Forecast on the demand for nitrogenous fertilizers and urea

Table 1-4-23 is a summary of the results of forecast made on the nitrogenous fertilizer demand formulated on the basis of the foregoing points. Table 1-4-24 gives the results concerning the High Case and the Low Case.

According to these results, the highest growth in the consumption is expected in the oil palm destined consumption. In the case of paddy, both the irrigated area rate and dosage level have already attained a considerably high level, thereby implying a possible stagnation in the growth rate of the demand for nitrogenous fertilizers during the decade of 1980s. On the other hand, in the case of rubber, a growth in the demand is expected in rubber plantation by small holder farmers. However, because of the off-setting effects of the cropping area reduction in the estate farms, the nitrogenous fertilizer demand generated by rubber cropping is likely to remain unchanged.

The following paragraphs will discuss an outlook on the future trend of demand for urea as one of the nitrogenous fertilizers:

According to the "Crop Cutting Survey", the urea application rate as against the total fertilizer application on paddy cropping has been growing gradually from a level slightly over 50% as of 1968 to 78% in 1974. In the case of compound fertilizers, the application rate as against the total nitrogenous fertilizer application has been declining; however, in terms of the absolute consumption amount, there has been no conspicuous change. On the other hand, in the case of rubber cropping, the application of urea has not been made because of the troublesome requirement to mixing with soil in applying urea.

It is therefore estimated that employment of urea for rubber in the future will not be very popular. In the case of oil palm, there is a problem in urea application similar to the case of rubber. However, it is possible to apply urea in the fields other than the inland region. Table 1-4-25 shows an estimation of the urea consumption for oil palm obtained by subtracting from the total urea consumption the paddy-destined and industrial-use urea. According to this table, the employment rate of urea for oil palm as against the total applied nitrogenous fertilizers fluctuate year after year. On average, the urea has accounted for 46.5% of total nitrogenous fertilizers applied on oil palm.

On the basis of the past trend of the demand for urea described in the above, the outlook on the future trend of urea demand in Malaysia has been formulated by taking into account the following points:

1. In the case of paddy cropping, the farmers who are presently employing compound fertilizers will keep applying compound fertilizers in the future. In terms of quantity, the level of demand will be 4.6 thousand tons N which will not greatly change in the future. However, along with the commencement of domestic production of urea, the use of urea will increase as one of the raw materials for compound fertilizers.

2. All the other paddy farmers are expected to continue to apply urea.

3. Out of the total nitrogenous fertilizer consumption for oil palm, 46.5% which has been the past average rate occupied by urea, will be applied in the form of urea.

4. No urea will be applied to rubber.

5. Along with the commencement of domestic production of urea, the practice of urea application on other crops is expected to increase.

6. Urea application will also gradually increase in Sabah and Sarawak.

Table 1-4-26 shows the outlook on the urea demand forecast on the basis of the above assumptions.

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

The industrial-use urea has been consumed by the urea-formaldehyde resin adhesive manufacturing as its raw material.

According to an estimation made by C. Itoh study, the demand for industrial-use urea as of 1975 was 3,900 tons N (8,500 tons in terms of urea).

There are three adhesive manufacturing plants in Malaysia in operation at present. The total production capacity of these three plants is estimated to be 7,000 T/month. On the basis of this capacity figure, the urea requirements as a raw material will be 37,000 T/Y. However, the actual level of demand for the adhesives is estimated to be equivalent to approximately 35% of the total production capacity, so that the urea requirement as raw material will be approximately 13,000 T/Y.

On the other hand, the urea requirements of 7,500 T/Y is calculated on the basis of the production amounts of plywood and particle boards.

Thus, the estimated present industrial-use urea consumption varies depending on the estimation sources. For the purpose of this Study, the C. Itoh study figure of 8,500 T has been employed.

Concerning the future demand for industrial-use urea, the extent of urea requirements as raw material has been calculated on the future trend of production of plywood and particle boards has been estimated on the basis of the past trend of production. The results are as shown in Table 1-4-26.

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

The domestic production outlook on nitrogenous fertilizers and urea is shown in Tables 1-4-27 and 1-4-28 respectively.

At present, Esso Malaysia has an ammonia producing capacity of 160 T/D. On the other hand, Malaysia is now formulating a project for constructing a new large-scaled ammonia plant having a capacity of 1,300 T/D on the basis of indigenous natural gas as the raw material. The onstream of this large-scaled plant is targeted for April of 1982. However, in view of the status of the progress of this project at present, it has been assumed in this study that the onstream will be during January of 1983. It is also assumed here that the existing plant of Esso Malaysia will terminate production simultaneously with the commencement of the operation of the new plant.

Regarding the operational rate of the existing plant, it has been assumed that a level of 95% will continue in view of the past and the present status of the operation. Concerning the operational rate of the new plant, the level is expected to be considerably higher in view of the records of operation of the existing plant, although Malaysia has no previous experience in operating such a scale of a plant. Therefore, the level of operational rate of the new plant is assumed to be comparable to that of Indonesia, i.e., 75% for the first year, 80% for the second, and 90% from the third year onward.

With respect to urea production, Malaysia has no existing producing facilities. In conjunction with the above-mentioned new ammonia plant, a urea production plant with production capacity of 1,500 T/D is also projected. It has been assumed that the onstream timing and the operational rate levels are exactly the same as assumed for the new ammonia plant.

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

Tables 1-4-27 and 1-4-28 respectively show an outlook on the supply/demand balance of nitrogenous fertilizers and urea in Malaysia formulated on the basis of the above-mentioned forecast on demand and supply.

According to these results, the supply/demand balance of nitrogenous fertilizers in Malaysia will continue to show a supply shortage until 1982, thereby gradually expanding the import requirements. However, along with the onstream of the new plant in 1983, the balance will turn into oversupply. The extent of the oversupply will be approximately 180 thousand tons N in terms of total nitrogenous fertilizers and slightly less than 300 thousand tons in terms of urea after the commencement of full-scale operation of the new plant from 1985 onward.

Therefore, the export requirements in the years after 1985 from Malaysia will be 300 thousand tons in terms of urea and 50 thousand tons approximately in terms of ammonia and others without the stock increase taken into consideration.

Annex II-2-1 Forecast Methodology on Nitrogenous Fertilizer Supply/Demand Balance in the World

2-1-1 Forecast methodology on nitrogenous fertilizer demand

The demand forecast methodology described hereafter is intended for formulating a long-term demand forecast. Therefore, this method does not take into consideration the fluctuation which will be caused by short-term causes, or other future elements such as abnormal weather conditions, etc.

The forecast is formulated for each subject country. Depending on the general pattern of demand and the availability of the data and information concerning the subject country, one of the following three methods has been selected to be applied to a particular subject country.

(a) Forecast on the basis of the 'Cropping area and per-hectare dosage'

This method was applied to the following countries: Japan, Korea, Taiwan, the Philippines, Indonesia, Thailand, Malaysia, Burma, Sri Lanka, Pakistan, and Iran.

This method first estimates the future trend of expansion of fertilized area in view of the possible progress in agricultural programs, irrigation/drainage projects, diffusion of HYVs, prevailing fertilizer application techniques, etc. At the same time, an estimation is made on the quantity of fertilizer applied per unit area of thus estimated fertilized area coverage. On the basis of these two estimations, the extent of fertilizer demand is calculated by means of the following formula:

(Fertilized area coverage) x (Per-hectare fertilizer dosage)

In order to estimate the per-hectare fertilizer dosage in the future, studies will be made in view both of the technically optimum dosage and the economically optimum dosage. In order to examine these factors, it is necessary at least to have realistic estimation on the crop-wise fertilizer application level in the subject countries (if possible, the estimation by region, as long as the weather and/or soil conditions differ from place to place). This being the circumstance, this method can be applied only to those subject countries upon which a sufficient degree of the pertinent data has already been attained.

b) Forecast on the basis of the trend extrapolation

Concerning the North American and West European countries, a linear regression analysis was first conducted concerning the past actual consumption figures. The future demand was projected by extrapolation to thus obtained trend curve. In these countries, the fertilizer dosage level has already attained a considerably high level, so that it is not likely that a sudden increase in the dosage, such as the one apt to take place in the case of developing countries when arriving at a certain level of economic and technological development, will appear in these countries. (In other words, a change which corresponds to an initial rising portion of a logistic curve is not likely to take place in these developed countries). It is therefore deemed possible to directly apply the past trend to the future. Another reason for the applicability of this method to these countries is that the past achievements in fertilizer consumption by these countries shows a linear trend except for short-term fluctuations.

c) Forecast based on the 'agricultural production requirements'

This method has been applied to those countries to which the above a) and b) are not applicable. Here, the future requirements of agricultural production (in this particular case, the future signifies 1990) is estimated on the basis of the present level of per capita agricultural product consumption together with the growth rate of population and also the growth rate of per capita agricultural product consumption. The difference between thus estimated requirements and the present level of production is the requirements by which the agricultural production in the subject country must be increased. In view of the physically expandable allowance of the cropping area and the status of the future irrigable area of the subject country, a forecast will be made as to whether the fulfillment of the agricultural product requirements will be made by increasing the cropping area or by enhancing the per-hectare yield. After estimating the future cropping area coverage and the future agricultural product yields per hectare, the dosage and fertilized area will be calculated in view of the yield level. Thus, the demand for fertilizers in the future upon attainment of the above-mentioned agricultural production requirements level will be obtained. The obtained figure signifies the extent of demand for fertilizers upon the attainment of the agricultural production requirements (this extent of demand shall be hereafter called the 'potential fertilizer demand' in the subject country), and not the projected demand. With the assumption that the period covering the present stage and the attainment stage will show a growth of the demand along the logistic curve, the annual estimation of the fertilizer demand will be forecast.

When calculating the agricultural product requirements for the forecast methodologies explained above, an assumption has been made regarding the perpetual food importing countries and perpetual food exporting countries that the present level of importation/exportation will continue in the future. Concerning most of the countries other than these, it has been assumed that they will exert efforts in attaining a target of self-sufficiency in the supply of food unless otherwise noted.

Although the maximum extent of incorporation will be made into the forecast regarding the factors which will affect the future trend of fertilizer consumption, the incorporation of these factors has been possible mostly for Asian subject countries. Regarding other subject countries, the incorporation of these affecting factors has been extremely limited due to the unavailability of pertinent data. The affecting factors mentioned here include the following:

- Degree of extension of high yielding varieties
- The fertilizer response on the crops
- Degree of governmental subsidy on fertilizers or extension of monetary aids, availability of agricultural loans, etc.
- The cost/benefit ratio of fertilizers and agricultural products
- The conditions of fertilizer distribution systems

The forecast data compiled by the United Nations will be adopted as the data for population increase rate of the subject countries. Regarding the data concerning agriculture and fertilizers, the locally collected data through field survey, etc. will be employed as much as possible, together with the statistical data of the 'Production Yearbook' and 'Annual Fertilizer Review' of FAO.

2-1-2 Method of forecasting the demand for industrial-use ammonia and urea

a) Demand forecast on industrial-use urea

The major field of demand for industrial-use urea are as follows:

1. As a raw material for melamine
2. As a raw material for urea resin
3. As a raw material for animal feed
4. Others

The 'Others' includes such applications as a stabilizer for explosives and cellulose, as an additive for paints, dyestuffs, pharmaceutical products, etc. However, this category accounts for a small amount of consumption which is deemed to be negligibly small. The data on production/consumption concerning the fields of melamine, urea resin, and animal feed are extremely scarce. Regarding these fields, incorporation of the data will be made for those countries on which the data are made available. The forecast will be formulated on the basis of an assumption that the past rate of growth can be applied to the years to come. Regarding those countries for which the past rate of growth cannot be calculated, the estimated world average growth rate will be uniformly applied. The world average rates are; -2%/year as a raw material for feed, and 4.9%/year as a raw material for melamine and urea resin.

b) Forecast on the demand for industrial-use ammonia for other applications

The major sources of demand for industrial-use ammonia are as follows:

1. As a raw material for nitric acid
2. As a raw material for ammonium nitrate
3. As a raw material for caprolactam
4. As a raw material for acrylonitrile
5. Others

The category 'Others' include the application as refrigerants, pharmaceutical products, and many other fields; however, the absolute amount of consumption is negligibly small. Regarding the use as a raw material for nitric acid, ammonium nitrate, caprolactam, and acrylonitrile, the production capacity of these items covering the existing plants, under-construction plants, and under-planning plants, will be totaled. Where it is possible to obtain the past data of the production achievements, the operational rate will be calculated on the basis of the production capacity and the production records. On the basis of thus calculated operational capacity, the future operational rate will be estimated. Regarding those countries for which the past records of production are not available, the following estimated operational rate will be applied on the basis of the current level of technology and the present status of national economy:

North America:	88 %
Central and South America:	65 %

Africa:	63 %
West Europe:	85 %
U.S.S.R. and East Europe:	80 %
Middle and Near East:	63 %
Far East:	85 %
Southeast Asia:	78 %
Southwest Asia:	68 %
Oceania:	80 %

On the basis of thus obtained production capacity and operational rate, the estimated production will be calculated. The calculated amount of production will be multiplied by the ammonia input basic consumption unit in order to estimate the extent of demand for industrial-use ammonia. It should be noted here that the amount of ammonia to be recovered in the form of a fertilizer will be subtracted from the ammonia input basic consumption unit, so that the net basic consumption unit will be used for the calculation.

c) Deduction of the double-counted portion

i) Deduction of fertilizer-use ammonium nitrate

Because the above-mentioned ammonium nitrate production capacities will also conduct the production of ammonium nitrate for fertilizer use. Therefore, the portion of ammonium nitrate which has already been calculated within the scope of the demand for fertilizers must be subtracted from the amount of ammonium nitrate to be counted as the industrial-use portion.

ii) Deduction of the double-counted portion of ammonium nitrate and nitric acid

Of the nitric acid production mentioned above, the portion used for the production of ammonium nitrate (for both industrial use and fertilizer use) will be subtracted from the total because of the fact that the nitrogen component will be doubly counted otherwise.

2-1-3 Method of forecasting supply of nitrogenous fertilizers

The supply amount was calculated in terms of the production amount of ammonia together with by-produced ammonium sulphate and calcium cyanamide. The calculation of the supply amount was based on an assumed maximum possible operational rate of those plants of the subject countries which are presently operating, under construction, and under planning. The assumption of the maximum possible operational rates was made in accordance with, and in view of, the technological level of the subject countries (or regions). Thus assumed maximum possible operational rate and the production capacity were multiplied with each other, and the obtained results were tabulated in the supply amount. It is also assumed that all the plants will start off with a certain level of operational rate, which will gradually increase during the first two years to the maximum possible operational rate attained in the third year.

Strictly speaking, therefore, the forecast which will be made here signifies the maximum supply capability attainable in each of the subject countries and regions under the conditions of their available technological level.

Annex II-2-2 Outlook on Supply/Demand Balance of Nitrogenous Fertilizers (Particularly Urea) in Asia's Major Urea-Importing Countries

2-2-1 India

(1) Outlook on the demand for nitrogenous fertilizers

From among the projections of nitrogenous fertilizer demands in India prepared by India itself, some of the latest are selected and given in Annex II/Figure 2-2-1*). One is the projection made by the FAI (The Fertilizer Association of India) in December, 1977 and the other is a government work to provide a framework for the 6th 5-Year Plan (1978-82). Projected demands in both schemes correspond to each other fairly closely.

The government projection is said to be based on 'crop-area method'. Namely, projected demands were calculated by multiplying crop-wise or variety-wise fertilized areas by per hectare dosage of respective crops or varieties. These data on cropped areas and dosages are collected from the governments of each state in India. They are more in the nature of policy targets rather than demand projections. In other words, the projected demands in this case can be considered the demands which are to be materialized only when the targets of 6th 5-Year Plan will be attained.

Apart from the above-mentioned projections, Table 2-2-1 shows the projections obtained by taking into consideration past trends and anticipated policy movements on agriculture and fertilizer consumption in India. These projections were obtained by the following calculation method.

1. Firstly, the crop-wise or variety-wise cultivated areas (referred to as (A) hereafter) in 1980, 1985 and 1990 were forecast on the basis of past trends of cultivated areas of individual crops.

2. The potential demand for nitrogenous fertilizers in respective years (referred to

Note: *) Table No.s and Figure No.s referred to hereafter are those numbers in Annex II.

as (B) hereafter) were calculated multiplying (A) by crop/variety-wise standard recommended dosages. The crop/variety-wise standard recommended dosages were estimated by incorporating the crop/variety-wise recommended dosages established by the government of each state in India. Thus, calculated potential demands signify the demand generated under the circumstances of the farmers applying the fertilizer on all the cultivated areas in the recommended dosages.

3. Potential demand in the past was also calculated in the same manner by using the past trend of cultivated areas of individual crops and the standard recommended dosages. Thus, obtained potential demand in the past is referred to as (C). The consumption achieved in the past (referred to as (D) hereafter) is thought to be the embodiment of (C') after subtracting the amount not achieved due to various restrictions on (C'). In other words, if there are no restrictions on the fertilizer application either economically or technically, the past consumption (D) should have been equivalent to (C'). The ratio of (D) over (C') (referred to as (E) hereafter), therefore, is expected to approach 100 % along with the promotion on fertilizer application and restriction removal.

4. The ratio (E) in the future is projected by regression of past (E) on a logistic function. By thus multiplying the obtained future (E) by the future potential demand (C), the demand for nitrogenous fertilizers in the future were finally forecast. The data used as a basis for the above projections are given in Tables 2-2-2 through 2-2-4.

The share occupied by urea in the total nitrogenous fertilizer consumption in the past has been increased year by year to 70 % as of 1975 (see Table 2-2-5). The possible share of urea in the future will change depending on the supply situation of nitrogenous fertilizers, such as in the case of India, where a large supply shortage will be felt in the future, although, generally, the share will change depending on the kinds of crops planted and specific soil conditions.

In the international export market of nitrogenous fertilizers, export competition is expected to be intensified especially so in the field of urea exportation. At the same time, approximately 85 % of nitrogenous fertilizers produced in India during the period from 1980 to 1982 are projected to be in the form of urea. Thus, for India the most available type of nitrogenous fertilizer in the future is expected to be urea. Therefore, such a supply situation will exert influence on the type-wise demand for nitrogenous fertilizers in India in that:

1. When a large amount of nitrogenous fertilizer importation is required, import effort will be centered on the most available type of fertilizer, in this case urea. Consequently, the share of urea as against total nitrogenous fertilizer consumption will increase.

2. However, if the demand for urea increases to such an extent that the urea import requirement exceeds the import requirement in terms of total nitrogenous fertilizers, then the demand for urea will be suppressed and the demand for other types of nitrogenous fertilizers will be promoted in order to serve foreign currencies.

The latter case will be expected in the middle of 1980s. Table 2-2-6 shows the outlook on the urea supply/demand balance projected on the basis of the above discussions.

(2) Outlook on the supply of nitrogenous fertilizers

India has depended for its supply of nitrogenous fertilizers largely on import in the past as is shown in Table 2-2-7. This does not mean that India did not make any effort for fertilizer self-sufficiency. On the contrary, the production capacity of India has rapidly expanded to 3,069 thousand tons N as of 1976*). The reason why India has required a large amount of fertilizer importation is the low operational rate of fertilizer manufacturing plant in that country.

Figure 2-2-1 shows supply projections that correspond to the two sets of demand projections as described in the previous section dealing with demand projections. The projection basis for the government projection has not been clarified. Table 2-2-8 lists the plants to be constructed and those under planning which are taken into account as a basis for the projection. The FAI projection has some points which need further discussion. In the case of the FAI projection, firstly, anticipated timing of the start-up of new plants is too optimistic. The increase in production capacity by 1981/82 is to result totally from the plants presently under construction and, therefore, there can be slight fluctuations but there will be no large differences

Notes: *) The production capacities of nitrogenous fertilizer manufacturing facilities in India are shown by 'Licensed Capacity', which is smaller than 'Designed Capacity' by approximately 10%. In this connection, all the production capacities in India in this study are shown in terms of 'Licensed Capacity.'

likely to occur. But, the listed plants expected to come operation after 1982 include five large plants with a capacity of 1,350 T/D NH_3 using natural gas from, Bombay High and Bassein as their raw materials, which belong to the public sector. These are the plants for which financiers are not yet decided, nor are their sites finalized due to pollution problems. Furthermore, it usually takes 2.5 - 3 years to build an N fertilizer plant in advanced countries, whereas in India, based on the past records for the public sector projects, it takes more than 5 years in many cases. Therefore, for these plants marked by *in Table 2-2-8, one must allow for a delay of more than one year at least.

The second problem involved in the FAI projections is that the anticipated rates of operation are too optimistic. The FAI projections assume average rates of operation of 70% for 1979, 73% for 1980 and 80% for 1981. In India, low rates of operation have been pointed out as a major problem in the past. As is shown in Table 2-2-7, the average operational rate was within a range of 45 to 50% during the period from 1973 to 1975, although the rate was improved to 62% in 1976.

The reasons pointed out for these low rates of operation include electric power shortage, a short supply of repair parts, etc. It is impossible to assume that these situations would be improved to an extent to justify the assumptions made in the FAI projections.

Taking the above into consideration, the supply of nitrogenous fertilizers in the future was forecast as shown in Table 2-2-1. The operational rates of new plants was assumed in this projection to be 25 % for the first year of production, 55 % for the second year, and 70 % for the third year and onwards, on the basis of past achievement of operational rate as is shown in Table 2-2-9. In the case of plants to be constructed in the future, the operational rate is expected to be improved, but in the case of existing plants, judging from the fact that in recent years no improvement in the operational rate has been observed, the operational rate of the existing plants was assumed unimproved in the future. In this connection, the operational rate of existing plants is estimated as 60% in this projection, whereas that of new plants is 70%.

As far as the projection on the supply/demand balance of urea, as shown in Table 2-2-6, modifications on the timing of the onstream of new plants were incorporated as in the case of projection on nitrogenous fertilizer supply. The operational rates of the urea plants were assumed to be the same as that of ammonia plants, in view of the fact that the past operational rate has been on the same level as that of ammonia plants.

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

As is shown in Table 2-2-1, despite the rapid increase in production capacity, supply ability will not catch up with the increase in the demand, and consequently, a large amount of import of nitrogenous fertilizers will be required. In the case of urea, as is shown in Table 2-2-6, India will continue to be a large-scaled importing country in the future.

2-2-2 Bangladesh

(1) Outlook on the demand for nitrogenous fertilizers and urea

In Bangladesh, all the nitrogenous fertilizers have been consumed in the form of urea, except for almost negligible amounts of ammonium sulphate used for tea cultivation. The past record of nitrogenous fertilizer consumption is given in Table 2-2-10. The forecast on the demand for nitrogenous fertilizers can be regarded as the forecast on urea in this regard.

Table 2-2-11 shows the comparison of projection results on the demand for nitrogenous fertilizers which were conducted in recent years. The data and methodologies employed in these projections are not clarified except for that of UNICO. Therefore, no evaluation on these projections are made in this study. UNICO's projection is based on 'Crop Area Method', and the data employed in the projection are given in Tables 2-2-12 and 2-2-13.

(2) Outlook on the supply of nitrogenous fertilizers and urea

There are two nitrogenous fertilizer plants in operation in Bangladesh. One is Fenchuganj Plant which has a capacity of 320 T/D of urea and 36 T/D of ammonium sulphate. The other is Ghorasal Plant with a capacity of 1,100 T/D of urea. Both plants belong to Bangladesh Industries Corporation. Table 2-2-14 gives the past production records of these plants.

There is one plant under construction, that is Ashuganj Plant, which was scheduled to be onstream in 1979, but now, the commencement of production is postponed to

September, 1981. In addition, two more plants are under consideration. One is Chittagong Plant with the capacity of 1,700 T/D of urea which is scheduled to be onstream in 1983, and the other is the plant to be constructed under Chinese financial assistance, the capacity and site of which are not decided yet. But, it is likely that the capacity will be around 100,000 T/Y as urea.

The operational rate of the Fenchuganj Plant achieved during the first seven years since the commencement of operation was as high as 87 % on the average, but the rate declined to around 50 % after 1970. The decline in the rate is attributable to the war of independence and insufficient maintenance of the facilities. The overhaul of the facility is now under plan and will be implemented this year. After the overhaul, the operational rate is expected to be improved to around 76 %. Ghorasal Plant commenced production in 1970, and was shut down during 1971/72 due to the war of independence. After the re-commencement of production, the plant stopped production again in 1977/78 for almost one year due to an accidental explosion. The operational rate achieved thereafter has been as low as 53 to 63 %. Two-month shutdown of the plant for the overhaul purposes is expected in 1977/78, and thereafter the operational rate is expected to rise to 70 %. The operational rate for Ashuganj Plant is assessed to be 79 % by those who are concerned. Taking into account the experiences in plant operations described above, the operational rate of the Chittagong Plant was assumed 90 % in this projection.

The outlook on the supply of nitrogenous fertilizers in Bangladesh projected on the basis of the above capacities and operational rates are given in Table 2-2-15. The plant to be constructed with the assistance of China is said to have the capacity of 100,000 T/Y, and is scheduled to be onstream in 1982/83. This information was incorporated in to this projection.

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

The outlook on the supply/demand balance of urea projected in the above supply and demand forecasts is given in Table 2-2-16.

According to the table, in the case of Moderate projection, self-supply of urea will be attained by 1981 when the Ashuganj Plant becomes onstream. A large amount of oversupply will be felt thereafter due to the commencement of production by two plants, despite expected increase in demand. In the case of Optimistic projection, oversupply will also be felt in the future as in the case of Moderate projection, although the amount of oversupply will not be so large.

Notwithstanding the above-described oversupply, the plants under construction are likely to be implemented in due course, in view of the fact that Bangladesh is intending to foster export-oriented industries based on the indigenous natural gas.

Thus, it is almost certain that Bangladesh will not only cease to be a urea-importing market, but also will become one of the major urea-exporting countries in the 1980s.

2-2-3 Vietnam

(1) Outlook on the demand for nitrogenous fertilizers and urea

Data on Vietnam's agriculture are not available in an amount sufficient to allow reliable projections on fertilizer demand. On the basis of as much data and information available at this stage, demand projections have been attempted and their results are given in Tables 2-2-17 and 2-2-18.

As in the case of China, the input of organic fertilizers is emphasized in Vietnam. But more than that, increased food production is one of the most important objectives for the country and, therefore, the input of chemical nitrogenous fertilizers is a task that calls for urgent implementation.

As for the types of fertilizers, compound fertilizers will be desired in the long run, but for the present, in order to meet the urgent target to apply more nitrogen fertilizers, the emphasis will be on urea in view of its high contents. In this connection, it was estimated in this projection that the share occupied by urea for total nitrogenous fertilizer consumption in the past (90 %) will persist into the future.

(2) Outlook on the supply of introgenous fertilizers and urea

In terms of supply, a modern nitrogen fertilizer manufacturing plant built by China as part of their technical assistance was officially put into operation in 1976 as the first such plant in Vietnam. As can be seen from Table 2-2-17, however, the supplies fall far short of the required amounts, and efforts will be directed towards expansion of supply capabilities, either by introducing large-scale plants with modern technology, or by constructing small-scale plants as those in China. But at present, Vietnam does not have enough technological capability to sustain operations on its own, and has no other recourse than to rely totally on outside technology.

As for outside assistance, that related to small-scale plants cannot be expected in the near future, as China terminated its technical assistance. And presently, there are no talks under way for the introduction of large-scale plants. Therefore, even if future plans are made for such plants, and even if there is a strong possibility of starting negotiations in one form or another in the near future, actual production is not likely to be materialized before 1985 at the earliest.

The data concerning operational rate achieved by the existing plant is not available. According to an estimation made on various sources, the rate is estimated to be around 60 %, and is expected to be improved along with the stabilization of production operation.

Table 2-2-17 gives the results of a supply projection, which is based on the following assumptions:

> The talk concerning the introduction of a large-scaled ammonia plant will be resumed in the near future, and the plant will become onstream in 1985. The operational rate of the plants, including that of the existing, will reach 75 %.

The supply projection on urea was made on the basis of the same assumptions as those of ammonia production.

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

The future supply/demand balance projected on the above demand and supply forecast implies the possibility that Vietnam will continue to be one of the largest urea-importing countries in the future. (See Tables 2-2-17 and 2-2-18). Commencement of production by the expected new plant will be 1985 at the earliest. Therefore, the import requirement before the onstream of this plant is expected to be fairly large. Even after commencement of production, domestic production will not be able to catch up with the increase in demand.

2-2-4 Pakistan

(1) Outlook on demand for nitrogenous fertilizers and urea

Table 2-2-19 gives the past trends of the supply/demand balance of nitrogenous fertilizers in Pakistan. Although demand stagnated in 1970, 1973 and 1974, it has increased steadily in the long run.

Table 2-2-20 shows some sets of projections on the demand for nitrogenous fertilizers made in recent years. The data and methodology employed in the projection conducted by the Pakistani government are not clarified. The projection by UNICO is made on 'Crop Area Method'. The base for other projections are not clarified, either, so therefore, in this study, the projected demand relies on UNICO's projection.

As is shown in Table 2-2-19, the share occupied by urea in total demand for nitrogenous fertilizers has been around 80 to 90 %. In view of the fact that urea, which has a high nutrient content, is advantageous from the standpoint of transportation, and also in view of the fact that a large portion of nitrogenous fertilizer production will be made in the form of urea, the major type of nitrogenous fertilizer in Pakistan in the future is expected to be urea.

However, during a period from 1979 to 1981, along with the commencement of producton by Pak-Arab Plant, the final product of which is to be ammonium nitrate, a self-supply of nitrogenous fertilizer will be attained. But in terms of urea, a supply shortage will be felt. In this connection, the demand promotion for ammonium nitrate will be intensified from the viewpoint of foreign exchange-saving. Taking into account the above discussion, the trend of future urea demand was forecast as shown in Table 2-2-21.

(2) Outlook on supply of nitrogenous fertilizers and urea

As is shown in Table 2-2-22, there are four existing nitrogenous fertilizer plants, three plants among which are producing urea. The past records of urea production are given in Table 2-2-23. The actual average operational rates of these plants are not clarified, but according to estimations made from the table, the operational rate of the NFC plant is estimated to be around 65 %, whereas the rate for the ESSO plant is estimated to be 85 %, and for the Dawood Hercules palnt, 100%.

On the other hand, two plants are under construction, one of which is scheduled to be onstream in 1978, the other in 1979. One plant is planning to produce ammonium nitrate as its final product, and no urea production by this plant is intended.

There are four plants under plan, each of which is expected to produce ammonia and urea. Among these plants, the Fauji Plant is expected to come into the construction stage in near future, and be onstream in 1982. However, the other three plants are still under consideration, and the onstream date is not decided yet. Among them, the NFC plant located in Hazara is expected to be constructed with Chinese assistance, and it is said that China is prepared for shipment of equipment. Therefore, as soon as Pakistan is ready, plant construction will be commenced, and it is likely that the plant will be onstream in 1982 if construction progresses favorably. As far as the expansion of the Dawood Hercules Plant is concerned, it is said that the project is in the general contractor selection stage. Therefore, it is reasonable to assume that the plant will be onstream in 1984. The other plant, which is planned to be very large-scaled, is still under consideration, and the possibility of materialization is still in question.

Table 2-2-21 gives the result of a projection on urea supply capability made on the basis of the above-described project circumstances. In this forecast, the Pak-Ajman plant was excluded. As for the expected operational rate of these new plants, the rate was assumed uniformly to be 75 % for the first year of operation, 80 % for the second year, and 90 % for the third year, in view of the fact that the operational rates achieved in the past were fairy high. Table 2-2-24 shows a forecast on the supply of nitrogenous fertilizers. The differences in the supply projection of urea and that of nitrogenous fertilizers are mainly caused by the fact that the Pak-Arab plant will produce ammonium nitrate and not urea as its final product.

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

Based on the above projections of supply and demand, the supply/demand balances of nitrogenous fertilizers and urea are given in Tables 2-2-21 and 2-2-24 respectively. According to the balances, a self-supply of nitrogenous fertilizer will be attained by 1979, and supply will exceed demand thereafter. As for urea, self-supply will be attained by 1982. During the period from 1979 to 1981, the supply of urea will be lower than the demand. However, in practice, due to the reason discussed in the foregoing, the importation of urea will not appear.

As one can guess from the fact that the large-scaled Pak-Ajman project is still under consideration (although this project is excluded from this projection), Pakistan is striving toward fostering export-oriented industries which are based on the indigenous natural gas. Thus, Pakistan is expected to become one of the major urea-exporting countries in the future.

Annex II-2-3 Outlook on the Trend of Future International Price of Urea

2-3-1 Introduction

As has been discussed so far, the worldwide supply/demand balance of nitrogenous fertilizers will show an increasing surplus in the suppliable amount over the estimated demand because of expected rapid progress in increased capacity of fertilizer-producing plants during the first half of the 1980s. This expansion of the gap will continue until 1985, and will start to decline thereafter. However, in spite of the decline, the surplus suppliable amount as of 1990 will still be larger than that which will exist in 1980. As already discussed, such a status of oversupply will also be true in the case of the international market situation concerning urea. In the following paragraphs, an analysis will be made in order to ascertain the level at which the international market price of urea will be formed under the prevailing condition of such an over-supply.

2-3-2 Past trend of international price of urea

Annex II/Figure 2-3-1*) illustrates the behaviour of the international price of urea in the past. During the period prior to the so-called Oil Crisis which took place in the last half of 1972, the general trend of international urea price showed a long-term decline except for temporary fluctuations. The supply/demand balance of nitrogenous fertilizers during this period was basically an oversupply.

The prices in a basically oversupply market are generally considered to be formulated at a production cost level of marginal producers in terms of the demand existing in the said market, as long as the market operates under the principle of free competition. Figure 2-2-3 illustrates the relationship between the marginal producers' production cost and price formation.

The vertical axis P represents the per-ton production cost of urea and per-ton price of urea, while the horizontal axis Q denotes the quantity of urea which will be supplied to the international market. The curve S is a supply curve. The quantity of urea turned out by

Note: *) Table numbers and Figure numbers referred to hereafter are those in Annex II, if not specified.

producers who are potentially capable of supplying urea to the international market is accumulated on the curve from the original point in the order of magnitude of lower production cost. For instance, the point (p_1, q_1) represents the fact that q_1 tons is the suppliable quantity of urea to the international market at a production cost below p_1. On the other hand, the line D stands for a demand curve (a straight line in this figure). For the sake of clarity, demand price elasticity is assumed here to be 0. In other words, the extent of the demand for urea in the international market during this particular year is shown here to be q_0 tons. The intersection of these two curves is A_0. If, for instance, the international price is formed at price p_1 which corresponds to point A_1 located on the right-hand side of A_0, the production increase would be immediately undertaken without necessitating any construction of new plants (because a certain extent of surplus suppliable amount, or a surplus production capacity, would already be available under the condition of basic oversupply), so that the amount of commodities appearing in the international market would be q_1 tons. Consequently, the position will be in oversupply, and the price will be pushed downward. If, on the contrary, the price were formed at P_2 corresponding to the point A_2, the situation would be completely in reverse, so that the price would be pushed upward. Thus, the international price will be formed at the point P_0.

However, in order for such a price formation mechanism to be effective, it is necessary that free competition be waged in the international market. In the case of the actual international market for urea, the West European countries have already formed an international cartel on nitrogenous fertilizers. However, the U.S.A. and Japan held price competitiveness comparable to the prices of West Europe and also possessed a vast amount of export surplus capacity. In view of the mode of export/import contracts made in the international market, a great many transactions have so far been concluded in the form of free bids (tenders) or in variations thereof. In view of these facts, it seems reasonable to assume that the situation of the international market of urea in the past was very close to what is called the 'free competition market.'

In order to examine the actual level of international price formation in such a basically oversupplied market, a preliminary calculation was conducted in regard to the production cost of the marginal producer for the years 1972 and 1977. The results show that marginal production cost figures were US$61 for 1972 and US$139 for 1977, both of which roughly coincide with the actual current international price level for the respective years. (Figures 2-3-3, 2-3-4.) Therefore it can be deemed that the international price under a basically oversupplied market as explained above was in the past formed on a level equivalent to the respective marginal producers' production costs.

A question still remains as to the causes for the perpetual decline in the international price of urea over a long period until the Oil Crisis took place in 1973. This decline was mainly due to the fact that all the producers in the world competed in expanding their producing facilities in order to enhance their price competitiveness in the basically oversupplied market conditions prevailing during this period, thereby trying hard to reduce the production cost. The producers also exerted their efforts in switching to lower-cost raw material ammonia. Figure 2-3-5 illustrates the supply/demand correlation in the same manner as for Figure 2-3-2.

The cost reduction effotts made by these producers resulted in a downward shift of the supply curve S to curve S'. On the other hand, the demand also showed a sharp increase since 1960 as mentioned earlier, thereby shifting the curve from D to D'. Consequently, the price was pushed downward from P_1 to P_2.

Such a condition persisted until the advent of the Oil Crisis in 1973, so that the international price of urea had shown a long-term, gradual downtrend.

Thereafter, in 1973 and 1974, during the days of the post-Crisis, the price suddenly increased sharply as shown in Figure 2-3-1. As a result, all the producers maximized their operational rate as much as possible, and also embarked upon the construction of new plants. At the same time, on the demand side, the price increase triggered a fall in the demand. The tightness which suddenly came about during the period after the Crisis naturally affected both supply and demand phases. Since 1975 up to present, mainly the stagnation which set in around this period on the demand side has been exerting its influence upon the market situation. As a result of the speculative hoarding of the commodities around 1974, a great amount of stockpile emerged on the stages of fertilizer distribution channels. The necessity of consuming this enormous inventory was one of the factors contributing to the stagnation of the apparent demand. On the supply side, the effects of supply increase because of the onstream of the newly constructed plants are expected to be materialized sometime after 1979. The major influences which are affecting the present situation of the market are various manifestations of factors leading to the increase in the production cost due mainly to the abnormal hike in the raw material prices. Figure 2-3-6 shows the supply and demand curves S and D prior to the Oil Crisis and S' and D' for the period after the Crisis. In other words, this illustration demonstrates the fact that the price has increased from P_1 to P_2 from the pre-Crisis to post-Crisis period because of the increase in the production cost in spite of the fact that the basic position of the market was maintained on an unchanged basic oversupply.

2-3-3 Outlook on the international price of urea in the future

In the following paragraphs, a forecast will be made on the international price of urea during the 1980s, on the basis of the analysis made on the correlation between the price and production cost of urea in the past.

The production cost of urea in certain countries was first estimated. These countries are those expected to have some export surplus destined toward the Asian market during a period from 1979 to 1985. The selection of these countries was made on the basis of the supply/ demand balance factors as discussed so far. Then, the suppliable amount of these producers was accumulated and plotted in the order of magnitude of lower cost, the cost being calculated by adding the production cost and the charges necessary for supplying the urea to India, which is the largest expected market during the 1980s. The curve S in Figure 2-3-7 graphically expresses the obtained results. In this figure, the curve D stands for the total amount of import requirements for urea into the Asian market.

A conspicuous feature regarding the urea production cost thus calculated is the following fact. That is, the production cost in the U.S.A., West European countries, and Japan, all of which have traditionally been the major urea exporters, will after 1982 be considerably higher than the production cost then registered by Mideastern countries and Indonesia. So far, the U.S.A., West European countries, and Japan have been enjoying a superior position over other regions and countries in terms of international price competitiveness because of lower plant construction cost factors, raw material costs much lower than the present level, and a high operational rate level. In the future, these countries will keep showing an advantage in terms of the production cost originated from plant construction cost alone because of the fact that these countries' plants were constructed a long time ago.

In spite of such an advantage, they are now incapable of effectively competing in price with Indonesia and Mideastern countries because of the raw material price hike factor, since the rate of raw material cost in total production cost has been sharply increasing during post-Crisis years. The following table shows the production cost figures in West Europe, the U.S.A., Japan, and Indonesia. (US$/T, Bulk, Ex-factory Prices).

Year	W. Europe	Japan	the U.S.A.	Indonesia
1983	158	184	148	99
1985	202	213	193	106

As a result of these, it is likely that price formation in the future may present a somewhat different mechanism in comparison to the conventional price formation process. This outlook will be explained hereunder by referring to Figure 2-2-3.

In the past, formation of the price was made on the production cost level P_1 of the marginal producer in correspondence with the extent of demand q_1. However, according to the supply curve for the 1980s, the marginal producer at point A will be Indonesia. The producer which follows immediately the marginal producer will also be Indonesia. The traditional exporters such as the U.S.A., West European countries, and Japan come into the picture only after point B. Therefore, it is not possible for such competitors as the USA, West Europe, and Japan to enter into the export market even if the international price level is slightly pushed upward from the level p_1, as long as the price level is lower than level B., with the assumption that these competitors will not export the urea at a price lower than their production costs. Once the price rises beyond level B, these competitors can afford to export their products, thereby resulting in oversupply in the international market, and the price declining back to level B. Thus, the price of urea in the international market will be formed at level B, not A.

However, in view of the fact that such competitors as the USA, West Europe, and Japan have a large amount of export potential in terms of quantity, and also in view of the fact that the depreciation in construction costs of their facilities have been paid off to a fair extent or in some cases wiped out, it is likely for them to continue their export as long as the price level is higher than the level at which they can obtain variable costs portion. Also, it is likely for them to continue their export from the standpoint of the fact that since they have a domestic outlet for the product in which they can sell it under more favorable conditions than the export market (due to advantages in freight cost), they can expect gain from export, the price of which is slightly higher than the variable cost level.

In view of the above discussions, the lowest price level at which these competitors cannot afford to enter into the export market is thought to be the level B', which is a lower level than level B on the supply curve. Thus, the point B' will be located within the range between the highest level which is equivalent to the total production cost of urea produced by these competitors, and the lowest level, which is equivalent to the variable costs of urea. In this projection, the point is assumed to be located at the middle of these two points. The projected result is given in Table 2-3-1, and the raw material price figures used in this projection are given in Table 2-3-2.

On the basis of the above projection, the estimated urea price in the international market in the future is obtained as follows. The price is estimated at CIF price at India, which is considered to be the major importing country, by adding the charges at India to the above projected costs.

1982	US$ 181 (bagged)
1983	US$ 198 (bagged)
1984	US$ 223 (bagged)
1985	US$ 243 (bagged)

This price trend seems to be reasonable, in view of the fact that the price trend is within the range of an annual price increase rate of 4.4 % (as of 1982) to 6.6% (as of 1985), as against the actual price level in 1977.

LAND USE IN INDONESIA, 1973

(1,000 ha)

	Total Area	Percentage of Total Indonesian Area	Forest Land	Percentage of Total Area	Total Land in Agric. Holdings*	Percentage of Total Area	Percentage of Total Indonesian land in Agric. Holdings
Java	13,218	6.9	2,891	21.9	6,183	46.8	37.7
Sumatra	47,360	24.9	28,420	60.6	5,117	10.8	31.2
Kalimantan	53,946	28.3	41,470	76.9	1,927	3.6	11.8
Sulawesi	18,921	9.9	9,910	52.4	1,651	8.7	10.1
Bali-Nusa Tenggara	7,361	3.9	2,036	27.7	1,225	16.6	7.5
Maluku	7,451	3.9	6,000	80.5	290	3.9	1.8
Irian Java	42,198	22.2	31,500	74.6	n.a.	n.a.	n.a.
Indonesia	190,457	100.0	122,227	64.2	16,393	8.6	100.0

Note: *: Include residential land in agricultural holdings, and some fallow land and land not suitable for cultivation etc.

Source: 1973 Agricultural Census, Agriculture: Volume I, Central Bureau of Statistics, Jakarta, Nov. 1976

GROSS DOMESTIC PRODUCT, AND EXPORTS, INDONESIA

		1961	1965	1969	1973
Gross Domestic Product in 1960 Constant Price (Bil. Rupiah)		413	430	531	711
Average annual growth rate (%)			1.0	5.4	7.6
% of GDP	Total Export	7.6	0.1	8.7	20.9
% of total export	Vegetable Products	60.9	53.5	48.1	41.2
	Estate Products	24.7	23.0	13.8	8.0
	Smallholder Products	35.3	29.7	29.9	14.8
	Forest Products	0.7	0.5	3.5	18.3
	Mineral Products	38.3	44.5	50.1	53.5

Source: Statistical Pocketbook of Indonesia

GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN, INDONESIA
(AT CONSTANT MARKET PRICES IN 1973)

	1960		1965		1970		1975	
	Rp. Billions	% of GDP	Rp. Billions	% of GDP	Rp. Billions	% of GDP	Rp. Billions	% of GDP
Agriculture, Forestry and Fishery	1,817.4	51.3	1,946.1	49.9	2,340.8	44.5	2,811.2	36.8
Farm Food Crops	1,030.5	29.1	1,094.3	28.1	1,353.3	25.7	1,696.1	22.2
Farm Non-food Crops	249.9	7.1	295.2	7.6	320.1	6.1	312.2	4.1
Estate Crops	135.5	3.8	139.7	3.6	149.3	2.8	183.2	2.4
Others	401.4		413.8		507.4		619.7	
Mining and Quarrying	236.7	6.7	263.0	6.8	526.0	10.0	828.1	10.9
Manufacturing	301.4	8.5	329.2	8.4	471.5	9.0	847.9	11.1
Wholesale and Retail Trade	462.6	13.1	558.8	14.3	829.0	15.7	1,293.8	17.0
Others	722.1	20.4	802.7	20.6	1,097.1	20.8	1,849.8	24.2
Gross Domestic Product	3,540.2	100.0	3,899.8	100.0	5,264.4	100.0	7,630.8	100.0

Source: Statistical Pocketbook of Indonesia, 1964/67-1977

NUMBERS OF ESTATES AND AREA HARVESTED BY ESTATES IN INDONESIA BY CROP, 1973

	Numbers of Estates (A)	Area (1,000 ha) (B)	(B)/(A) (ha)
Rubber	848	455.5	537
Coconut	444	16.2	36
Palm Oil	77	155.7	2,022
Cinchona	30	2.6	87
Cocoa	73	8.5	116
Coffee	219	38.6	176
Tobacco	78	12.2	156
Sugar Cane	66	99.8	1,512

Source: Statistical Yearbook of Indonesia, 1975

NUMBERS AND AREA OF FARMS CLASSIFIED BY SIZE OF FARM, INDONESIA

Size Class (ha)	Numbers of Farms		Area		
	1963 (% of Total)	1973 (% of Total)	1963 (% of Total)	1973 (% of Total)	Growth Rate 1963/73
0.10 - 1.00	70.1	70.4	28.6	29.0	111.1
1.00 - 3.00	23.9	24.0	35.3	37.7	117.5
3.00 - 10.00	5.3	5.0	23.6	23.0	107.8
10.00 - 15.00	0.4	0.3	4.6	3.9	91.5
15.00 and over	0.3	0.3	7.9	6.4	89.4
Total	100.0	100.0	100.0	100.0	110.0

Source: Statistical Yearbook of Indonesia, 1975

PER CAPITA PRODUCTION OF FOOD CROPS, AND IMPORT OF RICE, INDONESIA

	1955	1960	1965	1970	1975
- Population (1,000 persons)	88,440	98,259	105,414	117,469	132,110
- Per Capita Production of Agricultural Products (kg/person)					
Paddy	163.2	171.6	162.0	215.1	221.0
Corn	22.3	25.0	22.4	24.1	22.0
Cassava	105.3	115.8	119.9	89.2	95.0
- Import of Rice (1,000 tons)	N.A.	966.5	818.7	323.9*	326.5*

Note: *Not included Governmental Import.

Sources: 1955-1970: Calculated from Statistical Pocketbook of Indonesia
1975: Calculated from the Data provided by Dept. of Food Crops, Indonesia

SUPPLY/DEMAND OF NITROGEN FERTILIZER, INDONESIA

(N000 ton)

	Supply			Domestic Consumption	Export
	Production	Import	Total		
1959	-	25.4*	25.4	N.A.	-
1960	-	7.1*	7.1	N.A.	-
1961	-	79.3*	79.3	N.A.	-
1962	-	76.0*	76.0	N.A.	-
1963	-	63.5*	63.5	N.A.	-
1964	47.6	35.6	83.2	N.A.	-
1965	43.3	49.5	92.8	N.A.	-
1966	42.8	55.7	98.5	N.A.	-
1967	42.9	61.9	104.8	67.3	-
1968	43.9	142.4	186.3	101.3	-
1969	38.7	107.6	146.3	171.2	-
1970	45.3	103.6	148.9	183.8	-
1971	48.2	131.5	179.7	211.6	-
1972	59.9	258.1	318.0	267.4	-
1973	81.5	225.7	307.2	329.1	-
1974	120.8	461.8	582.6	317.3	-
1975	207.5	676.3	883.8	338.7	-
1976	184.2	7.3	191.5	351.9	-
1977	401.6	-	401.6	471.5	184.1

Note: *Import for food crop sub-sector only.

Sources: 1. National Fertilizer Study
2. Kumpulan Data Pupuk Indonesia, 1967-76
3. Dept. of Chemical Industries, GOI

PUSRI DISTRIBUTION SYSTEM

ANNEX II
Tab. 1-1-8

1) 4 Special bull carriers of 7.500 dwt. with self unloading gear.

2) 59 Inland Supply Depots, ranging capacities from 3.000 to 10.000 tons of each warehouses.

3) 175 rail wagons of 30 ton of carrying capacity.

4) 7 locomotives.

5) Expansion projects of unit Packing station:

- Jakarta with capacity of bagging.	300.000 ton/year
- Cilacap	400.000 ton/year
- Surabaya	400.000 ton/year
- Padang	100.000 ton/year
- Medan	150.000 ton/year
- Makasar	100.000 ton/year

Source: Dept. of Chemical Industry, Indonesia

INDONESIA FERTILIZER PRODUCTION (FINISHED PRODUCT)

(Product 000 ton)

Name	PUSRI I			PUSRI II			PUSRI III		
Product	Urea			Urea			Urea		
	Designed Capacity	Actual Production	%	Designed Capacity	Actual Production	%	Designed Capacity	Actual Production	%
1964	100.0	103.5	103.5						
1965	100.0	94.1	94.1						
1966	100.0	93.0	93.0						
1967	100.0	93.3	93.3						
1968	100.0	95.5	95.5						
1969	100.0	84.2	84.2						
1970	100.0	98.4	98.4						
1971	100.0	104.8	104.8	-	-				
1972	100.0	108.2	108.2	-	-				
1973	100.0	108.3	108.3	-	-				
1974	100.0	97.8	97.8	380.0	93.2	24.5			
1975	100.0	91.7	91.7	380.0	292.0	76.8	-	-	
1976	100.0	85.4	85.4	380.0	279.9	73.7	-	-	
1977	100.0	82.9	82.9	380.0	353.0	92.9	570.0	331.8	58.2

ANNEX II
Tab. 1-1-9

INDONESIA FERTILIZER PRODUCTION (FINISHED PRODUCT) (CONT'D.)

(Product 000 ton)

Name	PUSRI IV			P. T. Petrokimia					
Product	Urea			Urea			AS		
	Designed Capacity	Actual Production	%	Designed Capacity	Actual Production	%	Designed Capacity	Actual Production	%
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971				-	-		-	-	
1972				45.0	8.5	18.9	150.0	29.4	19.6
1973				45.0	13.9	30.9	150.0	120.4	80.3
1974				45.0	16.0	35.6	150.0	121.8	81.2
1975	-	-		45.0	13.2	29.3	150.0	118.8	79.2
1976	-	-		45.0	0.9*	2.0	150.0	74.9	49.9
1977	570.0	54.4	9.5	45.0	10.8	24.0	150.0	87.9	58.6

Note: *Urea was produced only in January.

Sources: 1. "National Fertilizer Study"
2. Direktorat Bina Sarana Usaha Tanaman Pangan "Kumpulan Data Pupuk Indonesia, 1967-76" (1977)
3. Dept. of Chemical Industries (GOI)
4. "Fertilizer Market Study, ASEAN Region" (1976)

ACTUAL AND PROJECTED DEMAND FOR NITROGEN FERTILIZER, INDONESIA

(N 000 ton)

	Actual + Study Forecast	NFS	Next Fert. Plant in Indonesia		NFPDS		AFS
			High	Low	High	Low	
1967	67*						
1968	101*						
1969	171*						
1970	184*						
1971	212*	194					
1972	267*	227					
1973	329*	266	351	338			
1974	317*	311	396	370			
1975	339*	345	441	404			
1976	352*	383	485	438	495	495	495
1977	472*	425	528	472	563	563	563
1978	559	472	571	506	642	642	642
1979	634	524	613	541	706	697	697
1980	699	563	655	576	792	748	780
1981	745		696	612	877	801	864
1982	784		737	648	978	873	950
1983	817		777	684	1,074	947	1,013
1984	844				1,161	1,013	1,116
1985	864				1,248	1,081	1,203
1986	891						
1987	915						
1988	937						
1989	956						
1990	974						

Sources: NFS: Agrar-Und Hydrotechnik Gmbh, "National Fertilizer Study, Indonesia", (1972)

Next Fert. Plant in Indonesia: BEICIP/UNICO, "Next Fertilizer Plant in Indonesia", (1972)

NFPDS: Resource Planning Consultants Ltd., "The National Fertilizer and Pesticide Distribution Study", (1976)

AFS: Agrar-Und Hydrotechnik Gmbh, "Fertilizer Market Study, ASEAN Region", (1976)

Note: *: Actual

ACTUAL AND PROJECTED DEMAND FOR UREA, INDONESIA

ANNEX II
Tab. 1-1-11

(Urea 000 ton)

	Actual + Study Forecast	NFS	NFPDS			AFS
			High	Low	Revised	
1967	115*					
1968	205*					
1969	308*					
1970	343*					
1971	413*	98				
1972	485*	124				
1973	669*	148				
1974	604*	203				
1975	676*	425				
1976	686*	486	992	992		952
1977	932*	504	1,128	1,128	973	1,088
1978	1,105	523	1,283	1,283	1,106	1,243
1979	1,257	542	1,390	1,370	1,249	1,350
1980	1,389	542	1,560	1,464	1,401	1,520
1981	1,483		1,730	1,564	1,554	1,690
1982	1,565		1,900	1,671	1,706	1,860
1983	1,633		2,060	1,785	1,849	2,011
1984	1,689		2,230	1,907	2,001	2,156
1985	1,732		2,400	2,038	2,159	2,304
1986	1,786					
1987	1,835					
1988	1,880					
1989	1,920					
1990	1,955					

Sources: NFS: Agrar-Und Hydrotechnik Gmbh, "National Fertilizer Study, Indonesia", (1972)

NFPDS: Resource Planning Consultants Ltd., "The National Fertilizer and Pesticide Distribution Study", (1976)

AFS: Agrar-Und Hydrotechnik Gmbh, "Fertilizer Market Study, ASEAN Region", (1976)

Note: *: Actual

AGRICULTURAL LAND AREA UNDER CROPS, 1963 AND 1973, INDONESIA

(000 ha)

	1963			1973[a)]		
	Java	Outer islands	Total	Java	Outer islands	Total
Sawah	2,528	1,547	4,075	2,631	2,209	4,840
Upland food crops	2,225	3,270	5,495	1,880	2,222	4,102
Perennial crops	120	2,007	2,127	329	2,282	2,611
Total	4,870	6,827	11,697	4,840	6,713	11,553

Note: a): Excluding Maluku.

Sources: 1. Census of Agriculture 1963, Republic of Indonesia, Final Report, Central Bureau of Statistics.

2. 1973 Agricultural Census, Agriculture: Volume I, Central Bureau of Statistics, Jakarta, November 1975.

ANNEX II
Tab. 1-1-13

ACTUAL AND PROJECTED PLANTED AREA OF PADDY, INDONESIA

(000 ha)

	Actual									Projected		
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Net wet land area (000 ha) (1)					4,840	5,049	5,049	5,124	5,194	5,375	5,616	5,752
Gross wet land area (000 ha) (2)						7,340	7,334	7,229	7,499	7,802	8,189	8,413
[Cropping intensity ratio (%) (3)=(2)/(1)]						145.4	145.3	141.1	144.4	145.2	145.8	146.3
Net irrigated area (000 ha) (4)					3,301	3,560	3,627	3,871	3,948	4,273	4,689	4,964
[Irrigation ratio (%) (5)=(4)/(1)]					68.2	70.5	71.8	75.5	76.0	79.5	83.5	86.3
Gross irrigated area (000 ha) (6)					4,852	5,237	5,351	5,608	5,792	6,281	6,893	7,297
[Cropping intensity ratio (%) (7)]					147.0	147.1	147.5	144.9	146.7	147.0	147.0	147.0
Wet season												
BIMAS HYV (000 ha) (8)	134	338	384	393	836	1,796	1,878	1,800		1,872	2,231	2,467
LV (000 ha) (9)	581	647	667	524	560	339	308	302	247	46	7	0
Total (000 ha) (10)	715	985	1,051	917	1,396	2,135	2,186	2,102		1,918	2,238	2,467
[(10)/((10)+(13)) (%)]	54.5	64.8	52.3	32.9	51.8	75.0	75.7	71.4		50.9	50.3	49.7
[(8)/(10) (%)]	18.7	34.3	36.5	42.9	59.9	84.1	85.9	85.6		97.6	99.7	100.0
INMAS HYV (000 ha) (11)	46	186	270	499	576	394	381	452		1,566	2,128	2,477
LV (000 ha) (12)	551	349	687	1,372	723	318	321	389	580	285	84	20
Total (000 ha) (13)	597	535	957	1,871	1,299	712	702	841		1,851	2,212	2,497
[(11)/(13) (%)]	7.7	34.8	28.2	26.7	44.3	55.3	54.3	53.7		84.6	96.2	99.2
Non-Program (000 ha) (14)					606	713	739	928		504	239	0
Total (000 ha) (15)					3,301	3,560	3,627	3,871		4,273	4,689	4,964
[((10)+(13))/(15) (%)]					81.6	80.0	79.6	76.0		88.2	94.9	100.0
Dry season												
BIMAS HYV (000 ha) (16)	248	99	184	182	371	759	762	763		826	971	997
LV (000 ha) (17)	344	151	184	144	123	103	139	110	89	150	38	8
Total (000 ha) (18)	592	250	368	326	494	862	901	873		976	1,009	1,005
[(18)/((18)+(21)) (%)]	72.7	44.3	41.9	33.4	34.9	69.2	66.3	57.0		48.6	45.8	43.1
[(16)/(18) (%)]	41.9	39.6	50.0	55.8	75.1	88.1	84.6	87.4		84.6	96.2	99.2
INMAS HYV (000 ha) (19)	53	148	244	334	539	286	298	467		887	1,153	1,317
LV (000 ha) (20)	175	166	266	315	384	97	161	192	212	103	37	11
Total (000 ha) (21)	228	314	510	649	923	383	459	659		990	1,190	1,328
[(19)/(21) (%)]	23.2	47.1	47.8	51.5	58.4	74.7	64.9	70.9		89.6	96.9	99.2
Non-Program (000 ha) (22)					134	432	364	205		42	4	0
Total (000 ha) (23)					1,551	1,677	1,724	1,737		2,007	2,203	2,333
[((18)+(21))/(23) (%)]					91.4	74.2	78.9	88.2		97.9	99.8	100.0
Net non-irrigated area (000 ha) (24)						1,489	1,420	1,253	1,246	1,102	927	788
Gross non-irrigated area (000 ha) (25)						2,103	1,983	1,621	1,707	1,521	1,296	1,116
[Cropping intensity ratio (%) (26)]						141.2	139.6	129.4	137.0	138.0	140.0	142.0
Gross dry land area (000 ha) (27)	1,470	1,456	1,432	1,296	1,340	1,168	1,161	1,137		857	550	244

Source of actual planted area: Dept. of Food Crops, Indonesia

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, BIMAS/INMAS PADDY, INDONESIA

	Actual or Estimated							Projected		
	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
BIMAS										
Wet Season										
A. Planted Area (000 ha)	1,051	917	1,396	2,135	2,186	2,102	1,827	1,918	2,238	2,467
B. Potential Dosage (N kg/ha)					93.5	93.7	93.3	100.8	101.8	101.3
C. Dosage (N kg/ha)					73.1	78.7	89.7	100.8	101.8	101.3
D. (C)/(B) (%)					78.2	84.0	96.1	100.0	100.0	100.0
E. Actual/Projected Demand (N 000 t)					159.8	165.4	164.0	193.3	227.8	249.9
Dry Season										
A. Planted Area (000 ha)	368	326	494	862	901	873	681	976	1,009	1,005
B. Potential Dosage (N kg/ha)					104.4	106.3	106.0	104.4	112.4	114.5
C. Dosage (N kg/ha)					95.7	92.0	129.3	104.4	112.4	114.5
D. (C)/(B) (%)					91.7	86.5	100.0	100.0	100.0	100.0
E. Actual/Projected Demand (N 000 t)					86.2	80.3	88.1	101.9	113.4	115.1
INMAS										
Wet Season										
A. Planted Area (000 ha)	957	1,871	1,299	712	702	841	1,737	1,851	2,212	2,497
B. Potential Dosage (N kg/ha)					80.7	83.1	87.6	95.9	102.2	103.8
C. Dosage (N Kg/ha)					22.5	10.6	29.0	31.8	49.0	65.3
D. (C)/(B) (%)					27.9	12.8	33.1	33.2	47.9	62.9
E. Actual/Projected Demand (N 000 t)					21.0	10.8	57.5	58.9	108.4	163.1
Dry Season										
A. Planted Area (000 ha)	510	649	923	383	459	659	1,038	990	1,190	1,328
B. Potential Dosage (N kg/ha)					90.8	94.9	100.9	107.8	112.9	114.4
C. Dosage (N kg/ha)					23.0	23.9	95.7	107.8	112.9	114.4
D. (C)/(B) (%)					25.3	25.2	94.8	100.0	100.0	100.0
E. Actual/Projected Demand (N 000 t)					10.6	15.8	99.3	106.7	134.4	151.9
Total										
Actual/Projected Demand (N 000 t)	187.9	222.4	307.4	266.6	277.6	272.3	408.9	460.8	584.0	680.0

Notes:
1. As for the planted area, see Table 1-1-3
2. Potential dosage is calculated using the recommended dosage in BIMAS/INMAS package.
3. (Actual Dosage) = (E)/(A)
4. (Projected Dosage) = (B) x (D)

ACTUAL AND PROJECTED PLANTED AREA OF PADDY, INDONESIA – HIGH CASE AND LOW CASE

ANNEX II
Tab. 1-1-15

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
Net wet land area (000 ha) (1)	5,375	5,616	5,752	5,375	5,616	5,752
Gross wet land area (000 ha) (2)=(1)x(3)	7,802	8,189	8,413	7,802	8,189	8,413
[Cropping intensity ratio (%) (3)]	145.2	145.8	146.3	145.2	145.8	146.3
Net irrigated area (000 ha) (4)	4,273	4,689	4,964	4,219	4,476	4,602
[Irrigation ratio (%) (5)=(4)/(1)]	79.5	83.5	86.3	78.5	79.7	80.0
Gross irrigated area (000 ha) (6)	6,281	6,893	7,297	6,202	6,580	6,765
[Cropping intensity ratio (%) (7)]	147.0	147.0	147.0	147.0	147.0	147.0
Wet season						
BIMAS: HYV (000 ha) (8)	2,240	2,675	2,964	1,279	1,515	1,727
LV (000 ha) (9)	55	8	0	273	197	100
Total (000 ha) (10)	2,295	2,683	2,964	1,522	1,712	1,827
[(10)/((10)+(13)) (%)]	60.9	60.3	59.7	40.9	40.3	39.7
[(8)/(10) (%)]	97.6	99.7	100.0	82.4	88.5	94.5
INMAS: HYV (000 ha) (11)	1,247	1,700	1,984	1,570	2,166	2,600
LV (000 ha) (12)	227	67	16	629	370	175
Total (000 ha) (13)	1,474	1,767	2,000	2,199	2,536	2,775
[(11)/(13) (%)]	84.6	96.2	99.2	71.4	85.4	93.7
Non-Program (000 ha) (14)	504	239	0	498	228	0
Total (000 ha) (15)	4,273	4,689	4,964	4,219	4,476	4,602
[((10)+(13))/(15) (%)]	88.2	94.9	100.0	88.2	94.9	100.0
Dry season						
BIMAS: HYV (000 ha) (16)	974	1,180	1,229	589	669	681
LV (000 ha) (17)	177	47	10	160	83	35
Total (000 ha) (18)	1,151	1,227	1,239	749	752	716
[(18)/((18)+(21)) (%)]	58.6	55.8	53.1	38.6	35.8	33.1
[(16)/(18) (%)]	84.6	96.2	99.2	78.6	88.9	95.1
INMAS: HYV (000 ha) (19)	729	942	1,085	993	1,208	1,376
LV (000 ha) (20)	85	30	9	199	140	71
Total (000 ha) (21)	814	972	1,094	1,192	1,348	1,447
[(19)/(21) (%)]	89.6	96.9	99.2	83.3	89.6	95.1
Non-Program (000 ha) (22)	42	4	0	42	4	0
Total (000 ha) (23)	2,007	2,203	2,333	1,983	2,104	2,163
[((18)+(21))/(23) (%)]	97.9	99.8	100.0	97.9	99.8	100.0

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, BIMAS/INMAS PADDY' INDONESIA HIGH CASE AND LOW CASE

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
BIMAS						
Wet Season						
A. Planted Area (000 ha)	2,295	2,683	2,964	1,522	1,712	1,827
B. Dosage (N kg/ha)	100.7	102.0	101.5	92.6	95.7	98.1
C. Projected Demand (N 000 t)	231.1	273.7	300.8	140.9	158.5	179.2
Dry Season						
A. Planted Area (000 ha)	1,151	1,227	1,239	749	752	716
B. Dosage (N kg/ha)	104.4	112.4	114.4	100.3	107.4	111.6
C. Projected Demand (N 000 t)	120.2	137.9	141.7	75.1	80.8	79.9
INMAS						
Wet Season						
A. Planted Area (000 ha)	1,474	1,767	2,000	2,199	2,536	2,775
B. Dosage (N kg/ha)	32.0	49.1	65.5	29.6	46.1	63.2
C. Projected Demand (N 000 t)	47.2	86.8	131.0	65.1	116.9	175.4
Dry Season						
A. Planted Area (000 ha)	814	972	1,094	1,192	1,348	1,447
B. Dosage (N kg/ha)	107.8	112.9	114.4	103.5	107.8	111.6
C. Projected Demand (N 000 t)	87.7	109.7	125.2	123.4	145.3	161.5
Total						
Projected Demand (N 000 t)	486.2	608.1	698.7	404.5	501.5	596.0

Note: See notes of Tab. 1-1-14.

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, BIMAS/INMAS SECONDARY FOOD CROPS, INDONESIA

	Actual or Estimated							Projected		
	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Soybeans										
A. Planted Area (000 ha)	680	698	744	768	752	636	(671)	775	829	882
B. Fertilized Area (000 ha)				96	71	140	188	315	454	557
C. (B)/(A) (%)				12.5	9.4	22.0		40.7	54.8	63.1
D. Dosage (N kg/ha) (Potential Dosage = 23.0 N kg/ha)				11.5	11.5	11.5		12.0	18.7	23.0
E. Actual/Projected Demand (N 000 t)				1.1	0.8	1.6		3.8	8.5	12.8
Corn										
A. Planted Area (000 ha)	2,627	2,160	3,433	2,669	2,445	2,064	3,197	2,666	2,666	2,666
B. Fertilized Area (000 ha)				202	312	444		1,698	2,034	2,053
C. (B)/(A) (%)				7.6	12.8	21.5		63.7	76.3	77.0
D. Dosage (N kg/ha) (Potential Dosage = 92.0 N kg/ha)				44.1	45.4	46.6		51.6	57.7	63.3
E. Actual/Projected Demand (N 000 t)				8.9	14.2	20.7		87.6	117.4	129.9
Peanut										
A. Planted Area (000 ha)	376	354	416	411	475	411	424	462	502	541
B. Fertilized Area (000 ha)				49	115	126		337	410	444
C. (B)/(A) (%)				11.9	24.2	30.7		73.0	81.6	82.0
D. Dosage (N kg/ha) (Potential Dosage = 23.0 N kg/ha)				23.0	23.0	23.0		23.0	23.0	23.0
E. Actual/Projected Demand (N 000 t)				1.1	2.6	2.9		7.7	9.4	10.2
Cassava										
A. Planted Area (000 ha)	1,406	1,468	1,429	1,509	1,410	1,435	1,431	1,421	1,404	1,388
B. Fertilized Area (000 ha)					6	31	28	90	98	97
C. (B)/(A) (%)					0.4	2.2	2.0	6.3	7.0	7.0
D. Dosage (N kg/ha) (Potential Dosage = 46.0 N kg/ha)					0	0	0	18.0	20.3	22.2
E. Actual/Projected Demand (N 000 t)					0	0	0	1.6	2.0	2.2
Total										
Actual/Projected Demand (N 000 t)	0	0	0	11.1	17.6	25.2		100.7	137.3	145.1

Notes:
1. Fertilized area up to 1977 is presumed to be equivalent to the planted area covered by the intensification programs.
2. (Projected Fertilized Area) = (A) x (C)
3. (Actual Dosage) = (E)/(B)
4. (Projected Demand) = (B) x (D)

Sources: Planted area in the intensification programs: Dept. of Food Crops, Indonesia
Planted area: "Statistical Pocketbook of Indonesia"

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, CORN, INDONESIA

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
Planted Area (000 ha)	3,163	3,163	3,163	2,150	2,150	2,150
Fertilized Area Ratio (%)	63.7	76.3	77.0	63.7	76.3	77.0
Fertilized Area (000 ha)	2,015	2,413	2,436	1,370	1,640	1,656
Dosage (N kg/ha)	51.6	57.7	63.3	51.6	57.7	63.3
Projected Demand (N 000 t)	104.0	139.2	154.2	70.7	94.6	104.8

Note: See notes of Tab. 1-1-17

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, NON-BIMAS/INMAS FOOD CROPS, INDONESIA

	Actual or Estimated							Projected		
	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Vegetables										
A. Planted Area (000 ha)		694	676	647	531	529		582	655	738
B. Dosage (N kg/ha) (Potential Dosage = 120 N kg/ha)		8.1	6.8	20.3	5.5	13.4		15.6	22.6	31.8
C. Actual/Projected Demand (N 000 t)	6.7	5.6	4.6	13.1	2.9	7.1	13.9	9.1	14.8	23.5
Upland Paddy										
A. Planted Area (000 ha)	1,432	1,296	1,340	1,168	1,161	1,137		857	550	244
B. Dosage (N kg/ha) (Potential Dosage = 92 N kg/ha)								25.8	29.0	31.7
C. Actual/Projected Demand (N 000 t)								22.1	15.9	7.7
Paddy in Non-irrigated Area										
A. Planted Area (000 ha)				2,103	1,983	1,621	1,707	1,355	915	584
B. Dosage (N kg/ha) (Potential Dosage = 30 N kg/ha)								8.4	9.5	10.4
C. Actual/Projected Demand (N 000 t)								11.4	8.6	6.0
Non-BIMAS/INMAS Paddy in Irrigated Area										
A. Planted Area (000 ha)			740	1,145	1,103	1,133		546	243	0
B. Dosage (N kg/ha) (Potential Dosage = 46 N kg/ha)								12.9	14.5	15.9
C. Actual/Projected Demand (N 000 t)								7.0	3.5	0
Total										
Actual/Projected Demand (N 000 t)	6.7	5.6	4.6	13.1	2.9	7.1	13.9	49.6	42.8	37.2

Notes: 1. Actual demand up to 1977 is computed subtracting the demand on foregoing crops from total Indonesian demand.

2. As for the paddy planted area, see Tab. 1-1-13

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, RUBBER, INDONESIA

	Actual or Estimated						Projected		
	1971	1972	1973	1974	1975	1976	1980	1985	1990
Estates									
Inmature									
A. Planted Area (000 ha)	89	75	61	47	33	19	17	15	13
B. Dosage (N kg/ha) (Potential Dosage = 12 N kg/ha)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
C. Actual/Projected Demand (N 000 t)	1.1	0.9	0.7	0.6	0.4	0.2	0.2	0.2	0.1
Mature									
A. Planted Area (000 ha)	387	391	394	393	395	389	348	302	262
B. Dosage (N kg/ha) (Potential Dosage = 40 N kg/ha)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
C. Actual/Projected Demand (N 000 t)	15.4	15.6	15.8	15.7	15.8	15.6	13.9	12.0	10.5
Smallholders									
Inmature									
A. Planted Area (000 ha)							392	392	392
B. Dosage (N kg/ha) (Potential Dosage = 12 N kg/ha)							4.7	5.3	5.8
C. Actual/Projected Demand (N 000 t)							1.8	2.1	2.3
Mature									
A. Planted Area (000 ha)							1,475	1,475	1,475
B. Dosage (N kg/ha) (Potential Dosage = 40 N kg/ha)							15.7	17.6	19.3
C. Actual/Projected Demand (N 000 t)							23.2	25.9	28.4
Total									
Actual/Projected Demand (N 000 t)	16.5	16.5	16.5	16.3	16.2	15.8	39.1	40.2	41.3

Source: Planted area: "Statistical Pocketbook of Indonesia"

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, SUGAR CANE, INDONESIA

	Actual or Estimated						Projected		
	1971	1972	1973	1974	1975	1976	1980	1985	1990
Estates									
A. Planted Area (000 ha)	84	88	100	107	105	116	136	163	191
B. Dosage (N kg/ha)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
C. Actual/Projected Demand (N 000 t)	10.1	10.6	12.0	12.8	12.6	13.9	16.3	19.6	22.8
Smallholders									
A. Planted Area (000 ha)	49	72	70	72	87		115	146	177
B. Dosage (N kg/ha) (Potential Dosage = 120 N kg/ha)	60.0	60.0	60.0	60.0	60.0	60.0	67.2	75.6	82.8
C. Actual/Projected Demand (N 000 t)	2.9	4.3	4.1	4.3	5.2		7.7	11.0	14.7
Total									
Actual/Projected Demand (N 000 t)	13.0	14.9	16.1	17.1	17.8	13.9	24.0	30.6	37.5

Source: Planted area: "Statistical Pocketbook of Indonesia"

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, OTHER ESTATE CROPS, INDONESIA

	Actual or Estimated						Projected		
	1971	1972	1973	1974	1975	1976	1980	1985	1990
Oil Palm									
A. Planted Area (000 ha)	139	143	156	164	171	180	240	288	330
B. Dosage (N kg/ha)									
(Potential Dosage = 60 Nkg/ha)							23.5	26.5	29.0
C. Actual/Projected Demand (N 000 t)							5.6	7.6	9.6
Tobacco									
Estates									
A. Planted Area (000 ha)	11	12	12	13	12	11	12	12	13
B. Dosage (N kg/ha)									
(Potential Dosage = 80 Nkg/ha)							31.4	35.3	38.6
C. Actual/Projected Demand (N 000 t)							0.4	0.4	0.5
Smallholders									
A. Planted Area (000 ha)	18	29	32	32	14		25	25	25
B. Dosage (N kg/ha)							26.9	30.2	33.1
(Potential Dosage = 80 Nkg/ha)									
C. Actual/Projected Demand (N 000 t)							0.6	0.8	0.8
Tea									
Estates									
A. Planted Area (000 ha)	66	62	62	61	61	60	58	55	52
B. Dosage (N kg/ha)							33.3	37.5	41.1
(Potential Dosage = 85 Nkg/ha)									
C. Actual/Projected Demand (N 000 t)							1.9	2.1	2.1
Smallholders									
A. Planted Area (000 ha)	36	35	33	34	34		35	35	35
B. Dosage (N kg/ha)							28.6	32.1	35.2
(Potential Dosage = 85 Nkg/ha)									
C. Actual/Projected Demand (N 000 t)							1.0	1.1	1.2

Continued on next page.

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, OTHER ESTATE CROPS, INDONESIA (CONT'D.)

	Actual or Estimated						Projected		
	1971	1972	1973	1974	1975	1976	1980	1985	1990
Coffee									
Estates									
A. Planted Area (000 ha)	39	39	39	38	37	37	36	34	33
B. Dosage (N kg/ha) (Potential Dosage = 115 Nkg/ha)							45.1	50.7	55.5
C. Actual/Projected Demand (N 000 t)							1.6	1.7	1.8
Smallholders									
A. Planted Area (000 ha)	366	357	341	347	366		355	355	355
B. Dosage (N kg/ha) (Potential Dosage = 115 Nkg/ha)							38.6	43.5	47.6
C. Actual/Projected Deand (N 000 t)							13.7	15.5	16.9
Total									
Actual/Projected Demand							24.8	29.2	32.9

Notes: 1. Dosage means the average dosage on the planted area.
2. (Projected Demand) = (A) x (B)

Source: Planted area: "Statistical Pocketbook of Indonesia"

ESTIMATED RECOMMENDED DOSAGE, AND ASSUMED ACTUAL APPLICATION RATIO ON ESTATE CROPS, INDONESIA

	Estimated Recommended Dosage (N kg/ha)	Assumed Actual Application Ratio	
		Estates	Smallholders
Rubber	Mature tree 40	Not Applicable	(A) x 0.7
	Inmature tree 12	Not Applicable	(A) x 0.7
Sugar Cane	120	Not Applicable	(A) x 1.0
Oil Palm	60	(A) x 0.7	Not Applicable
Tobacco	80	(A) x 0.7	(A) x 0.6
Tea	85	(A) x 0.7	(A) x 0.6
Coffee	115	(A) x 0.7	(A) x 0.6
Coconut	30	(A) x 0	(A) x 0

Notes: 1. (A): Actual Application Ratio on Corn which is projected as follows:

in 1980 56%
in 1985 63%
in 1990 69%

2. Estimated per hectare dosage is computed by following formula:

(Estimated per Hectare Dosage) =

(Estimated Recommended Dosage) x (Assumed Actual Application Ratio)

For expample, estimated per hectare dosage on estate-oil palm in 1985 will be computed as follows:

60 x 0.63 x 0.6 = 26.5

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, ESTATE CROPS, INDONESIA HIGH CASE AND LOW CASE

		High Case			Low Case		
		1980	1985	1990	1980	1985	1990
Rubber	Estates	14.1	12.2	10.6	14.1	12.2	10.6
	Smallholders	35.7	40.1	44.0	12.5	14.0	15.4
	Total	49.8	52.3	54.6	26.6	26.2	26.0
Sugar Cane	Estates	16.3	19.6	22.8	16.3	19.6	22.8
	Smallholders	7.7	11.0	14.7	7.7	11.0	14.7
	Total	24.0	30.6	37.5	24.0	30.6	37.5
Oil Palm		8.0	10.9	13.7	2.8	3.8	4.8
Tobacco	Estates	0.5	0.6	0.7	0.2	0.2	0.2
	Smallholders	1.1	1.3	1.4	0.3	0.4	0.4
	Total	1.6	1.9	2.1	0.5	0.6	0.6
Tea	Estates	2.7	3.0	3.0	0.9	1.1	1.1
	Smallholders	1.7	1.8	2.0	0.5	0.5	0.6
	Total	4.4	4.8	5.0	1.4	1.6	1.7
Coffee	Estates	2.3	2.4	2.6	0.8	0.8	0.9
	Smallholders	22.8	25.8	28.2	6.8	7.7	8.5
	Total	25.1	28.2	30.8	7.6	8.5	9.4
Estate Crop Sector Total		112.9	128.7	143.7	62.9	71.3	80.0

SUMMARY OF DEMAND FORECAST ON NITROGEN FERTILIZER, INDONESIA

(N 000 ton)

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

Continued on the next page.

SUMMARY OF DEMAND FORECAST ON NITROGEN FERTILIZER, INDONESIA (CONT'D.)

Notes of Tab. 1-1-25

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

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

SUMMARY OF DEMAND FORECAST ON NITROGEN FERTILIZER, INDONESIA
HIGH CASE AND LOW CASE

(N 000 ton)

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
Food Crop						
BIMAS/INMAS						
Rice: BIMAS (WET)	231.1	273.7	300.8	140.9	158.5	179.2
BIMAS (DRY)	120.2	137.9	141.7	75.1	80.8	79.9
INMAS (WET)	47.2	86.8	131.0	65.1	116.9	175.4
INMAS (DRY)	87.7	109.7	125.2	123.4	145.3	161.5
Soybeans	3.8	8.5	12.8	3.8	8.5	12.8
Corn	104.0	139.2	154.2	70.7	94.6	104.8
Peanuts	7.7	9.4	10.2	7.7	9.4	10.2
Cassava	1.6	2.0	2.2	1.6	2.0	2.2
Non-BIMAS/INMAS						
Vegetables	9.1	14.8	23.5	9.1	14.8	23.5
Rice: Upland	22.1	15.9	7.7	22.1	15.9	7.7
Non-irrigated	11.4	8.6	6.0	11.4	8.6	6.0
Non-B/I irrigated	7.0	3.5	0	7.0	3.5	0
Sub-total	652.9	810.0	915.3	537.9	658.8	763.2
Estate Crop						
Rubber Estates	14.1	12.2	10.6	14.1	12.2	10.6
Smallholders	35.7	40.1	44.0	12.5	14.0	15.4
Sugar Cane	24.0	30.6	37.5	24.0	30.6	37.5
Oil Palm	8.0	10.9	13.7	2.8	3.8	4.8
Tobacco	1.6	1.9	2.1	0.5	0.6	0.6
Tea	4.4	4.8	5.0	1.4	1.6	1.7
Coffee	25.1	28.2	30.8	7.6	8.5	9.4
Coconut	0	0	0	0	0	0
Sub-total	112.9	128.7	143.7	62.9	71.3	80.0
Grand Total	765.8	938.7	1,059.0	600.8	730.1	843.2

CONSUMPTION OF NITROGEN FERTILIZERS BY TYPE OF FERTILIZER AND BY CROP SECTOR, INDONESIA

(N 000 ton)

	1971	1972	1973	1974	1975	1976	1977
Food Crop Sector							
BIMAS/INMAS							
Total Nitrogen Fertilizer	187.9	222.4	307.4	277.7	308.4	306.2	429.3
of which:							
Ammonium sulphate	-	-	-	-	-	-	6.5
Urea	186.7	220.9	307.4	277.7	308.4	306.2	422.8
Others	1.2	1.5	-	-	-	-	-
Non-BIMAS/INMAS							
Total Nitrogen Fertilizer	6.7	5.6	4.6	13.1	2.9	7.1	13.9
of which:							
Ammonium sulphate	4.5	3.6	1.3	6.8	-	3.4	4.9
Urea	-	-	-	-	-	-	5.7
Others	2.2	2.0	3.3	6.3	2.9	3.7	3.3
Estate Crop Sector							
Total Nitrogen Fertilizer	17.1	27.3*	16.9	25.6	27.5	39.0	30.6
of which:							
Ammonium sulphate	9.6	29.2	12.4	22.3	19.7	22.2	24.5
Urea	3.2	2.3	0.3	0.2	2.7	9.4	-
Others	4.3	6.0	4.2	3.1	5.1	7.4	6.1

Note: *Total of constituent fertilizers is 37.5.

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

DEMAND FORECAST ON UREA, INDONESIA

(Urea 000 ton)

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

Note: 1975-1977: Actual or estimated.

PUSRI'S SALES OF AMMONIA

	NH_3 (tons)
1970	2,300
1971	2,300
1972	2,723
1973	2,374
1974	2,294
1975	1,509
1976	2,171

Source: PUSRI

UREA CONSUMPTION FOR INDUSTRIAL USES, INDONESIA

1.	P.T. Sasa Inti	2,800 M.T/year
2.	P.T. Ajinomoto Indonesia	1,800 "
3.	Industri Textil	600 "
4.	P.T. Estoni Jaya (Urea formaldehyde)	1,350 "
5.	P.T. Aruki (Urea formaldehyde)	4,250 "
6.	P.T. Pamolite (Urea formaldehyde)	4,000 "
	Total	14,800 M.T/year

Source: Dept. of Chemical Industry, Indonesia

NITROGENOUS FERTILIZER SUPPLY/DEMAND PROJECTION, INDONESIA

(N 000 ton)

			1975*)	1976*)	1977*)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Capacity/Production															
PUSRI - I	NH3	Cap. (A)	49	49	49	49	49	49	49	49	49	49	49	49	49
		Prod. (B)	42	39	38	44	44	44	44	44	44	44	44	44	44
		(B)/(A) %	86	80	78	90	90	90	90	90	90	90	90	90	90
PUSRI - II	NH3	Cap. (A)	180	180	180	180	180	180	180	180	180	180	180	180	180
		Prod.	134	129	162	162	162	162	162	162	162	162	162	162	162
		(B)/(A) %	75	72	90	90	90	90	90	90	90	90	90	90	90
PUSRI - III	NH3	Cap.			270	270	270	270	270	270	270	270	270	270	270
		Prod.			162	203	216	243	243	243	243	243	243	243	243
		(B)/(A) %			60	75	80	90	90	90	90	90	90	90	90
PUSRI - IV	NH3	Cap.			23	270	270	270	270	270	270	270	270	270	270
		Prod.			27	203	216	243	243	243	243	243	243	243	243
		(B)/(A) %			118	75	80	90	90	90	90	90	90	90	90
P.T. Petrokimia	NH3	Cap.	60	60	60	60	60	60	60	60	60	60	60	60	60
		Prod.	31	16	24	30	30	30	30	30	30	30	30	30	30
		(B)/(A) %	52	27	39	50	50	50	50	50	50	50	50	50	50
Aceh (1982/1)	NH3	Cap.								270	270	270	270	270	270
		Prod.								203	216	243	243	243	243
		(B)/(A)								75	80	90	90	90	90
Kujang (1978/8)	NH3	Cap.				113	270	270	270	270	270	270	270	270	270
		Prod.				84	208	227	243	243	243	243	243	243	243
		(B)/(A) %				75	77	84	90	90	90	90	90	90	90
Kalitim (1980/10)	NH3	Cap.							100	400	400	400	400	400	400
		Prod.							75	305	330	360	360	360	360
		(B)/(A) %							75	76	83	90	90	90	90
Total		Cap.	289	289	582	942	1,099	1,199	1,499	1,769	1,769	1,769	1,769	1,769	1,769
		Prod.	208	184	413	726	876	1,025	1,270	1,498	1,541	1,568	1,568	1,568	1,568
Industrial Use			3	3	4	7	8	8	9	9	10	10	10	11	12
Supply Capability			205	181	409	719	868	1,017	1,261	1,489	1,531	1,558	1,558	1,557	1,556
Demand			339	352	474	559	634	699	745	784	817	844	864	891	915
Balance			-134	-171	-65	160	234	318	516	705	714	714	694	666	641

Continued on next page.

NITROGENOUS FERTILIZER SUPPLY/DEMAND PROJECTION, INDONESIA (CONT'D.)

Notes of Tab. 1-1-31

1. *) Actual or estimated
2. "Supply capability" and "Demand" denote those of fertilizer use.
3. "Supply capability" is calculated on the following formula:
   (Supply Capability)=(Total Production) - (Industrial Use)

ANNEX II
Tab. 1-1-32

UREA SUPPLY/DEMAND PROJECTION, INDONESIA

(Product 000 ton)

		1975*)	1976*)	1977*)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Capacity/Production														
PUSRI - I	Urea Cap. (A)	100	100	100	100	100	100	100						
	Prod. (B)	92	85	95	95	95	95	95						
	(B)/(A) %	92	85	95	95	95	95	95						
PUSRI - II	Urea Cap.	380	380	380	380	380	380	380	380	380	380	380	380	380
	Prod.	292	280	353	354	354	354	354	354	354	354	354	354	354
	(B)/(A) %	77	74	93	93	93	93	93	93	93	93	93	93	93
PUSRI - III	Urea Cap.			570	570	570	570	570	570	570	570	570	570	570
	Prod.			332	428	456	513	513	513	513	513	513	513	513
	(B)/(A) %			58	75	80	90	90	90	90	90	90	90	90
PUSRI - IV	Urea Cap.			47	570	570	570	570	570	570	570	570	570	570
	Prod.			54	428	456	513	513	513	513	513	513	513	513
	(B)/(A) %			115	75	80	90	90	90	90	90	90	90	90
P.T. Petrokimia	Urea Cap.	45	45	45	45	45	45	45	45	45	45	45	45	45
	Prod.	13	1	11	14	14	14	14	14	14	14	14	14	14
	(B)/(A) %	30	2	24	30	30	30	30	30	30	30	30	30	30
Aceh (1982/1)	Urea Cap.								570	570	570	570	570	570
	Prod.								427	456	513	513	513	513
	(B)/(A) %								75	80	90	90	90	90
Kujang (1978/8)	Urea Cap.				238	570	570	570	570	570	570	570	570	570
	Prod.				178	439	480	513	513	513	513	513	513	513
	(B)/(A) %				75	77	84	90	90	90	90	90	90	90
Kaltim (1980/10)	Urea Cap.						143	570	570	570	570	570	570	570
	Prod.						107	434	470	513	513	513	513	513
	(B)/(A) %						75	76	83	90	90	90	90	90
Total	Cap.	525	525	1,142	1,903	2,235	2,378	2,805	3,275	3,275	3,275	3,275	3,275	3,275
	Prod.	397	366	833	1,495	1,814	2,075	2,436	2,804	2,875	2,932	2,932	2,932	2,932
Industrial Use		3	3	4	12	13	14	15	16	17	18	19	20	21
Supply Capability		394	363	829	1,483	1,801	2,061	2,421	2,788	2,858	2,914	2,913	2,912	2,911
Demand		676	686	932	1,105	1,257	1,389	1,483	1,565	1,633	1,689	1,732	1,786	1,835
Balance		-282	-323	-103	378	544	672	938	1,223	1,225	1,225	1,181	1,126	1,076

See note of Tab. 1-1-31.

AREA UNDER AGRICULTURAL HOLDINGS, 1960 AND 1971, THE PHILIPPINES

(000 ha)

	Total Area (A)	Area under agricultural holdings (B)	(A)/(B)
1960	30,000	7,772	25.9 %
1971*	30,000	8,494	28.3 %

Note: *Preliminary

Source: Philippine Statistical Yearbook 1977

PERCENT DISTRIBUTION OF GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN, THE PHILIPPINES. (AT CONSTANT PRICES OF 1972)

(%)

	1950	1955	1960	1965	1970	1975
Agriculture, Fishery and Forestry	35.1	33.5	32.4	31.7	31.0	26.6
Manufacturing and Quarrying	16.8	20.1	22.4	21.9	25.0	26.4
Infrastructure	14.0	10.9	8.8	10.1	8.1	11.6
Commerce and Services	34.1	35.5	36.4	36.3	35.9	35.4
Gross Domestic Product	100.0	100.0	100.0	100.0	100.0	100.0

Source: 1950 - 1955: Statistical Report, National Economic Council

1960 - 1975: Philippine Statistical Yearbook, National Economic and Development Authority

ANNEX II
Tab. 1-2-3

GROSS DOMESTIC PRODUCT AND EXPORTS, THE PHILIPPINES (AT CURRENT MARKET PRICES)

	1960				1965				1970				1975			
	Million U.S. dollars	%*	%**	%***	Million U.S. dollars	%*	%**	%***	Million U.S. dollars	%*	%**	%***	Million U.S. dollars	%*	%**	%***
Gross Domestic Product	5,464				6,242				6,323				15,876			
Total Export	560	10.2			768	12.3			1,062	16.8			2,294	14.4		
Coconut Products	179			46.6	270			57.0	209			44.4	466			36.9
Sugar and Sugar Products	143			37.2	147			31.0	196			41.6	616			48.8
Sub-total: Agricultural Products	384		68.6		474		61.7		471		44.4		1,263		55.1	
Exports to U.S.	284		50.7		349		45.4		440		41.4		655		28.6	

Notes: %*: % of GDP
%**: % of Total Export
%***: % of Sub-total

Source: Philippine Statistical Yearbook, National Economic and Development Authority

AVERAGE GROWTH RATE OF GROSS DOMESTIC PRODUCT
BY INDUSTRIAL ORIGIN, THE PHILIPPINES. (AT CONSTANT PRICES OF 1972)

(%)

	1950–55	1955–60	1960–65	1965–70	1970–75
Agriculture, Fishery and Forestry	7.15	6.49	4.31	4.22	2.74
Manufacturing and Quarrying	11.97	9.67	4.31	7.47	6.98
Infrastructure	2.82	2.91	7.47	0.32	13.80
Commerce and Services	9.00	7.78	4.72	4.37	5.61
Gross Domestic Product	8.11	7.26	4.75	4.67	5.88

Source: 1950 - 1955: Statistical Report, National Economic Council
1960 - 1975: Philippine Statistical Yearbook, National Economic and Development Authority

HARVESTED AREA BY MAJOR CROP, THE PHILIPPINES

	1960		1965		1970		1975	
	000 ha	%	000 ha	%	000 ha	%	000 ha	%
Food crops:	6,007.9	79.1	5,995.1	72.7	6,403.4	71.6	8,014.6	69.9
Paddy	3,306.5	43.5	3,199.7	38.8	3,112.4	34.8	3,579.3	31.2
Corn	1,845.5	24.3	1,922.7	23.3	2,419.6	27.1	3,257.0	28.4
Fruit and nuts	342.5	4.5	400.6	4.9	401.5	4.5	456.4	4.0
Root crops	289.1	3.8	273.6	3.3	252.2	2.8	355.5	3.1
All other food crops	224.3	3.0	198.5	2.4	217.7	2.4	366.4	3.2
Commercial crops	1,587.8	20.9	2,256.5	27.3	2,540.9	28.4	3,445.8	30.1
Abaca	175.2	2.3	199.3	2.4	173.1	1.9	244.3	2.1
Coconut	1,059.4	13.9	1,604.7	19.4	1,883.9	21.1	2,521.2	22.0
Sugar Cane (Centrifugal)	204.3	2.7	327.7	4.0	344.0	3.8	533.0	4.7
Sugar Cane (Muscovado and panocha)	37.8	0.5	22.8	0.3	22.1	0.3		
All other food crops	111.1	1.5	102.0	1.2	117.8	1.3	147.3	1.3
Total harvested area	7,595.7	100.0	8,251.6	100.0	8,944.3	100.0	11,460.4	100.0

Source: Bureau of Agricultural Economics

SUPPLY/DEMAND OF NITROGEN FERTILIZER, THE PHILIPPINES

(N000 ton)

	Supply			Demand for Fertilizer
	Domestic production	Import	Total	
1960	7.3	22.1	29.4	
1961	12.2	28.0	40.2	(34.2)*
1962	16.4	16.7	33.1	(34.2)
1963	16.3	13.0	29.3	(37.6)
1964	17.4	32.9	50.3	(41.8)
1965	18.1	27.8	45.9	(43.1)
1966	21.0	12.1	33.1	(51.6)
1967	41.9	34.0	75.9	(61.6)
1968	46.3	29.5	75.8	(69.4)
1969	56.6	-	56.6	(78.8)
1970	48.5	55.5	104.0	(96.1) 107.1
1971	52.4	75.2	127.6	(121.7) 125.4
1972	56.3	77.2	133.5	117.8
1973	55.4	93.9	149.3	153.8
1974	54.6	247.8	302.4	180.4
1975	58.5	53.7	112.2	134.5
1976	58.5	45.8	104.3	156.0
1977	39.6	144.2	183.8	179.5

Note: *Figures in the parenthesis are 3 years moving averages of supply total.

Sources; 1. 1960 - 1969:
F.I.A. Quoted from "Philippine Agriculture in the Last Twenty Years" (NEDA)
2. 1970 - 1977:
F.P.A.

PRODUCTION CAPACITIES AND ACTUAL PRODUCTION OF NITROGEN FERTILIZER BY PRODUCER, THE PHILIPPINES

(Product 000 ton)

Manufacturer	Planters Products						Atlas Fert.					
Product name	Urea			NPK			AS			NPK		
Year	Cap.	Prod.	%	Cap.	Prod.	%	Cap.	Prod.	%	Cap.	Prod.	%
1960										96.4	12.6	13.1
1961										96.4	34.5	35.8
1962										96.4	53.8	55.8
1963										96.4	48.4	50.2
1964										96.4	53.0	55.0
1965										96.4	48.6	50.4
1966	60.0	3.0	5.0	165.0	14.0	8.5	70.0	10.5	15.0	65.0	26.6	40.9
1967	60.0	10.2	17.0	165.0	36.0	21.8	70.0	34.0	48.6	65.0	36.8	56.6
1968	60.0	17.9	29.8	165.0	121.8	73.8	70.0	29.0	41.4	65.0	50.5	77.7
1969	65.0	27.0	41.5	294.0	118.2	40.2	70.0	31.4	44.9	65.0	42.7	65.7
1970	67.5	21.6	32.0	294.0	128.2	43.6	70.0	38.9	55.6	65.0	17.3	26.6
1971	67.5	23.0	34.1	294.0	136.1	46.3	70.0	36.4	52.0	65.0	33.2	51.1
1972	67.5	20.3	30.1	294.0	146.1	49.7	70.0	59.7	85.3	65.0	45.3	69.7
1973	67.5	11.7	17.3	294.0	163.0	55.4	70.0	49.8	71.1	65.0	42.8	65.8
1974	67.5	11.8	17.5	294.0	184.0	62.6	70.0	49.7	71.0	65.0	28.3	43.5
1975	67.5	23.8	35.3	294.0	140.5	47.8	70.0	70.9	101.3	65.0	31.5	48.5
1976	67.5	14.1	20.9	294.0	154.5	52.6	70.0	81.6	116.6	65.0	31.8	48.9
1977	67.5	-	-	294.0	134.7	45.8	70.0	50.2	71.7	65.0	30.6	47.1

Srouces: 1. FIA, quoted from "Philippine Agriculture in the Last Twenty Years" (NEDA)
2. FPA

PRODUCTION CAPACITIES AND ACTUAL PRODUCTION OF NITROGEN FERTILIZER BY PRODUCER, THE PHILIPPINES (CONT'D.)

(Product 000 ton)

Manufacturer	Maria Cristina			Chem. Ind. of Philippine					
Product name	AS			AS			NPK		
Year	Cap.	Prod.	%	Cap.	Prod.	%	Cap.	Prod.	%
1960	59.4	24.5	41.2				9.0	1.0	11.1
1961	59.4	30.1	50.7				9.0	2.3	25.6
1962	59.4	35.5	59.8				9.0	2.0	22.2
1963	59.4	39.1	65.8				9.0	2.4	26.7
1964	59.4	41.2	69.4				9.0	1.1	12.2
1965	59.4	44.4	74.7	30.0	4.3	14.3	9.0	1.0	11.1
1966	50.0	24.9	49.8	30.0	7.0	23.3	12.0	6.0	50.0
1967	50.0	40.4	80.8	54.0	6.0	11.1	12.0	5.0	41.7
1968	50.0	6.6*	13.2	54.0	8.0	14.8	12.0	8.0	66.7
1969	50.0	39.2	78.4	54.0	6.9	12.8	12.0	0.3	2.5
1970	50.0	34.3	68.6	54.0	3.8	7.0	12.0	-	-
1971	50.0	42.2	84.4	54.0	-	-	12.0	-	-
1972	50.0	32.6	65.2	54.0	-	-	12.0	-	-
1973	50.0	40.1	80.2	54.0	-	-	12.0	-	-
1974	50.0	29.8	59.6	54.0	-	-	12.0	-	-
1975	50.0	29.8	59.6	54.0	-	-	12.0	-	-
1976	50.0	17.1	34.2	54.0	-	-	12.0	-	-
1977	50.0	10.1	20.2	54.0	-	-	12.0	-	-

Note: *Production stopped due to prolonged labour strike.

Sources: 1. FIA, quoted from "Philippine Agriculture in the Last Twenty Years" (NEDA)
2. FPA

ACTUAL AND PROJECTED DEMAND FOR UREA AND NITROGEN FERTILIZER, THE PHILIPPINES

ANNEX II
Tab. 1-2-8

	N 000 ton				Urea 000 ton		
	Actual + Study Forecast	TVA	FPA	AFS (1976)	Actual + Study Forecast	FPA	AFS (1976)
1970	107*				122*		
1971	125*	128			159*		
1972	118*	139			133*		
1973	154*	149			153*		
1974	180*	161			212*		
1975	135*	172			144*		
1976	156*	184		156	175*		186
1977	180*	196	176	173	228*	226	226
1978	194	209	194	193	236	255	272
1979	208	223	213	212	245	287	314
1980	221	238	235	233	256	323	359
1981	233		258	257	270	362	407
1982	245		284	282	284	407	456
1983	257		313	310	298	456	511
1984	269		344	342	313	510	572
1985	280		378	375	329	571	638
1986	292				344		
1987	304				358		
1988	316				374		
1989	327				387		
1990	339				402		

Sources: TVA: TVA, "The Fertilizer Industry in the Philippines", (1971)

FPA: Provided by the Fertilizer & Pesticide Authority, the Philippines

AFS: Agrar-Und Hydrotechnik Gmbh, "Fertilizer Market Study, ASEAN Region", (1976)

Note: *: Actual

ANNEX II
Tab. 1-2-9

PLANTED AREA OF PALAY, ACTUAL AND PROJECTED, THE PHILIPPINES

(000 ha)

	Actual								Projected		
	1970	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Wet Land Palay Planted Area in:											
A. Irrigated Area	1,346	1,470	1,332	1,241	1,494	1,412	1,494	1,490	1,551	1,696	1,849
(a) in Wet season	791	840	745	734	904	812	854	874	901	965	1,034
(b) in Dry season	555	630	587	507	590	600	640	616	650	731	815
(Double Cropping ratio: (b)/(a)) (%)	70.1	75.0	78.8	69.0	65.3	73.9	74.9	70.5	72.2	75.7	78.8
of which:											
(a') HYV	827	985	977	873	1,195	1,109	1,207		1,388	1,611	1,806
(b') Other varieties	519	485	355	368	299	303	287		163	85	43
(HYV Planting ratio: (a')/(A)) (%)	61.4	67.0	73.3	70.3	80.0	78.6	80.8		89.5	95.0	97.7
B. Non-irrigated Area	1,356	1,278	1,548	1,436	1,534	1,674	1,695	1,658	1,615	1,624	1,597
(a) in Wet season	979	876	1,038	1,057	1,073	1,139	1,152	1,114	1,118	1,097	1,071
(b) in Dry season	377	402	510	379	461	535	543	544	497	527	526
(Double Cropping ratio: (b)/(a)) (%)	38.5	45.9	49.1	35.8	42.9	47.0	47.1	48.8	44.4	48.0	49.1
of which:											
(a') HYV	527	581	850	807	982	1,066	1,093		1,315	1,486	1,538
(b') Other varieties	828	697	698	629	552	608	602		300	138	59
(HYV Planting ratio: (a')/(B)) (%)	38.9	45.4	54.9	56.2	64.0	63.7	64.5		81.4	91.5	96.3
C. Total											
(a) Net planted area: (A·a)+(B·a)	1,770	1,716	1,783	1,791	1,977	1,951	2,006	1,988	2,019	2,062	2,105
(b) Gross planted area: (A)+(B)	2,702	2,748	2,880	2,677	3,028	3,086	3,189	3,148	3,166	3,320	3,446
(Irrigated ratio: (A·a)/(C·a)) (%)	44.7	49.0	41.8	41.0	45.7	41.6	42.6	44.0	44.6	46.8	49.1
Gross Upland Palay Planted Area (D)	412	365	366	434	409	453	390	400	426	442	459
Grand Total: (C·b)+(D)	3,114	3,113	3,246	3,111	3,437	3,539	3,579	3,548	3,592	3,762	3,905

Source: Actual: Bureau of Agricultural Economics

ESTIMATED NITROGEN FERTILIZER DOSAGE AND FERTILIZED AREA RATIO, PALAY, THE PHILIPPINES

	1970			1972			1975		
	Dosage (N kg/ha)	Ferti-lized Area Ratio (%)	Average Dosage on Planted Area (N kg/ha)	Dosage (N kg/ha)	Ferti-lized Area Ratio (%)	Average Dosage on Planted Area (N kg/ha)	Dosage (N kg/ha)	Ferti-lized Area Ratio (%)	Average Dosage on Planted Area (N kg/ha)
HYV in irrigated area	36	100	36	35	100	35	43	100	43
LV in irrigated area	23	40	9.2	23	63	14.5	23	80	18.4
HYV in non-irrigated area	-	-	-	14	20	2.8	14	40	5.6
LV in non-irrigated area	-	-	-	14	10	1.4	14	20	2.8

ANNEX II
Tab. 1-2-11

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, PALAY, THE PHILIPPINES

	Actual or Estimated								Projected		
	1970	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
HYV in Irrigated Area											
A. Planted Area (000 ha)	827	985	977	873	1,195	1,109	1,207	1,253	1,388	1,611	1,806
B. Dosage (N kg/ha) (Potential Dosage = 65.5 N kg/ha)	36.0	37.4	38.9	40.3	41.7	43.0	44.3	45.6	49.1	54.0	57.6
C. Actual/Projected Demand (N 000 t)	29.8	36.8	38.0	35.2	49.8	47.7	53.5	57.1	68.2	87.0	104.0
Other Varieties in Irrigated Area											
A. Planted Area (000 ha)	519	486	355	368	299	303	287	237	163	85	43
B. Dosage (N kg/ha) (Potential Dosage = 23.0 N kg/ha)	9.2		14.5	15.6	17.2	13.7	15.6	17.2	20.6	22.5	22.9
C. Actual/Projected Demand (N 000 t)	4.8	5.0	5.1	5.7	5.1	4.2	4.5	4.1	3.4	1.9	1.0
HYV in Non-irrigated Area											
A. Planted Area (000 ha)	527	580	850	807	982	1,066	1,092	1,192	1,315	1,486	1,538
B. Dosage (N kg/ha) (Potential Dosage = 11.2 N kg/ha)	0	0	2.8	3.6	4.6	2.8	3.6	4.6	7.6	10.4	11.1
C. Actual/Projected Demand (N 000 t)	0	0	2.4	2.9	4.5	3.0	3.9	5.5	10.0	15.5	17.1
Other Varieties in Non-irrigated Area											
A. Planted Area (000 ha)	828	697	698	629	552	608	602	466	300	138	59
B. Dosage (N kg/ha) (Potential Dosage = 8.4 N kg/ha)	0	0	1.4	1.8	2.3	1.4	1.8	2.3	4.1	6.7	8.1
C. Actual/Projected Demand (N 000 t)	0	0	1.0	1.1	1.3	0.9	1.1	1.1	1.2	1.0	0.5
Total											
Actual/Projected Demand (N 000 t)	34.6	41.8	46.5	44.9	60.7	55.8	63.0	67.8	82.8	105.4	122.6

Notes: 1. As for the planted area, see Tab. 1-2-9.
2. (C) = (A) x (B)

STUDY PROJECTION AND 5/10 YEAR PLAN TARGET ON PALAY PRODUCTION IN 1982 AND 1987, THE PHILIPPINES

	1982			1987		
	5 Year Plan Target	Study Projection		10 Year Plan Target	Study Projection	
		Mod. Case	High Case		Mod. Case	High Case
- Area Harvested (000 ha)						
Irrigated						
HYV	1,932	1,477	1,741	2,541	1,689	2,056
Traditional	145	132	154	-	68	82
Other Areas						
HYV	1,035	1,446	1,151	844	1,596	1,239
Traditional	557	678	629	362	561	535
Total	3,670	3,733	3,675	3,748	3,914	3,912
- Yield (ton/ha)						
Irrigated						
HYV	2.71	2.29	2.31	3.09	2.34	2.38
Traditional	2.32	1.96	2.04	-	1.98	2.16
Other Areas						
HYV	1.71	1.59	1.60	1.87	1.63	1.68
Traditional	1.19	1.42	1.42	1.22	1.45	1.45
- Production (000 t)						
Palay	7,999	6,903	7,071	9,870	7,501	7,928
Rice equivalent	5,119	4,418	4,525	6,514	4,951	5,232
- Domestic Demand (000 t)						
Rice	4,640	4,640	4,640	5,350	5,350	5,350

Source: 5/10 Year Plan Target: "Five-Year Philippine Development Plan, 1978-1982"

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, PALAY, THE PHILIPPINES HIGH CASE AND LOW CASE

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
HYV in Irrigated Area						
A. Planted Area (000 ha)	1,612	1,934	2,239	1,388	1,579	1,739
B. Dosage (N kg/ha)	49.8	56.7	63.6	49.1	54.0	57.6
C. Projected Demand (N 000 t)	80.3	109.7	142.4	68.2	85.3	100.2
Other Varieties in Irrigated Area						
A. Planted Area (000 ha)	189	102	53	163	83	41
B. Dosage (N kg/ha)	23.6	33.6	43.6	20.6	22.5	22.9
C. Projected Demand (N 000 t)	4.5	3.4	2.3	3.4	1.9	0.9
HYV in Non-irrigated Area						
A. Planted Area (000 ha)	1,103	1,223	1,182	1,315	1,450	1,490
B. Dosage (N kg/ha)	7.6	11.8	16.3	7.6	10.4	11.1
C. Projected Demand (N 000 t)	8.4	14.4	19.3	10.0	15.1	16.5
Other Varieties in Non-irrigated Area						
A. Planted Area (000 ha)	252	114	45	300	134	57
B. Dosage (N kg/ha)	4.1	6.7	8.1	4.1	6.7	8.1
C. Projected Demand (N 000 t)	1.0	0.8	0.4	1.2	0.9	0.5
Total						
Projected Demand (N 000 t)	94.2	128.3	164.4	82.8	103.2	118.1

See note of Tab. 1-2-11.

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, CORN, THE PHILIPPINES

	Actual or Estimated								Projected		
	1970	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Program Farmers											
A. Planted Area (000 ha)	0	0	0	0	138	368	423	446	598	892	1,234
B. Dosage (N kg/ha)	0	0	0	0	47.0	47.0	47.0	47.0	47.0	47.0	47.0
C. Actual/Projected Demand (N 000 t)	0	0	0	0	6.5	17.3	19.9	21.0	28.1	41.9	58.0
Non-program Farmers											
A. Planted Area (000 ha)	2,420	2,392	2,432	2,235	2,625	2,695	2,834	2,738	2,921	3,163	3,336
B. Fertilized Area Ratio (%)	27.0	28.2	29.4	30.6	31.8	29.4	30.4	32.4	35.7	41.7	47.0
C. Dosage (N kg/ha)	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
D. Actual/Projected Demand (N 000 t)	15.0	15.5	16.5	16.3	19.2	18.2	19.8	20.4	24.0	30.3	36.1
Total											
Actual/Projected Demand (N 000 t)	15.0	15.5	16.5	16.3	25.7	35.5	39.7	41.4	52.1	72.2	94.1

Notes: 1. Program Farmers: (C) = (A) x (B)
2. Non-program Farmers: (D) = (A) x $\frac{(B)}{100}$ x (C)

Source: Planted area: Bureau of Agricultural Economics

ANNEX II
Tab. 1-2-15

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, SUGAR CANE AND COCONUT, THE PHILIPPINES

	Actual or Estimated								Projected		
	1970	1971	1972	1973	1974	1975	1976	1977	1980	1985	1990
Sugar Cane											
A. Planted Area (000 ha)	366	442	447	455	491	536	533		497	572	642
B. Fertilized Area Ratio (%)	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0	93.0
C. Dosage (N kg/ha)	132.6	131.6	130.0	133.8	125.4	102.5	103.8		127.5	127.5	127.5
D. Actual/Projected Demand (N 000 t)	45.1	54.1	54.0	56.6	57.3	51.1	51.5		58.9	67.8	76.1
Coconut											
A. Planted Area (000 ha)	1,884	2,049	2,126	2,133	2,206	2,280	2,521		2,652	2,978	3,299
B. Dosage (N kg/ha) (Potential Dosage = 54.0 N kg/ha)	1.0	1.1	1.2	1.5	1.6	1.1	1.2		1.2	1.9	2.8
C. Actual/Projected Demand (N 000 t)	1.9	2.2	2.6	3.1	3.6	2.6	3.1	3.6	3.2	5.6	9.4
Total											
Actual/Projected Demand (N 000 t)	47.0	56.3	56.6	59.7	60.9	53.7	54.6		62.1	73.4	85.5

Notes: 1. Sugar Cane: $(D) = (A) \times \frac{(B)}{100} \times (C)$
2. Coconut: $(C) = (A) \times (B)$

Source: Planted area: Bureau of Agricultural Economics

FORECAST ON DEMAND FOR NITROGEN FERTILIZER, SUGAR CANE, THE PHILIPPINES
HIGH CASE AND LOW CASE

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
Planted Area (000 ha)	497	572	642	497	572	642
Fertilized Area Ratio (%)	93.0	93.0	93.0	93.0	93.0	93.0
Dosage (N kg/ha)	132.0	132.0	132.0	115.4	115.4	115.4
Projected Demand (N 000 t)	61.0	70.2	78.8	53.3	61.4	68.9

See note of Tab. 1-2-15.

SUMMARY OF DEMAND FORECAST ON NITROGEN FERTILIZER, THE PHILIPPINES

(N 000 ton)

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

For notes of this table, see notes of Tab. 1-1-25.

SUMMARY OF DEMAND FORECAST ON NITROGEN FERTILIZER, THE PHILIPPINES HIGH CASE AND LOW CASE

(N 000 ton)

	High Case			Low Case		
	1980	1985	1990	1980	1985	1990
Food Crop						
Rice: Irrigated HYV	80.3	109.7	142.4	68.2	85.3	100.2
Irrigated LV	4.5	3.4	2.3	3.4	1.9	0.9
Non-irrigated HYV	8.4	14.4	19.3	10.0	15.1	16.5
Non-irrigated LV	1.0	0.8	0.4	1.2	0.9	0.5
Corn	52.1	72.2	94.1	52.1	72.2	94.1
Vegetables	8.9	10.5	12.4	8.9	10:5	12.4
Sub-total	155.2	211.0	270.9	143.8	185.9	224.6
Export Crop						
Sugar Cane	61.0	70.2	78.8	53.3	61.4	68.9
Coconut	3.2	5.6	9.4	3.2	5.6	9.4
Pineapple, Tobacco, Banana, Others	14.9	18.9	24.0	14.9	18.9	24.0
Sub-total	79.1	94.7	112.2	71.4	85.9	102.3
Grand Total	234.3	305.7	383.1	215.2	271.8	326.9

ANNEX II
Tab. 1-2-19

CONSUMPTION OF UREA IN THE PHILIPPINES

(N 000 ton)

	1970	1971	1972	1973	1974	1975	1976	1977
Food Crop Sector								
Consumption of Total Nitrogen Fertilizer				81.1	95.1	80.3		
of which: Urea				33.7	52.2	39.2		
(% of Total Nitrogen Fertilizer)				41.6	54.9	48.8		
Export Crop Sector								
Consumption of Total Nitrogen Fertilizer				73.4	85.6	54.5		
of which: Urea				36.7	45.4	27.0		
(% of Total Nitrogen Fertilizer)				50.0	53.0	49.5		
Total								
Consumption of Total Nitrogen Fertilizer	107.1	125.4	117.8	153.8	180.4	134.5	156.0	179.5
of which: Urea	55.9	73.1	61.0	70.4	97.6	66.2	80.4	104.8
(% of Total Nitrogen Fertilizer)	52.2	58.3	51.8	45.8	54.1	49.2	51.5	58.4

Source: FPA