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held in
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Report of the CENTO Ad Hoc Working Party on Fertilizers

held in Islamabad, Pakistan
September 24-27, 1968

CENTRAL TREATY ORGANIZATION
(CENTO)

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FOREWORD

This book reports the proceedings and conclusions of the CENTO Ad Hoc Working Party on Fertilizers held in Islamabad, Pakistan September 24-27, 1968, and presents the background papers prepared for the meeting on the fertilizer situation in each of the three countries of the CENTO region.

The basic papers on Iran, Pakistan and Turkey were prepared by Mr. John M. Hill and Mr. Leonard H. Rhodes, Agricultural and Economic Advisers at the U.S. AID Mission to Turkey following a survey of fertilizer production and consumption in the CENTO region sponsored by the Office of the U.S. Economic Coordinator for CENTO Affairs.

The Ad Hoc Working Party on Fertilizers was held with the object of bringing experts together from each of the five CENTO countries to estimate the CENTO intra-regional fertilizer supply and demand requirements through 1980 together with the related capital and raw material needs; investigate the possibility of intra-regional trade in fertilizers and related materials; investigate the individual distribution systems; and devise uniform standards, specifications, labelling, analyses, and bagging.

Throughout the meeting, great stress was placed on the importance of foreign exchange costs as a determinant of the importation of fertilizers and related materials versus domestic plant construction for domestic production. Full attention was paid to the complex economic decisions which must be reached in relation to the effects on capital investment of possible outside soft-term loans and possible foreign exchange earnings from exports of agricultural surpluses arising from the use of fertilizers on improved high-yielding grain and other seeds.

In relation to intra-regional trade and fertilizer use, an analysis was made of the relative strengths and weaknesses of the fertilizer distribution system within the individual CENTO regional countries.

Finally, the Working Party recommended another Working Party Meeting late in 1969 after the main FAO Conference to be held at that time, in order to benefit from the findings of that Conference and, in the interim, to update and improve its present forecasts of fertilizer production, import needs and capital requirements.

WELCOME ADDRESS

By
Mr. M. Yamin Qureshi, S.K., G.A.R.,
Joint Secretary to the Government of Pakistan,
Ministry of Agriculture and
Leader of the Pakistan Delegation

My delegation takes this opportunity to thank the CENTO authorities for organizing this meeting on a subject which is of vital importance to the member countries of the region from the point of view of increased agricultural production. The problem of providing food to an ever-increasing population is a world problem. Increasing food production as quickly as possible is an urgent task that demands priority effort. In the words of our President, Field Marshal Mohammad Ayub Khan, "Our agriculture was not, and still is not modern and unless a country's agriculture is put right and people are given the full and necessary ingredients of healthy life they cannot carry through other forms or measures of progress."

Pakistan, like other developing countries, is trying to meet the challenge of not only feeding her own teeming millions but also of producing surplus food. Under the orders of our President, the Government of Pakistan has been following a policy of revolutionizing our agricultural development. Agriculture has been accorded first priority after Defence and all efforts are directed towards maximizing agricultural production and achieving self-sufficiency in food by the end of 1969-70. During 1967-68, this policy has borne encouraging results and Pakistan has been able to achieve a real breakthrough in agricultural production which has surpassed all previous records of production. Wheat production increased from 4.3 million tons in 1966-67 to 6.3 million tons in 1967-68 - an increase of 46.5 percent. Rice production increased from 10.77 million tons in 1966-67 to 12.47 million tons -an increase of 15.6 percent. Maize production increased from 0.581 million tons to 0.782 million tons - an increase of 34.6 percent. Jute production increased from 6.40 to 6.85 million bales - an increase of 7 percent. Cotton production increased from 2.62 to 2.90 million bales - an increase of 10.6 percent. The production of tea increased from 63 to 64.5 million pounds - an increase of 2.4 percent.

It has been possible to achieve this heartening progress with the application of agricultural inputs, of which fertilizer is an important one. Extensive experiments in the country have shown that increased and judicious use of fertilizers is one of the quickest and, perhaps, the cheapest means of increasing agricultural production. With intensive educational campaigns through demonstration and other means, subsidizing the sale of fertilizers, improvement in the system of distribution, and provision of credit facilities to the farmer, the consumption of fertilizer increased to 289,000 nutrient tons in 1967-68 from 136,000 nutrient tons in 1965-66 and 185,000 nutrient tons in 1966-67. This gives an annual rate of increase of 40.6 percent during the last two years. The targets of consumption for 1968-69 and 1969-70 are 510,000 and 720,000 nutrient tons respectively.

The rapid increase in the consumption of fertilizers has been mainly due to the subsidy allowed by the government. It is over 50 percent in East Pakistan and 35 percent in West Pakistan.

To streamline the supply of fertilizers to the farmers, the distribution work has also been entrusted to private firms such as ESSO, Pakistan National Oils and Dawood Corporation in West Pakistan in addition to the Rural Supply Services Cooperatives and the commission agents appointed by the West Pakistan Agricultural Development Corporation. In East Pakistan, the Agricultural Development Corporation has appointed about 15,000 commission agents at the village level throughout the Province to distribute fertilizers.

At present about 25 percent of the fertilizers required is met from local production and the balance is imported. The annual requirements of foreign exchange are estimated at 90 to 100 million dollars; and these requirements are likely to increase in the coming years. This is a heavy drain on the government's foreign exchange resources. The requirements are either met through credit or barter. Difficulties have been experienced in the past in the timely availability of foreign exchange.

To reduce dependence on foreign assistance and the strain on foreign exchange resources, steps have been taken to step up local production of fertilizers. Not only expansion of the existing factories has been allowed but additional new plants have been sanctioned recently. It is hoped that in the near future the country will become self-sufficient in nitrogenous fertilizers.

The Agricultural Development Bank has also simplified its procedures to provide credit to the farmers on easy terms. Efforts are being made to meet the credit requirements of the farmers to the maximum extent. In addition, credit for fertilizers is also being

extended to the farmers by the cooperatives and by government as taccavi loans.

At present mostly nitrogenous fertilizers are applied to the crops. Experiments have shown that with the application of balanced fertilizers, the production can be increased very considerably. An extensive campaign has been launched to educate the farmers to the advantages of application of balanced fertilizers in proper ratio. Efforts are being made to bring about the ratio of 2:1 in the use of nitrogenous and phosphatic fertilizers. Studies and soil tests are also being carried out to determine the exact extent of requirements of different nutrients so that the farmer is advised about the correct types and combinations of various fertilizers. Use of compound fertilizers is being encouraged to provide the required nutrients to the soil. Research on crop responses to different types of fertilizers with different combinations under different conditions is also being carried out.

It will be observed that within the limited resources available, Pakistan is making every effort to increase the production and consumption of fertilizers which in turn affects the agricultural production.

My delegation is eagerly looking forward to hearing the experiences of other participating countries in this field and to have the benefit of the views of experts on these important problems.

FERTILIZER PROGRESS IN THE ASIAN CENTO COUNTRIES

By
Frank M. Kennedy
Division of Chemical Development
Tennessee Valley Authority
Muscle Shoals, Alabama

INTRODUCTION

The Central Treaty Organization of the Middle East (CENTO) comprises Turkey, Iran, Pakistan, and the United Kingdom, with United States having various participations. This report is concerned with fertilizer aspects of the three Asian CENTO countries which span about 4,400 miles from Western Turkey to East Pakistan. They have a combined population of 170 million.

As far as tonnage is concerned, the fertilizer industry has just begun in the Asian CENTO countries. Fertilizer consumption has increased tenfold in the last ten years, but it still amounts to less than one percent of the world total. However, tonnages have now reached a level where the continuation of past growth percentages would mean massive additions in cost and effort. Some of these additions are underway. Low dietary levels in the Asian CENTO countries and relatively low fertilizer use make a strong case for attempting to continue this progress.

This report deals with the fertilizer progress which has been made and outlines some of the dimensions of the job of additional uplift. For consistency, FAO data are used for consumption, production, and trade.

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FERTILIZER CONSUMPTION

The overall growth of fertilizer consumption in the Asian CENTO countries (Figure 1) is striking in both rate and similarity among the three areas. For approximately the past decade, each of the member countries, and hence the group, has increased consumption at 26 to 27 percent per year. This means a tenfold expansion in this short space of time.

Pakistan and Turkey have used about the same tonnages, each accounting for 44 to 45 percent of the group total, whereas Iran, with the smallest population, has averaged about 11 percent of the total.

In Figure 2 the same Asian CENTO consumption is subdivided according to plant nutrient. In recent years, about two-thirds of the fertilizer nutrients have been as nitrogen, about 30 percent as phosphate, and less than 5 percent as potash. The wide range of the data makes the small values not clear and it is helpful to look at the

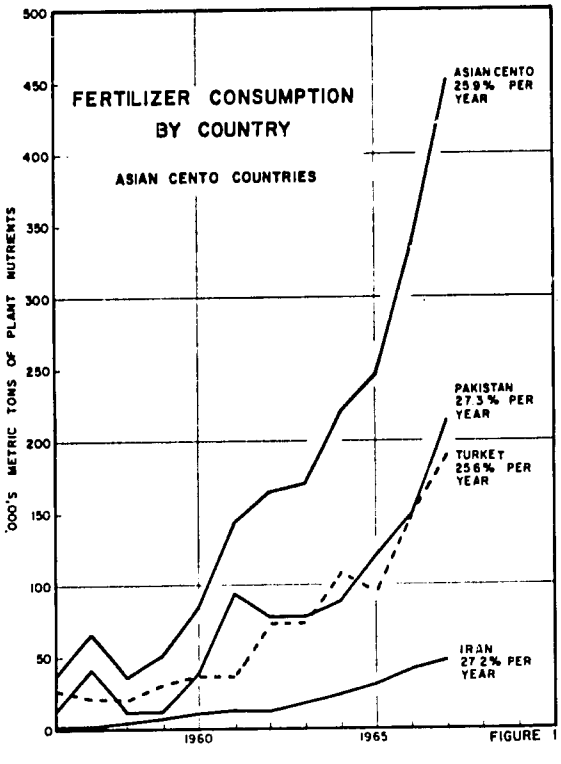


FIGURE 1

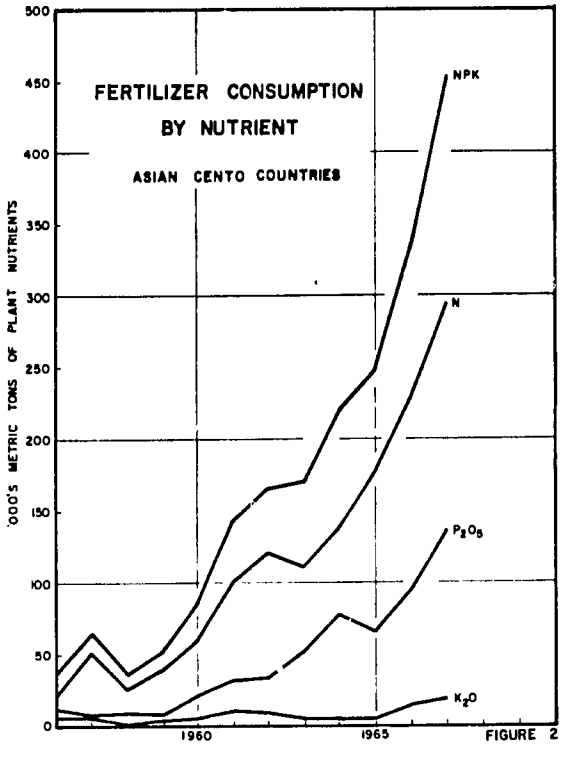


FIGURE 2

same distribution on logarithmic scale (Figure 3). This type of plotting not only shows the high and low values with equal clarity it provides a direct indication of growth rate, such as percent per year. A straight line means constant growth rate and its steepness indicates unit percentage per year.

This plotting shows that nitrogen and total nutrients have been generally parallel throughout the years, meaning that they have increased at about the same percentage per year. The similarity is to be expected because nitrogen is the bulk of the NPK tonnage. Phosphate has been roughly parallel since about 1960, and potash has been independent of the other nutrients and at a much lower level.

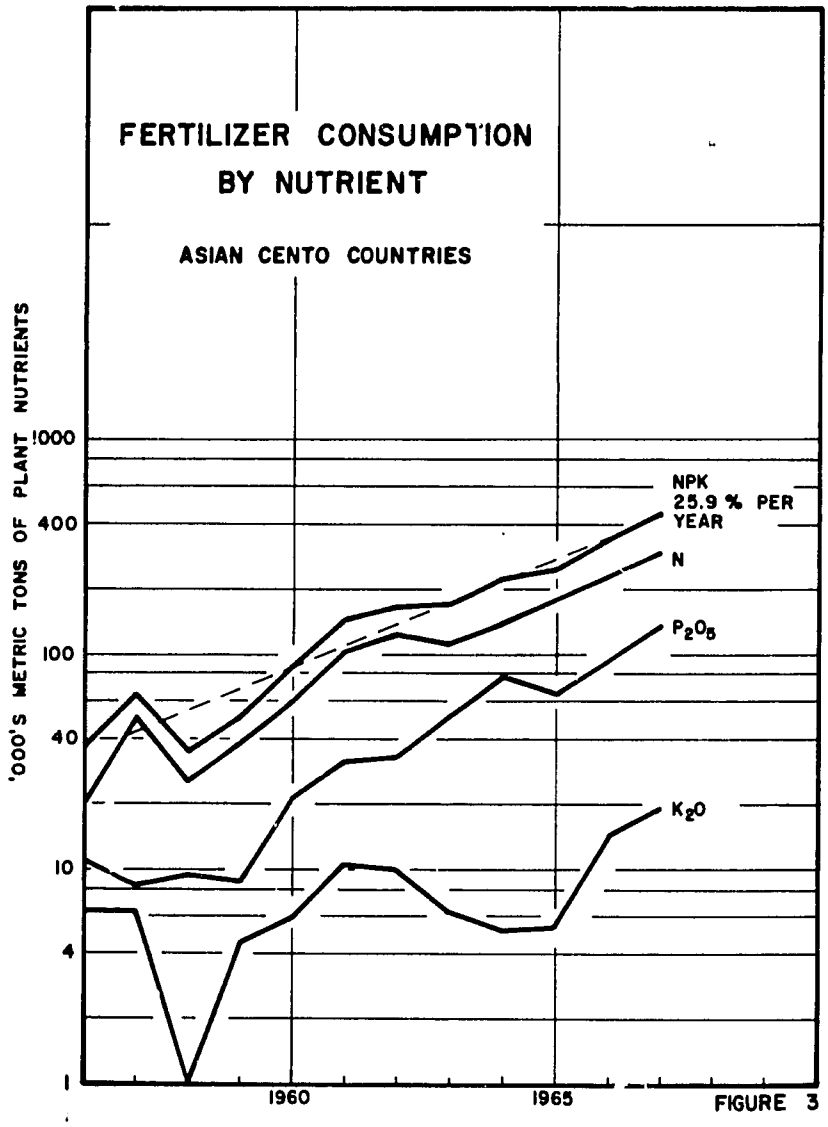


FIGURE 3

Figures 4, 5, and 6 are similar portrayals for Iran, Pakistan, and Turkey, individually. The mixes of nitrogen, phosphate, and potash vary considerably among them. Except for the last two years, Iran has used roughly equal tonnages of nitrogen and phosphate. One-third to one-half of the nitrogen has been as urea and most of the phosphate has been as concentrated superphosphate. Potash has been much lower and since 1962, almost constant.

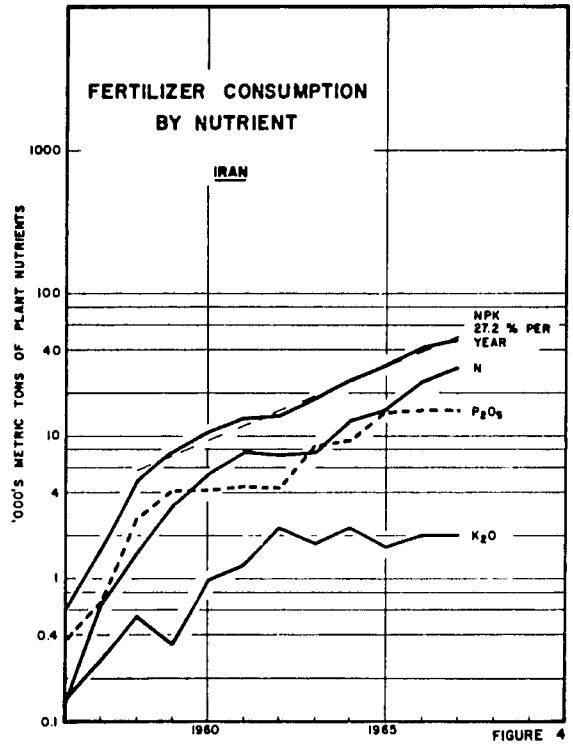
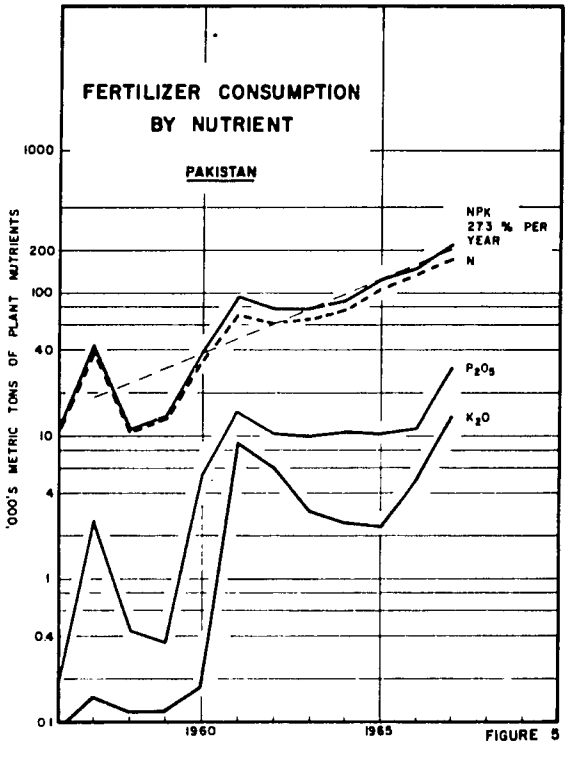


FIGURE 4



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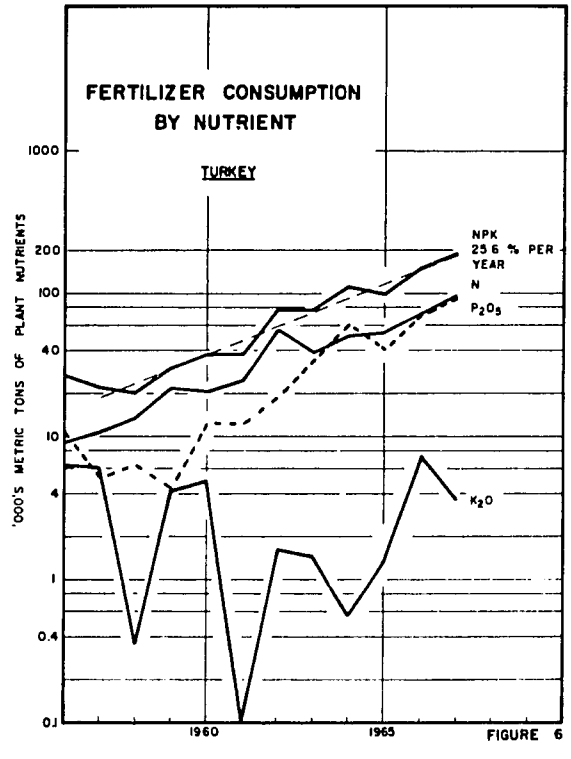


FIGURE 6

On the other hand, Pakistan has consistently emphasized nitrogen, more than half of which is now urea. Phosphate as concentrated superphosphate and potash as muriate rose to significance in 1960-61, but they have not had growth patterns since that time. Turkey is unusual in having had consumption of phosphate increase faster than consumption of nitrogen, so that the two have been at essentially equal tonnages since 1963. The expanded phosphate consumption was provided by increased production of single supersphosphate and by recent importing of concentrated superphosphate. Turkey's potash consumption tonnages have been low and highly variable.

FERTILIZER CONSUMPTION PER CAPITA

Comparing fertilizer consumptions on a per capita basis eliminates one large difference among countries, that of population. For example, in Figure 1, it would be an incomplete comparison to note that Pakistan and Turkey consume approximately the same fertilizer tonnage without also noting that Pakistan's population (and hence its food responsibility) is more than three times that of Turkey.

To allow for the effect of population, each of the tonnages of Figure 1 (fertilizer consumption by countries) was divided by the appropriate population. The resulting values of metric tons per capita were multiplied by 1000 to convert to kilograms per capita, a more convenient size unit. These fertilizer consumptions as kilograms per capita are given in Figure 7 for the three countries and for their group combination. They show Iran and Pakistan as almost identical for the past give years; Turkey is subtantially a higher level.

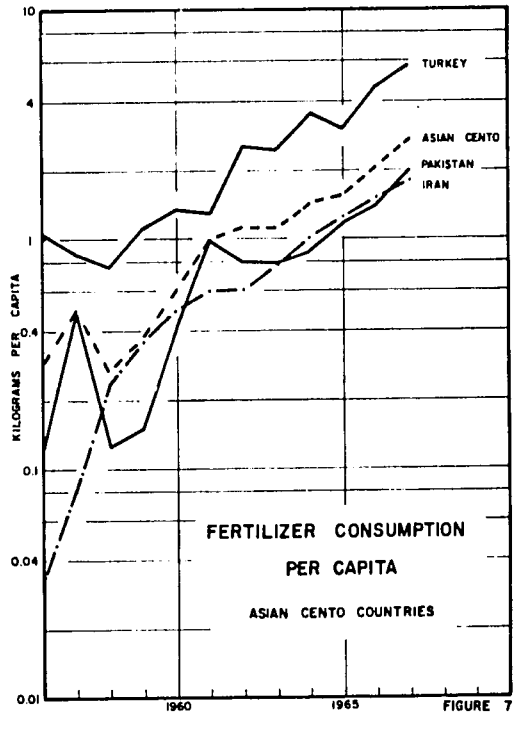
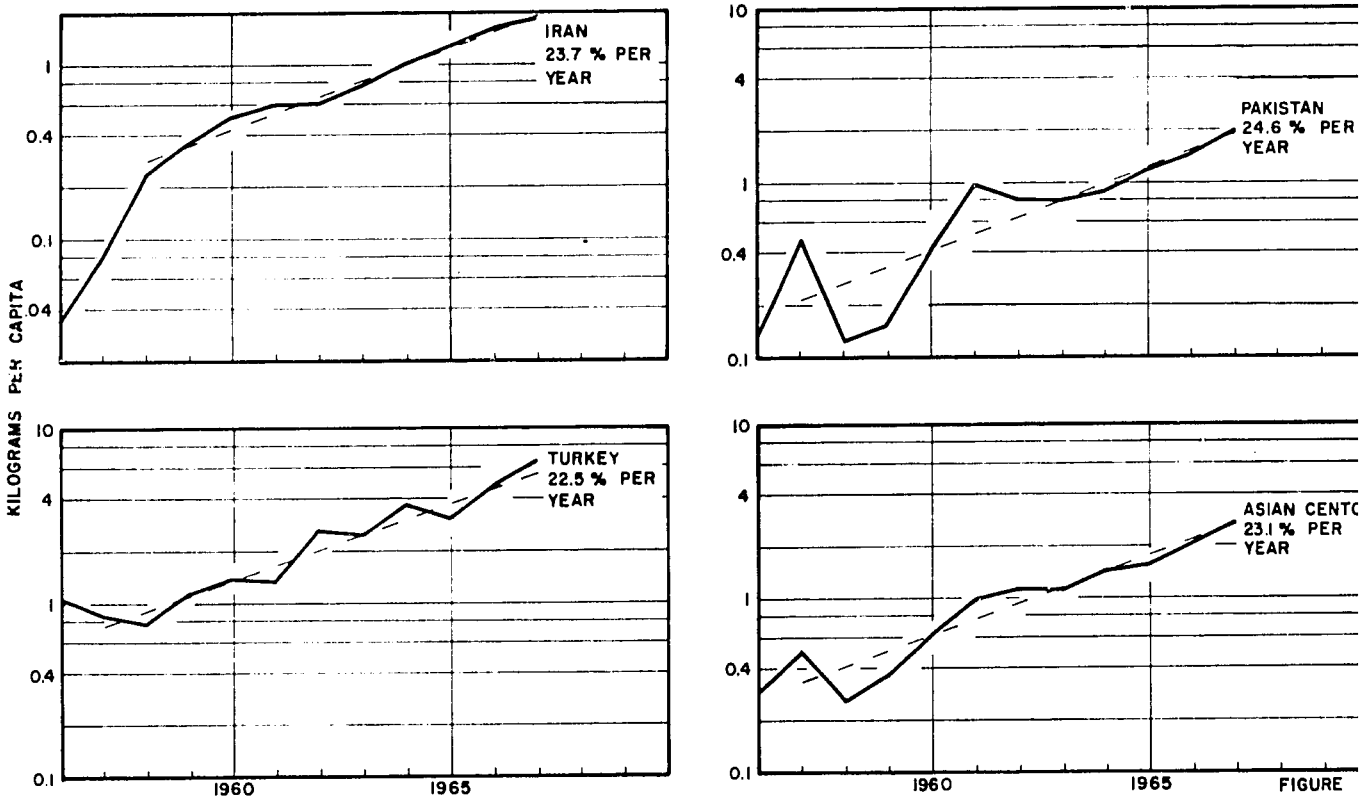


FIGURE 7

Because of the interference from overlapping, the graphs of Figure 7 are shown individually in Figure 8, each with its representative trend line. The percentage increases in fertilizer consumption per capita are inherently somewhat lower than those for tonnage consumption, because of population increases. Consumptions per capita have trended upward at 23 to 25 percent per year against 26 to 27 percent per year for tonnage rise. Both growth rates are phenomenally high but their effect has been that of catching up with other developing countries rather than exceeding their average.

FERTILIZER CONSUMPTION PER CAPITA

ASIAN CENTO COUNTRIES



FIGURE

The Asian CENTO countries' fertilizer consumption per capita is compared with that of other regions of the world in Figure 9. By 1967, the Asian CENTO group was at about 75 percent of the level of the developing countries of the world, which includes the CENTO three. At present rates of growth (14.7 percent per year for developing countries, 23.1 per year for Asian CENTO countries), the CENTO group would equal the total developing group by about 1971.

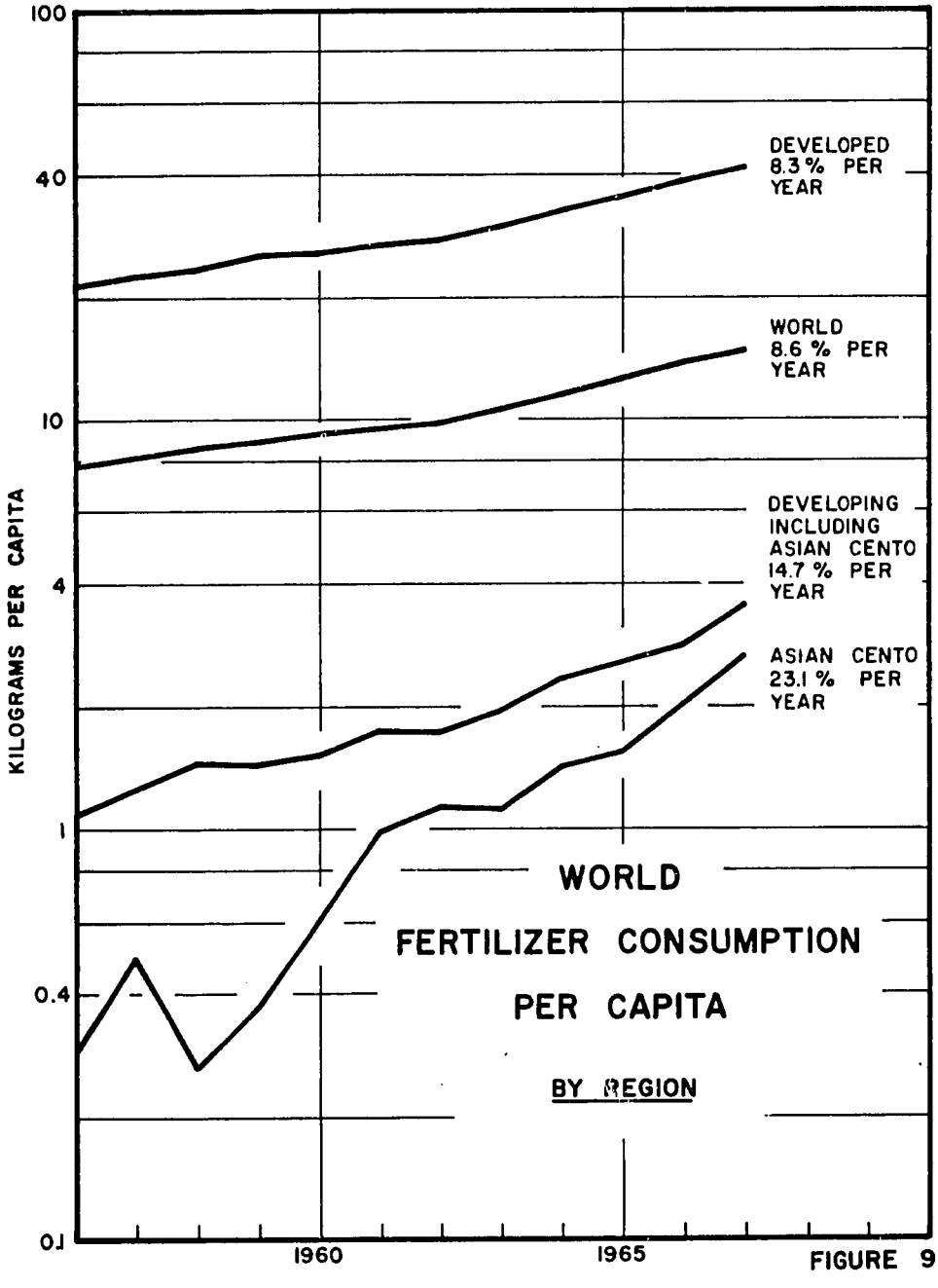


FIGURE 9

POPULATION TRENDS IN THE ASIAN CENTO COUNTRIES

The populations of the Asian CENTO countries are of special importance because their rapid rises lead to rapidly increasing food requirements. In Table 1, the population data of the Asian CENTO members are projected to 1980. These projections are based on the unusually consistent growth rates which preceded 1966. In Table 2, the population increases beyond 1967 are expressed as a percentage of the 1967 populations. This means that in 1975 the population of the Asian CENTO countries will be 20 percent greater than in 1967, and the tonnage of food will need to be 20 percent greater than in 1967 to maintain the same dietary levels. By 1980 the increase will be 34.5 percent.

Figure 10 shows the graphical appearance of the percentge increases given in Table 2.

TABLE 1
PROJECTED POPULATIONS OF ASIAN CENTO COUNTRIES
(millions of people)

	Iran	Pakistan	Turkey	Asian CENTO
Increase percent per yr.	2.74	2.11	2.60	2.31
1966 (actual)	25.50	105.04	32.12	162.66
1967(estimated)	26.1	107.3	33.0	166.4
1968	26.8	109.5	33.9	170.2
1970	28.3	114.2	35.7	178.2
1972	29.9	119.1	37.5	186.5
1975	32.4	126.7	40.6	199.7
1980	37.0	140.7	46.1	223.8

TABLE 2
POPULATION GROWTH IN THE ASIAN CENTO COUNTRIES
(percentage increase above 1967)

	Iran	Pakistan	Turkey	Asian CENTO
1968	2.7	2.1	2.6	2.3
1970	8.4	6.5	8.0	7.1
1972	14.5	11.0	13.7	12.1
1975	24.1	18.2	22.8	20.0
1980	41.8	31.1	39.6	34.5

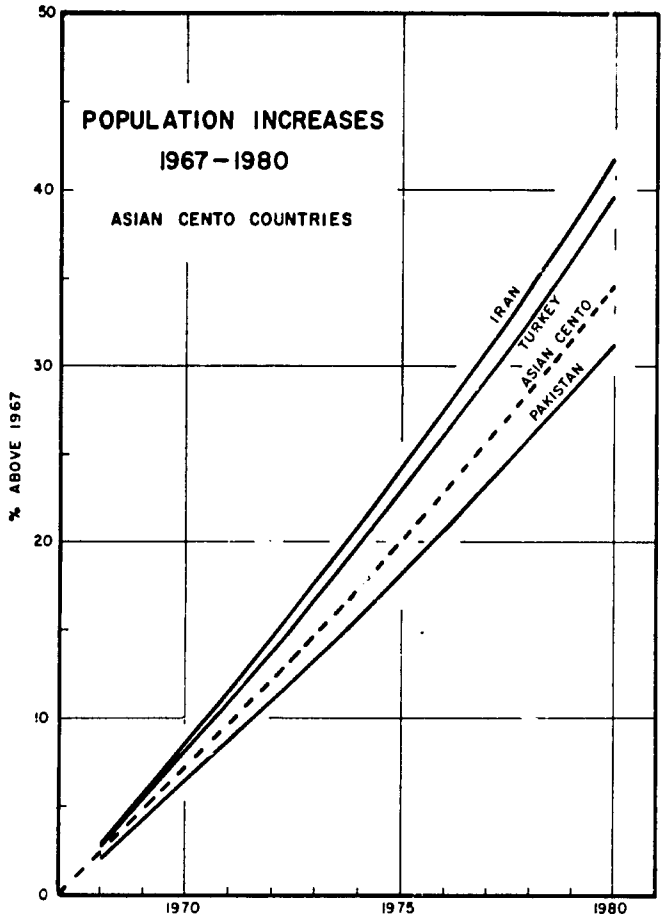


FIGURE 10

FERTILIZER PRODUCTION

Except for single superphosphate production in Turkey, commercial fertilizer production in the Asian CENTO countries is only five to ten years old. With the same exception, the production pertains to nitrogen only, as shown in Table 3.

TABLE 3
THE RECENT BEGINNING OF FERTILIZER PRODUCTION
IN THE ASIAN CENTO COUNTRIES

	Iran	Pakistan	Turkey
N	Started 1964, now 80% of consumption.	Started 1958, now above 50% of consumption.	Commercial 1961, now one-third of consumption.
P_2O_5	-	Started 1957	Supplied small consumption until 1961.
K_2O		-	-

It is worthwhile to look at the production levels in relation to consumption and the consumption-less-production deficit which approximates imports. Figure 11 shows that for the Asian CENTO group, production increases slowed after 1963 or 1964 while consumption continued its rapid growth. The difference rose quickly from 50,000 to 250,000 metric tons per year.

The same pattern of very sharply rising import needs applies with variations to each of the three countries. Figure 12 shows Iran's production as rising steadily but not rising as fast as consumption; its import need is growing at a roughly constant rate of 2,000 to 2,500 metric tons per year. Pakistan's production (Figure 13) increased between 1961 and 1963 or 1964, then remained constant through 1967. The resulting production-consumption deficit has varied widely but is now (1967) at 120,000 metric tons per year. Figure 14 shows Turkey's production trend to be increasing during the early 1960's and leveling during the middle 1960's. Combined with consumption, it has given a production-consumption deficit which increased gradually until the past two years but is now, like Pakistan's, at 120,000 metric tons per year.

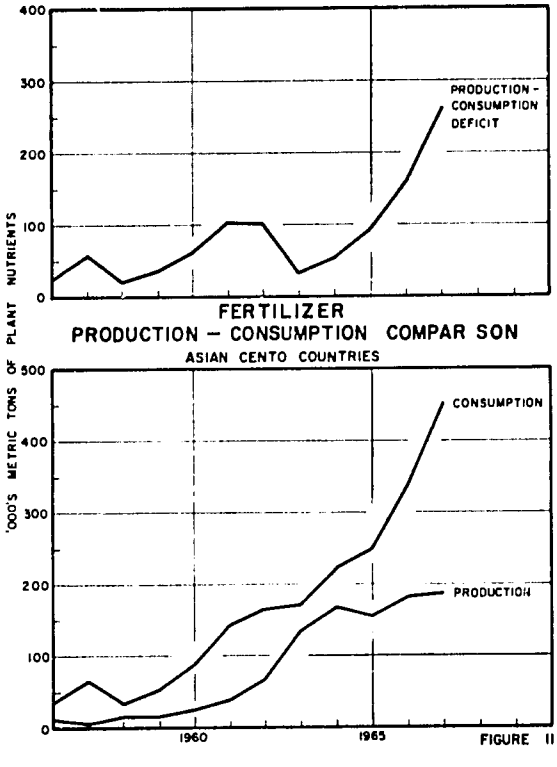
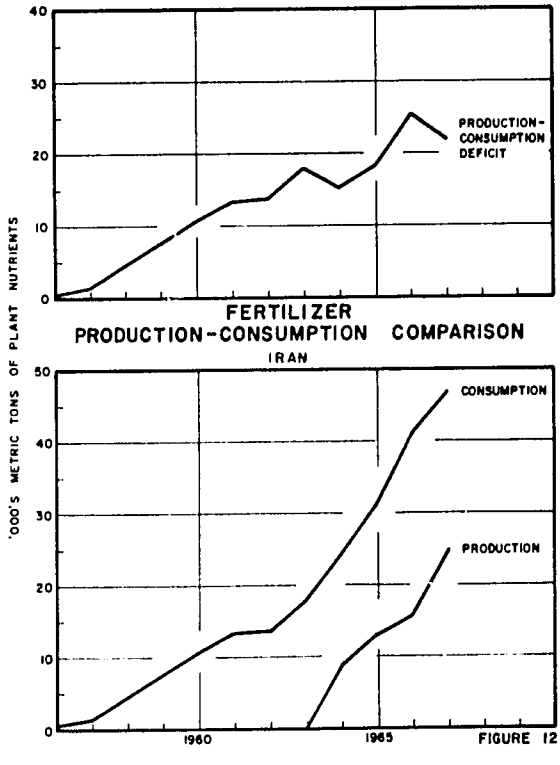


FIGURE 11



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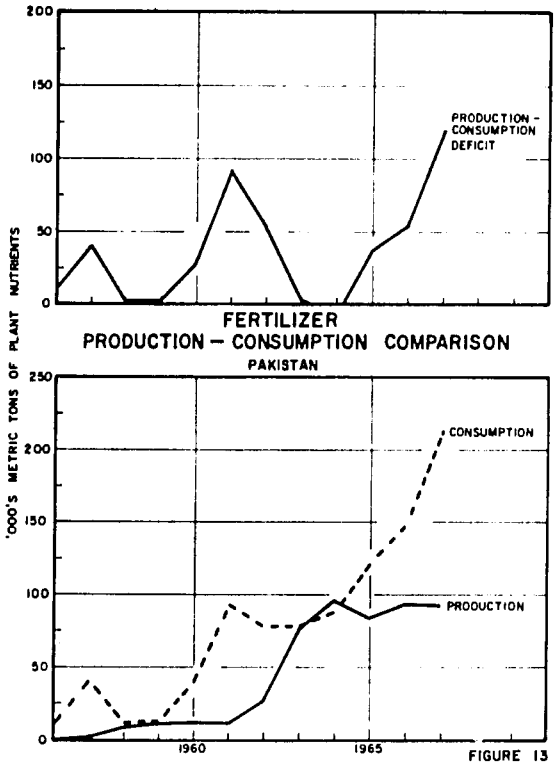

FIGURE 13

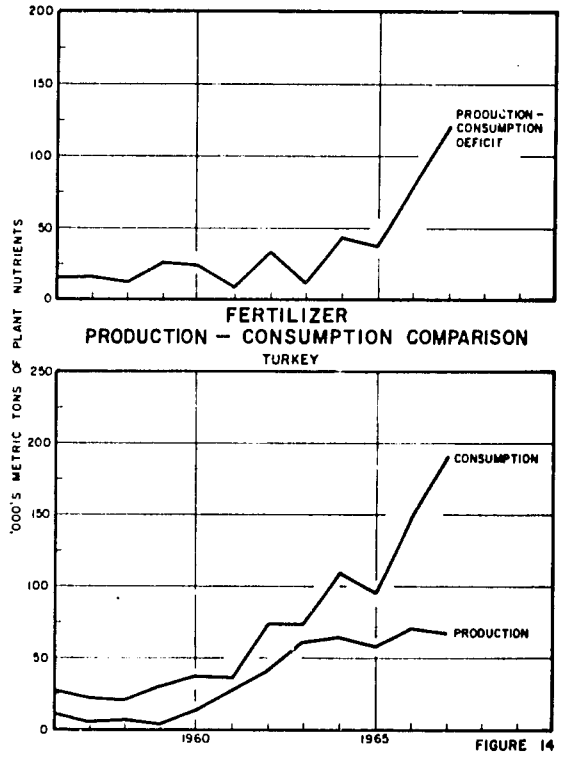

FIGURE 14

PRODUCTION-CONSUMPTION OUTLOOK

The future fertilizer production and consumption in the Asian CENTO countries is not estimated in this presentation in the sense that it is often forecast for the world and its major subdivisions. The industry is too new to be self-supporting at high rates of growth, and a change in timetable of even one or two major cooperators would change the forecast very radically. The fertilizer outlook in the Asian CENTO countries is more nearly one of plans, intentions, and possibilities.

However, as an illustration rather than as a forecast, we can consider the range of consumption level which is implied by planned production capacity supplemented by importing. Figure 15 shows this type of comparison. The course of production is given by actual production through 1967 and by the production capacity[1] of the facilities

1. Tonnage of actual production at full plant output but with normal losses, downtime, etc., which are sustained in long-term operation. These are the Potential Fertilizer Production data determined by the Tennessee Valley Authority; geographically, the location is that of production of the basic materials—ammonia, phosphoric acid, and potassium chloride or sulfate.

which are now planned to come on stream, 1968 through 1972. The solid consumption line is that of actual consumption through 1967. The dashed consumption line, labeled 25.9 percent per year, is a continuation of the 1957-67 trend. The lower dashed consumption line was drawn from the 1967 level through production capacity of 1970-72; from 1967 forward, it would provide for an annual consumption growth of 13.8 percent.

The upper section of Figure 15 is a plotting of the production consumption deficits (which approximate the import requirements) resulting from the production and consumption levels outlined in the lower section of Figure 15.

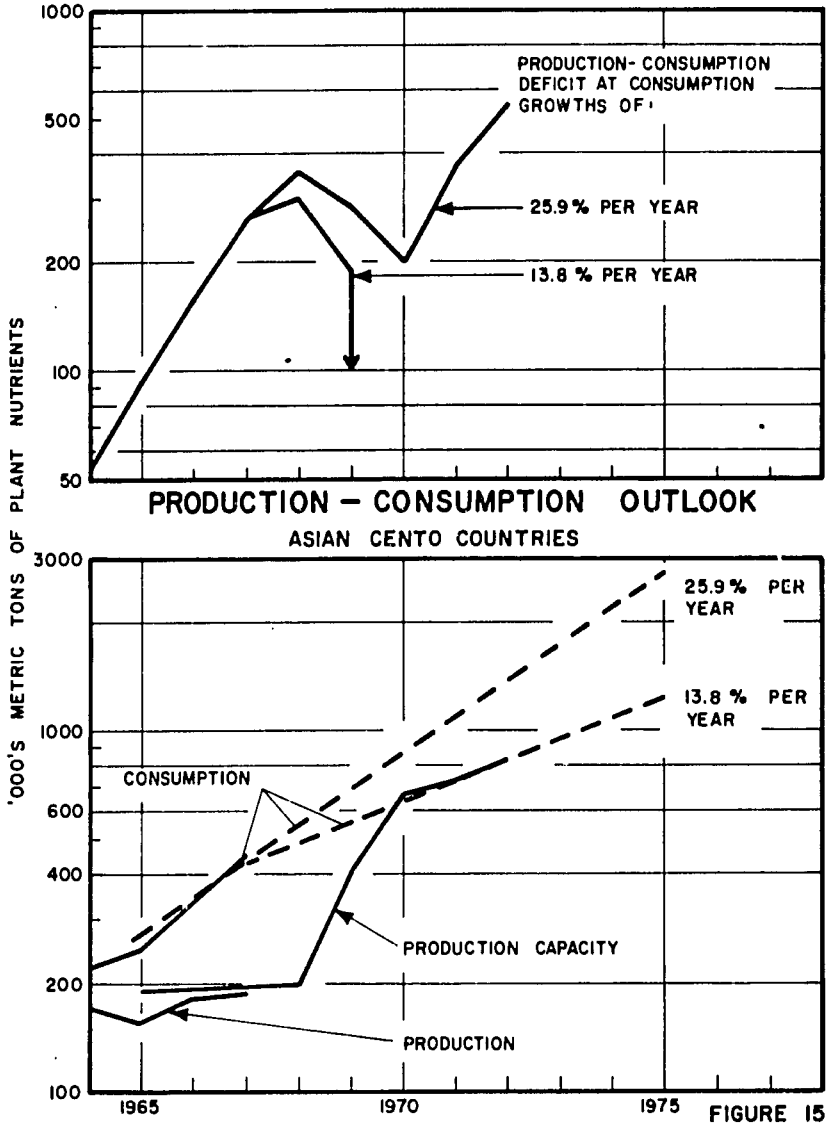

FIGURE 15

For 1968, the production-consumption deficit is moving toward a temporary peak of not more than 300,000 to 350,000 metric tons. During 1969 and 1970, the deficit should decrease sharply because of the increased production capacity. In the 1970-72 period, the deficit could range from zero to several hundred thousand metric tons. It would be zero if consumption slowed to an annual growth of 13.8 percent and used only the output of planned production. However, if consumption maintained its annual growth of 25.9 percent, the deficit would expand from 200,000 to 550,000 tons during the 1970-72 period.

Feasible importing is not likely to supply the upper level of deficits in Figure 15. Fertilizer consumption can therefore be expected to recede from its annual growth of 25.9 percent. However, any importing during 1970-72 would provide for consumption above the annual 13.8 percent line. An intermediate growth rate in the range of 15 to 18 percent per year is therefore reasonable between the present and 1970-72.

For comparison, the developing countries of the world had in 1962-67 an annual tonnage increase of 16.2 percent, and at 1972 it is projected in TVA estimating to be 14 to 15 percent per year.

But beyond 1972 what? Figure 15 shows that if production capacity were to increase even at 13.8 percent per year, the 1973, 1974, and 1975 increase would be 116,000, 132,000, and 150,000 metric tons respectively; they would carry the 1975 production capacity to one and one-fourth million metric tons. If this type of increase is to be achieved, it must become a target of current long range planning.

REPORT OF THE CENTO AD HOC WORKING PARTY ON FERTILIZERS SEPTEMBER 24-27, 1968

INTRODUCTION

The Conference on National and Regional Agricultural Development Policy, which was held in Tarabya, near Istanbul, in September 1967, recommended that a Regional Working Party on Fertilizers be established. That recommendation was selected for action by the Sixteenth Session of the Economic Committee in March 1968. The meeting of the Ad Hoc Working Party was held at the Ministry of Agriculture and Works (Agriculture Wing), Islamabad, from September 24 to 27, 1968.

The Working Party was called to order by the Economic Secretary of the Central Treaty Organization who made a few welcoming remarks on behalf of the Secretary General.

An address of welcome was made by the Leader of the Pakistani Delegation, Mr. M. Yamin Qureshi, S.K., Joint Secretary, Ministry of Agriculture and Works (Agriculture Wing), Islamabad.

After opening statements from the leaders of the delegations of the other CENTO countries, Mr. M. Yamin Qureshi, S.K., Leader of the Pakistan Delegation was elected Chairman. The Chairman then designated the Leaders of the Turkish, the United Kingdom and the United States Delegations to be Vice Chairmen.

CONFERENCE OBJECTIVES AS RECOMMENDED BY THE CONFERENCE ON NATIONAL AND REGIONAL DEVELOPMENT POLICY

1. Review of total system of planning for production and distribution of the three nations and consolidation insofar as is feasible into one total system for the region.

2. Review of overall capital requirements and ability to meet these requirements on a mutual basis.

3. Devising methods for a) Joint research projects, b) Research and technology information exchange, c) Attracting research institutes and activities into the region to insure attention to adaptation of interrelated advances in improved varieties, soil fertility and water management, and other production practices.

4. Devising methods of mutually solving the tremendous problems of education of teachers, extension personnel, fertilizer dealers, and farmers in the proper use of fertilizers.

5. Devising uniform standards of regulation in each country which would protect farmers' interests and would also assist manufacturers of fertilizer in facilitating intra-regional trade.

6. Investigate the possibility of trade arrangements between the three nations for raw materials, finished fertilizer products, and other needed items.

7. Review the various successful distribution systems, methods, and economics and act as a clearing house of information on both successful and unsuccessful attempts.

METHOD OF PROCEDURE

Papers were presented in each Session, as shown in the Agenda, followed by questions and discussion of points presented or raised by other delegations. Conclusions were reached on each of the topics presented.

A Keynote Address was made on the subject of "Fertilizer Progress in the Asian CENTO Countries" by Mr. Frank M. Kennedy of the United States Tennessee Valley Authority.

SUMMARIES AND RECOMMENDATIONS OR FINDINGS

AGENDA ITEM IV (b) - "Estimated World Fertilizer Production Capacity as Related to Future Needs"

Summary of Working Party Findings

It was brought out that in the production of high-concentration fertilizers the impurities are much less than in ordinary fertilizers. These impurities generally contain trace elements. Therefore where high-concentration fertilizers are used, trace elements should be added to the fertilizers as needed for widely varying soil conditions. It was noted that the more water soluble phosphate fertilizers have proved to be superior in Pakistan.

Different types of fertilizers react differently under different conditions. It was concluded that research should be carried out to determine the best types of fertilizers for the specific crop and soil conditions within each country.

AGENDA ITEM V - "The Green Revolution: Its Impact on Fertilizer and Food Balances"

Summary of Working Party Findings

The three CENTO countries are experiencing a "Green Revolution". This means that fertilizer consumption and agricultural production will continue to rise for some time in the region.

It was noted that other Asian countries are also in the process of reducing their food grain deficits making the absorption of any eventual excess grains from the CENTO countries difficult. On the other hand, nutritional levels in CENTO regional countries themselves are low and it is hoped that the increased agricultural output could be used to raise these levels in addition to meeting the requirements of rapidly increasing populations.

The more efficient use of fertilizer, through improved varieties, should speed up the achievement of needed crop production.

AGENDA ITEM VI - "Fertilizer Supply and Demand in CENTO Countries"

Summary of Working Party Findings

Projections of fertilizer increases should be related to the country's requirements, cash crop requirements and known export possibilities.

Potash in the CENTO countries is required in special locations and on special crops. Moreover experience is needed before recommendations for the construction of potash fertilizer plants in CENTO countries can be made.

AGENDA ITEM VII - "Turkey's Fertilizer Supply and Demand Position for 1968-1982: By Product Types, Import Projections and Dollar Value"

Summary of Working Party Findings

The decision to produce fertilizer locally using indigenous raw materials or imported semifinished products is essentially an economic one closely related to the true cost of foreign exchange and other real resource costs to the country making such a decision.

AGENDA ITEMS VIII AND IX - "Pakistan's Fertilizer Supply and Demand Position for 1969-1980: By Product Types and Dollar Value"

Summary of Working Party Findings

The projections given in the two papers appear to be realistic, subject to the assumptions made, including the dependence of supply and demand upon the interplay of an intricate complex of economic factors.

In view of fertilizer consumption projections for 1979-80 reflecting a nitrogen-phosphate (N/P) ratio of approximately 2:1, more emphasis should be laid on production of complex fertilizers in the future. It was also agreed that the future nutrient production should be based on the balanced nutrition of major crops of CENTO regional countries, according to their ecological conditions.

AGENDA ITEM X - "Fertilizer Product Types in Iran"

Summary of Working Party Findings

The Working Party felt that surpluses of urea in 1971 and 1972 were likely. Fertilizer distribution in Iran and also in Pakistan is possibly limited by the lack of credit facilities at the dealer and farmer level and by high costs of transportation.

AGENDA ITEM XI - "Prospects for Trade Among the CENTO regional countries for Fertilizer Products and Raw Materials"

General Summary of Working Party Findings

There is a potential for intra-regional trade in fertilizers, but they are very limited since deficiencies in fertilizers may still be significant by 1980.

- There is a possibility of intra-regional CENTO trade in raw materials (depending upon future mineral discoveries), and in some intermediates.

- The main difficulties in possible intra-regional trade are costs of transportation and payments arrangements.

- The three regional countries will need 150 to 160 million dollars of imported fertilizer and raw materials for 1968-69.

- There are no known commercial phosphate deposits in the three regional countries.

- Present regional demand for potash is small but is expected to grow within the next few years.

Iran

- Large sources of natural gas can make a surplus of finished nitrogen fertilizers or intermediates possible.

- The prospective Bandar Shahpur plant is expected to produce a surplus of phosphoric acid, sulfur, ammonia, and urea.

Pakistan

- Substantial reserves of natural gas in Pakistan could be used to produce surplus ammonia for sale as such or in the form of urea.

- Technologically, sulfuric acid from gypsum can be used to produce phosphoric acid and phosphate fertilizers.

- There is the possibility of importing into Pakistan Iranian sulfur produced from sour gas.

- An existing source of potassium chloride may permit the refining of this material and the potential production of potassium sulfate for domestic use or for export.

Turkey

- No exportable surpluses of fertilizers currently exist. By the end of 1969 or early 1970 it may be possible to export surplus sulfuric acid to the other regional countries. However, the Turkish Government would need to know projected CENTO demand in order to assist in production planning.
- Ammonia is now produced expensively from coal in Turkey. Ammonia could also be imported for future needs from Pakistan or Iran where it is produced more cheaply from natural gas.

AGENDA ITEM XII - "Capital and Raw Material Needs for Fertilizer Products through 1980"

Summary of Working Party Findings

The picture presented by the aggregate import needs of the three CENTO regional countries, in foreign exchange terms, is a gross figure which needs qualification. Some opinion was expressed that if fertilizers are used to the extent implied by these forecasts then an exportable surplus of agricultural products might be generated, and the foreign exchange so earned would offset or, conceivably, completely outweigh the foreign exchange need for fertilizer imports. The net effect could be a gain in foreign exchange.

Alternatively it can be suggested that export markets may not be found. In that case fertilizer inputs and agricultural outputs could be readjusted.

In addition, fertilizer imports can be regarded as a substitute for more costly food imports.

The following is a forecast of capital needs to meet fertilizer manufacturing demands:

1. Soft-term loans from outside financial sources allowing for economic long-term payout of the plants.

2. Cost of building finished fertilizer plants: Currently the cost of nitrogen plants ranges from $40 million to $60 million per 100,000 metric tons of capacity and the cost of phosphate plants ranges from $13 million to $20 million per 100,000 metric tons of P_2O_5 capacity. These investments include housing, medical care and other amenities.

3. Based on current forecasts of plant nutrient demand, the need for new plant investment beyond those currently approved are approximately (in millions of dollars):

Country	By 1974-75	Total by 1979-80
Turkey	172.5	285.0
Iran	10.0	64.8
Pakistan	207.0	662.0
TOTAL	389.5	1011.8

Assumption:

Fifty million dollars per 100,000 metric tons of capacity for N and $15 million per 100,000 metric ton capacity of P_2O_5, both supplied as ready-to-use fertilizer product. About half of this capital need may be in local currency.

AGENDA ITEM XIII - "Fertilizer Distribution and Market Development"

Summary of Working Party Findings

The principal strengths of the fertilizer distribution systems of the three CENTO regional countries are as follows:

- ***Iran—*** There is an excellent agricultural extension service which is involved in a package program whereby seeds and appropriate fertilizers are sold together.

- ***Pakistan—*** The one-pricing system used in Pakistan helps eliminate confusion among farmers as to the best types of fertilizers to use, and encourages them to increase the use of fertilizer. There is a strong retail dealer organization in Pakistan.

- ***Turkey—*** The distribution system is well organized and functions efficiently. Fertilizer is readily available to farmers throughout Turkey. Retail credit to farmers accounts for 80 percent of the retail sales, which is handled through the government banking system.

The principal weaknesses of the fertilizer distribution systems of the three CENTO regional countries are as follows:

- ***All countries—*** The existing warehousing system is inadequate for long-term storage of fertilizers and will become increasingly so with increasing domestic fertilizer production. Domestic production requires storage space on a year-round basis, tending to displace space now used for harvested crops; on

the other hand, imported fertilizers are stored on the average of three to four months.

- ***Iran and Turkey—*** Fertilizer manufacturers do not have a direct participation in the distribution system. This could lead to the possibility that investment in new plants may not be optimized.

- ***Pakistan and Iran—*** The lack of a strong system of credits to farmers has held down fertilizer sales. Pakistan's coming experience in credit extension will be of interest to the CENTO countries.

AGENDA ITEM XIV - "Standards, Specifications and Regulations for Fertilizer Products and Labelling"

Summary of Working Party Findings

It was RECOMMENDED that:

- A common set of standards and specifications for fertilizers be adopted by the three regional countries. Agreed standard method of analysis should accompany these specifications;

- A standard system of labelling fertilizer products be adopted;

- Standard specifications for bagging and closure of bags be adopted.

It was AGREED that bulk handling and bagging of fertilizers at docks, wherever possible, is a major objective to ensure substantial savings in foreign exchange. Trials are needed in Pakistan to demonstrate the feasibility of bulk handling and mechanical bagging.

OTHER RECOMMENDATIONS

The Working Party RECOMMENDED that another meeting of the Working Party on Fertilizers he held late in 1969 in Tehran in close proximity to the main FAO Conference to be held in November or December 1969, to formally adopt the common standards recommended above. At that time the various data presented should be updated based on current conditions and outlook. These are:

- Fertilizer demand forecasts
- Fertilizer production
- Import forecast by nutrient and product type
- Forecasts of plant capital needs to meet fertilizer demands.

CLOSING REMARKS

The Working Party meeting was closed by the Chairman who expressed his appreciation to all the delegations for their hard work and cooperation in making the meeting a success. The delegates, in turn, expressed their appreciation and gratitude to the Government of Pakistan for acting as host to the Working Party and for the generous hospitality extended to the delegates. Expressions of appreciation were also extended to the Chairman and Vice-Chairmen for their leadership and help towards the smooth working of the meeting.

THE GREEN REVOLUTION: ITS IMPACT ON FERTILIZER AND FOOD BALANCES

By
Leon F. Hesser
Assistant Director for Agricultural Policy
USAID Mission to Pakistan

Dramatic changes are taking place in agriculture in selected countries in the Near East and South Asia. This change and ferment has been aptly described as a "Green Revolution." Several factors have helped to bring about the sharp increases in agricultural production, but the catalysts in the process have been the new seed varieties that are a product of several years of research in international seed research centers sponsored by the Rockefeller and Ford Foundations -- new high-yielding, short-strawed varieties of wheat and rice, which are highly responsive to heavier applications of fertilizer, and improved varieties of maize (corn), sorghum and millet.

The Green Revolution is a reality in each of the three region countries -- Iran, Pakistan and Turkey. All three countries have been net importers of wheat and other food grains in recent years, but now Turkey and Iran are searching for export markets for wheat and a strong possibility exists that West Pakistan will soon be in an export position for rice and perhaps wheat. Pakistan's wheat crop recently harvested was more than 30 percent larger than the previous record crop. Only a few short years ago, projections of population and food grain production in Asia made a dismal picture. Today, the problems in several Asian countries, including the three region countries, have shifted to those associated with plentiful production of grains -- i.e., problems of storage, transportation, marketing, and maintaining reasonable prices and incomes for farmers. These are the kinds of problems we prefer to be concerned with.

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Since I am more familiar with Pakistan than with Turkey or Iran, let me discuss more specifically some of the dimensions and implications of Pakistan's Green Revolution.

PAKISTAN'S GREEN REVOLUTION

As it is in the other two region countries, agriculture is the largest sector in Pakistan's economy. It is the principal source of national income, employment and raw materials for domestic use and export.

In recent years the Government of Pakistan has made a number of policy and resource allocation steps which have markedly improved short-run prospects for agriculture. During the last two years particularly, the Government of Pakistan has placed top priority on increasing cereal production. The original Third Five Year Plan (which ends in 1970) aimed at achieving an annual growth rate in agriculture of five percent, which would be a "move towards self-sufficiency in food." Shortly after the beginning of the Third Five Year Plan period, the time frame was shortened. Top priority was accorded to achieving cereal self-sufficiency by the end of the Third Plan period and financial and other resource allocations were altered to strengthen programs having a bearing on food grain production. Necessary imports, of which improved seeds, fertilizer and water are the key ones, have been made more readily available. Policies have also been altered to create a more favorable environment for private sector investment in agriculture.

What are the prospects for achieving Pakistan's goal of self-sufficiency in food grains by 1970?

West Pakistan's prospects for achieving food grain self-sufficiency appear, if anything, more favorable than a year ago. Exceptionally favorable weather has inclined everyone toward optimism, but that is only part of the answer. Improved varieties of wheat, rice, and maize have amply fulfilled expectations. Fertilizer use is increasing rapidly. The larger farmers in particular are showing a general awakening to new technology. Coupled with the favorable weather, these factors have contributed to a dramatic increase in food grain production in West Pakistan. With a 6.2 million ton wheat crop officially estimated as harvested, the potential of close to a million acres of IRRI rice for harvest during the autumn of 1968, and prospects for further increases in corn production, West Pakistan appears to have sufficient cereals to maintain recent dietary standards without importing food grains. Indeed, some grain may be available for export. Assuming average weather and that the new varieties of food grains continue to be bypassed by major disease and insect problems,

indications are that food grain self-sufficiency will be maintained in West Pakistan. The prospects for avoiding calamitous plant disease occurrences are good. There exist genetic seed materials with differences in inherent disease resistance; promising new seed varieties are being developed and multiplied to replace those which may ultimately become susceptible to disease and to provide for planting several varieties in each season in order to lessen the impact of possible disease infestation.

In East Pakistan, projections for agricultural growth are more favorable than in the past. Rural Works and other agricultural development expenditures are rising and fertilizer use is increasing rapidly, as is the area irrigated by low-lift pumps. Improved local varieties of rice and generally improved management practices also contribute to increased production. In contrast to West Pakistan where IRRI rice seems to do very well and apparently has no major problems, in East Pakistan its short-run potential is not as great as originally hoped. Both IRRI-8 and IRRI-5 show some promise as stopgap varieties, pending the development of other improved varieties. The IRRI strains were anticipated to be particularly useful during the Boro and Aus seasons. However, there are problems of susceptibility to local strains of diseases, incorrect cultural practices, insufficiency of irrigation water, and excessive growing period under East Pakistan sun conditions. The last problem may perhaps be overcome by earlier planting. These problems point up the necessity for strengthening the existing rice breeding programs in East Pakistan as well as intensifying the search for adaptable varieties and suitable germ plasm from other sources.

Dimensions of the Green Revolution in Pakistan

Preliminary estimates indicate that food grain production in FY 1968 increased 15 percent in East Pakistan and at least 34 percent in West Pakistan over the previous year's production, but the FY 1967 crops were very poor ones. The weather in FY 1968 was unusually favorable in West Pakistan and slightly better than average in East Pakistan. Hence, the very favorable weather compared to the poor weather the year before accounts for much of the increase. However, new seeds, more fertilizer, more irrigation, and better farming practices did have a substantial impact.

The contribution of added inputs and weather to increased production was evaluated by means of an analysis based upon an estimating method adapted from one developed by U.S. Advisors in India and is described in the ERS/USDA report, "Accelerating India's Food Grain Production." (Data used in the analysis for Pakistan are available

upon request.) The analysis indicates that in FY 1967 unfavorable weather had a negative influence on production of 322 thousand tons in East Pakistan and 363 thousand tons in West Pakistan. In FY 1968, favorable weather had a positive influence of 925 thousand tons in West Pakistan and none in East Pakistan. Since, however, it is generally believed that weather was slightly favorable in East Pakistan during FY 1968, the model and/or the data may have underestimated the weather effect in East Pakistan. If average weather had prevailed in both years, the analysis indicates that acreage expansion, including additional irrigated acreage and more multiple cropping, accounted for an increase of 8.1 percent in food grain production in FY 1968 over FY 1967 in West Pakistan, and greater use of fertilizer and improved varieties accounted for an increase of 6.2 percent. Comparable figures for East Pakistan were estimated as 9.4 percent for acreage and 1.7 percent for fertilizer and improved varieties. Following are quantitative estimates of the contribution of each to the increase of production in FY 1968 above FY 1967, had FY 1967 been on trend:

Factors Contributing to Increase	Increase in Production: East Pakistan	Increase in Production: West Pakistan
	(thousand tons)	
Expansion of acreage planted	919	587
Heavier fertilization of increased acreage of improved varieties	29	303
Heavier fertilization of local varieties	134	
Irrigated, West Pakistan		119
Barani, West Pakistan		28
Unexplained residual ("weather")	-4	925
Total	1,078	1,962

The estimating model can also be used to forecast production of food grains. Entering reasonable values for the rate of adoption of new varieties, fertilizer consumption, output response ratios, and area planted, food grain production between now and 1975 is estimated to increase at an average annual compounded rate of 6 percent in East Pakistan and 9 percent in West Pakistan. Allowing for population increase as estimated by the U.S. Bureau of Census

(Bracket and Akers, series D) and allowing one percent per year increase in per capita consumption of food grains as a result of rising incomes, it is estimated that Pakistan will be "self-sufficient" in food grains on a net basis by FY 1972. This assumes, however, that other foodstuffs will be available in adequate amounts to meet minimum daily caloric requirements.

Assuming average weather, West Pakistan will maintain self-sufficiency and will have grain to export in FY 1970. It must be emphasized that this analysis makes no allowance for variation in weather, which can have a catastrophic effect particularly in East Pakistan, or for failure of various events assumed in the projections to occur.

Implications of the Green Revolution

In West Pakistan the most immediate problem created by the bumper wheat crop just harvested is in the distribution system. For several years domestic production of grains has been largely consumed in rural, producer areas, while major cities have been supplied by imported grains, predominantly wheat under PL 480. Storage and marketing facilities were geared to this pattern and, since imported grains could be programmed the year around, large stocks at any one time were unnecessary. With cereal self-sufficiency in West Pakistan problems of handling, storing, and transportation loom large. Considerable storage capacity is available in Karachi and in East Pakistan but it takes time and money to move quantities from production areas to storage. A related problem is that of operating the price support program effectively. Considering the magnitude of the crop, the GOWP did a commendable job of purchasing wheat to maintain the price support level during the recent threshing season.

Several additional implications — both political and economic — are inherent in the Green Revolution. However, this Working Group is concerned with fertilizer. Hence, the concluding remarks of this paper are confined to the implications for fertilizer.

Fertilizer occupies a key role in the drive to increase agricultural production in Pakistan. The policy of the Government of Pakistan is to provide adequate supplies of fertilizer and to encourage its use by subsidizing the price and providing educational programs for the farmers. USAID continues to support the Government's policy through production loans for fertilizer imports in the interim period before local production is sufficient, and by encouraging private investment to develop increased indigenous capacity to manufacture fertilizer.

Use of fertilizer is increasing rapidly in both East and West Pakistan. Percentage increases in sales for the past two years were:

	FY 1967	FY 1968
	Percent Increase	
East Pakistan	40	35
West Pakistan	64	65

Continued rapid growth in fertilizer consumption is expected. If one were to look at Pakistan or any one of the other region countries in isolation, he would quickly conclude that the demand for fertilizer is going to increase very rapidly in the future because the new high-yielding varieties are so dramatically responsive to fertilizer. At existing prices of grain and fertilizer, it is apparently highly profitable to use more fertilizer. If surplus grain is produced, it can be exported.

But let us take a look at the situation from a global standpoint. With the new varieties, it now takes less fertilizer to produce a given amount of grain than it did with traditional varieties. Increase in world consumption of grain is limited primarily to increase in population and increases in purchasing power in the poorer countries. Together, these factors probably account for annual increases in world food grain demand someplace around three percent. A widespread global adoption of the new varieties could potentially increase food grain production much more than 3 percent per year in the next few years. This possibility raises many interesting questions about the kinds of adjustments that may be forthcoming in cropping patterns, price policy, international trade in agricultural commodities, etc., as a result of potential over-capacity for producing foodgrains.

In conclusion, I think we can safely say that in the immediate future, the demand for fertilizer is going to increase very rapidly because of the new varieties of food grains. Looking a little further ahead, I am not so sure the demand for fertilizer for food grain production will increase rapidly, if at all, because with the new varieties it actually takes less fertilizer to produce a given amount of grain. On the other hand, if land is shifted out of food grain production into other crops, increasing quantities of fertilizer could be used on the remaining land in food grain crops to produce the needed grain.

Like most economists, I have raised more questions than I have answered. Now it's your turn to raise some.

FERTILIZER AND IRANIAN AGRICULTURE

By
John M. Hill
Fertilizer Adviser, USAID/Ankara
and
L. R. Rhodes
Adviser in Agricultural Economics, USAID/Ankara

SUMMARY OF CONTENTS

This paper is a preliminary analysis of the prospective levels of demand and supply of chemical fertilizers in Iran. Thus, it includes an appraisal of the major factors which will affect fertilizer production and use during the foreseeable future, mostly to 1972.

- The Fourth Five Year Plan of Iran provides a basis for rapid progress toward increased use of fertilizer in the five years beginning in March 1968.

- The Ministry of Agriculture, the Fertilizer Distributing Company and other responsible agencies are taking steps to implement the Plan.

- Economic benefits from the use of fertilizers in Iran are generally high in relation to the cost of fertilizer, except where the insufficient supply of water prevents efficient use of fertilizers.

- The lack of adequate credit is a major limiting factor in the use of needed amounts of fertilizer. Credit needed may exceed a billion rials in 1971-72.

- Cooperatives could greatly expand their services to members by selling fertilizers at a small margin above cost, as a source of needed funds.

Other factors which restrict fertilizer use are:

- Incomplete plans and programs for farmer education
- Inadequate transportation and storage of fertilizer
- The lack of adequate plans to utilize private resources to the fullest extent for fertilizer distribution
- Inadequate use of other modern practices for crop production, such as improved seeds, proper soil preparation and planting, and adequate irrigation
- Insufficient good statistics on farm prices, areas of crop land, crop yields, size of farms, soil characteristics, etc. which affect forward fertilizer planning and manufacture.

• The utilization of fertilizer, nevertheless, is increasing rapidly in Iran, so that the Shahpur plant probably will not produce enough phosphates to meet the demand in any fiscal year, and the planned domestic production of nitrogen probably will be inadequate after 1973-74.

• The domestic requirements for fertilizer products may be about 317,000 tons in 1971-72 and 835,000 tons in 1981-82.

• The prospective levels of fertilizer production and utilization in 1981-82 will require increases in warehousing at a total investment cost of 200 million to 300 million rials.

• There is a need for quantity discounts and seasonal discounts in fertilizer prices for sales to private distributors and dealers.

• Considering experience in low rainfall areas of Turkey, it seems likely that the use of fertilizer will be found to be profitable on most of the dry land wheat in Iran, but this has not been assumed in the above analysis.

CLIMATE, LAND AND PEOPLE

Iran's latitude gives it generally cold winters and hot summers. Precipitation occurs principally in winter, except in the Caspian region, where the annual precipitation is 400 to 2000 mm. In other parts of the country, the precipitation is generally less than 400 mm per year.[1] Thus, irrigation is required for most crops outside of the Caspian region, although wheat and barley are grown with annual precipitation of 300 mm and even less. Much of the country is on a plateau that is mostly 100 meters or more above sea level.

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1. Soil fertility Survey and Establishment of a Soil Fertility Unit, Iran, Vol. 1, General Report, FAO, Rome, 1966.

The cultivated lands in Iran are largely fine textured alluvial soils which are composed of relatively recent sediments. These soils usually have a PH between 7.5 and 8.0. They generally have a low content of available phosphorous, nitrogen and organic matter.

Thus, only about 6.1 million hectares or 43 percent of the area of Iran is cultivated in any given year, although there are 12,400,000 hectares (7.5 percent) of fallow land that is in rotation with crops.[2] Of the crop land, about 40 percent (3,150,000 ha) is irrigated and about 15 percent (nearly 1,000,000 ha) is in the high rainfall area in the Caspian region. (This includes some double cropping.) Fertilizers have not been generally profitable on dryer areas, so that only about 55 percent of the crop area is recommended for increases in fertilizer use. Not only will fertilizer increase the yields of crops on at least half of the land now cultivated, but fertilizer can increase the frequency of planting crops on some fallow land, especially where there is irrigation of adequate rainfall (Table 1).

The population in Iran was nearly 26 million in 1966, thus allowing only about one-fourth hectare of crop area per person. Also, the population is growing at the rate of about 2.6 percent per year. Thus, it is estimated that the population of Iran will reach 30 million people in 1972.[2] During this period, it is estimated that the rural population will decline from 61 to 57 percent of the total, although increasing from 16.3 million in 1967 to 17.4 million in 1972. The rural people live mostly in the 50,000 villages which have an average size of about 300 persons, or 50 to 60 families.[2]

NATIONAL PLANNING AND ECONOMIC GROWTH[3]

Gross per capita production per year reached 18,500 rials ($244) in 1966, compared to 14,200 rials ($187) in 1959. The average yearly growth rate of per capita production in this period was 3.8 percent (deducting the population growth rate of 2.8 percent). During this period, the national income (GNP) increased from 267 to 413 billion rials, while the per capita income increased from 12,300 to 15,900 rials. Also during this period, the production contribution of the agricultural sector increased from 98.7 billion to 108.8 billion rials, but dropped in percentage from 30.8 to 20.8 percent of the total gross value of products. The annual rate of growth of agricultural production was 1.4 percent in the period 1959-66.

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2. The Fourth Five Year Plan of Iran.

3. This section is from the Fourth National Five Year Plan of Iran.

During the Third Plan period (1963-67), the objective was to realize a growth rate of 4 percent per year in agricultural production, but the actual rate of increase was no more than 2.6 percent. As far as agriculture is concerned, the Third Plan Period has been one of infrastructure building for attaining a faster growth rate in the future. The implementation of the land reform program was one of the most important factors and outstanding measures taken toward the objectives of increasing production.

The Organization for Seed Improvement supplied 6,500 tons of wheat and barley seed, 2,300 tons of cotton seed, 300 tons of rice seed and some improved vegetable seeds and fruit trees in 1966.

Research has been used to test and select 13 improved varieties of wheat and 4 of barley. Also American and Italian varieties of rice have been multiplied and distributed to farmers. Two long grain varieties are being multiplied for distribution. Improved varieties of other crops are being studied.

The overall objective of the Fourth Plan is to realize a growth rate of 4 percent in the agricultural sector, and the projected growth is 40 percent in the period 1966-72, an annual rate of about 5 percent. Unusually good weather conditions, however, were experienced in the years of 1966 and 1967.

For land grading (levelling) and drainage, ten operating units will be set up with a performance capacity of 75 to 100 thousand hectares per year. Also 3,000 tractors will be sold to farmers in the first year, with 6 years to pay, and an assembly plant will be established to provide 3 to 5 thousand new tractors each year. Small tractors also will be produced. Cooperatives will distribute kerosene and proper cooking utensils to their members, so as to reduce the use of dung as fuel, and credit will be available for facilities to preserve the manure for fertilizer.

Policies to increase the use of chemical fertilizer will include:

1. At the Shiraz plant, the production of ammonium nitrate will be replaced by 20-20-0 fertilizer.

2. The government will establish a well-equipped network of facilities to distribute fertilizers in such a way that farmers will receive supplies at the right time. This will include the use of the facilities of cooperatives.

3. The private sector also will be used in fertilizer distribution.

4. Extension programs will be expanded, and training courses will be provided for technicians.

5. The prices of fertilizers will be set at a minimum.

6. Increased credit will be provided by the Agriculture Bank and the Central Organization for Cooperatives.

7. Plant protection also will be improved, including the use of the private sector.

The Fourth Plan program will include the following steps to improve marketing of agricultural products:

1. Establish a marketing organization to collect data and teach and expand modern marketing principles

2. Provide needed technicians and equipment to the Agricultural Statistics and Economic Research Bureau

3. Provide credit to organizations and companies that will invest in facilities for storage and transportation of farm supplies and products

4. Increase the capacity of grain silos to 700,000 tons

5. Establish new laws and regulations for classification and marketing of farm products

6. Establish marketing centers and slaughter houses for livestock.

CROP PRODUCTION

Iran has about 6,745,000 hectares of land devoted to crop production in 1968 (Table 1). This is 10 percent more than was planted in 1960, although the area planted without irrigation increased only slightly during this period. Thus, the irrigated area was increased about 25 percent during these eight years. Major increases were realized in the area planted in cotton, sugar beets, tea, oil seed crops, and forage crops, as well as wheat and barley. The area planted in tobacco, however, declined during the period.

Total production of most crops increased substantially during the period from 1960 to 1966. Except for wheat, barley, tobacco and tea, the production is largely on irrigated land. In fact, more than half of the wheat also is produced on irrigated land.

Crop yields are much improved by irrigation. Thus, wheat yields in 1960 averaged 1204 kilos per hectare on irrigated land, compared to only 469 kilos without irrigation (Table 1). Oil seed crops and vegetables yield three to five times as much on irrigated land as on dry land, but tobacco yields more on rain-fed land than on irrigated land. Yield data are not available for 1968 or for 1966.

The numbers of farms planting the various crops were reported by the 1960 census, so that the area planted per farm may be determined. Thus, for example, there were nearly two million farms on which wheat was planted and more than a million on which barley was planted (Table 1). Most of those with barley also had wheat, no doubt. The area planted in those crops per farm (average) was generally only about half as much on irrigated land as on land without irrigation. The irrigated farms, however, planted barely more than 1.5 hectares of the two crops per farm and those without irrigation had less than three hectares each, in these crops. Other crops are found in smaller areas per farm, and only cotton farms have more than 1.0 hectare each on irrigated land, while only wheat, barley, cotton and sugar cane are found in areas greater than 1.0 hectare per farm on dry land.

This information demonstrates that irrigation is a major factor in agricultural production and that its importance is increasing rapidly. Also, areas planted per farm are small so that a large number of farmers must be contacted to cause a substantial increase in crop production.

Since wheat, rice and sugar are the principal food products, they are also the major items of food consumed in Iran. It is estimated that the average consumption per capita in 1964-66 was 152.5 kilos of wheat, 29.0 kilos of rice and 21.3 kilos of sugar (Table 2). Thus, these three foods provide about 1,900 calories per capita per day. Vegetable oils and pulses provide an additional 150 calories per person daily, while fruits and vegetables provide, perhaps, 100 to 200 calories per capita daily. The projected consumption rates for 1971 include less wheat and slightly more vegetable oils, pulses and vegetables. These changes are probably in the desirable direction, but it seems that the suggested decline in consumption of wheat (to 127.5 kilos in 1971) is not likely to be offset by increases in consumption of other products. In fact, these data indicate that at least 145 kilos of wheat will be needed per capita in 1971, or a total of about 4,200,000 tons, instead of 3,698,000 tons. This amount of consumption in 1971 would seem to preclude the probability of exporting wheat in that year, if weather is normal (Table 2).

EXTENSION EDUCATION

Iran has made good progress in recent years toward informing farmers of the advantages of using fertilizers and other improved practices for crop production. It has been estimated that most of the farmers want to use fertilizer to increase their crop yields. There is no doubt that many of them have wanted more fertilizer than they have been able to obtain in recent years. Nevertheless, there remains the need for instructing them further in regard to how, when, and how much fertilizer they should apply for each crop under their conditions of soil and climate.

The progress to date has included the development and use of extension personnel in three specific types of activities, as follows:

1. The college-trained technicians who have offices in nearly all countyseat towns in the country. There are now about 500 of these trained extension agents and it is anticipated that the number will increase to 1,200 in 1972. The efficiency of these men recently has been increased by giving them credit to buy vehicles (mostly motorcycles) to give them mobility. They also have funds for operating expenses of these vehicles and they pay for them from their travel allowances.

2. The Extension Corps of the Armed Forces by which young men fulfill their military duty by doing work in agricultural extension education, living in villages. There will be in 1969 about 3,000 of these men working closely with the Extension Service of the Ministry of Agriculture and it is expected that the number will be doubled by 1972. Those who join this program as new members must at least be high school graduates and all are given a 4-month training course, consisting of 155 hours of classroom work and 190 hours of field work. These conscriptees work in teams of about 15 members, each team being supervised by a leader who is a college graduate. Each member of the team generally remains in a village where he works directly with farmers. The team leader has a vehicle and travels between villages, giving supervision to the team members.

3. The mobile extension teams. Both of the above groups cooperate in the formation of mobile teams that serve areas where permanent resident agents are not available. Their work has included the establishment of many fertilizer demonstrations. They also distribute publications and posters and otherwise conduct extension activities through lectures, discussion groups,

radio broadcasts and the showing of educational films. These units served in parts of four provinces in 1967 and their work is being expanded to other provinces.

The "package" program is another recent development in the extension program in Iran. The purpose of this activity is to coordinate the efforts of the various agencies working in this field so as to promote the application of all of the needed improved practices for each crop at one time and place. The program is directed by a national committee and the implementation is effected through a field committee of the same agency in each of the major cities. These field committees meet monthly during the crop growing season to plan actions that are needed, especially the procurement of needed supplies of seed, fertilizer, insecticides, equipment, etc. for each village in the district.

The "package" program specifically has the objective of implementing the Five Year Plan that has been promulgated by the National Plan Organization. This activity went into operation in the spring of 1968 and it is expected to gain momentum and effectiveness in future years. In order to increase the rate by which farmers adopt the package program, the needed fertilizer is sold to the farmers at two-thirds of the regular price, a subsidy of 33 percent. By this subsidy, it is hoped that rapid progress will be made in the application of the package program for each major crop. During the first few years, the package program will be applied only in selected geographical areas, others being added each year.

Thus, the package program is a part of the regular extension programs, including the use of crop demonstrations, which usually have demonstrated only one practice on each field. For example, more than 10,000 fertilizer demonstrations have been completed and the results have been published by FAO, covering six years of this activity. The total number of crop demonstrations conducted each year from 1957 to 1966 inclusive is shown in the following tabulation:

Year	Number of Demonstrations	Year	Number of Demonstrations
1957	340	1962	2856
1958	2109	1963	1207
1959	3112	1964	2730
1960	4955	1965	3042
1961	5167	1966	5711

The extension agencies are utilizing the cooperation of various other agencies to apply the package program for the major crops in Iran. This program was applied on 30,000 hectares of rice in the

spring of 1968 with the use of improved seed, heavier fertilization and other improved seed practices. A total of 6,500 tons of fertilizer were used in this activity for rice production. This may be compared to the estimate of 100,000 hectares of rice that was fertilized in 1967-68 and a projected increase to 200,000 hectares in 1971-72 (Table 14).

The package program for wheat looks less promising than that for rice, at least in the immediate future. The farmer's profit is much lower from using fertilizers on wheat than from using it on rice (Tables 4 and 6). In fact, about 60 percent of the wheat land is in areas where the rainfall is too low to make fertilizer generally profitable, under known technology and at present prices. Thus, it is necessary to select carefully, the wheat areas in which the package program will be instituted. This process of selection is underway and should be completed soon, but already valuable time is being lost in initiating the program for planting in the fall of 1968. The Ministry of Agriculture has 7,000 tons of improved seed and is importing 1,500 tons of short stemmed Mexican varieties of seed from Turkey, in order to increase the efficiency in utilization of heavy fertilization. It is generally recognized also that the planting of wheat in rows causes a substantial increase in its response to fertilizer and a strong program is needed to provide the needed planting equipment in many parts of the country.

The package program is being applied to most other crops by the various State enterprises and producers' associations. This includes cotton, sugar beets, sugar cane, tea, tobacco, oil seed crops, and some vegetables and fruits. No doubt, good progress will be made in these programs if the market provides satisfactory prices. In the case of tobacco, for example, there may be a need for government action to prevent further accumulation of stocks, or otherwise to assure the producers that prices will be adequate to return a fair profit for increased use of fertilizer.

LAND REFORM AND COOPERATIVES

A major land reform program was instituted in Iran under the leadership of the Shahanshah in 1962. Prior to that time, there were many tenant farmers who paid high rental rates for the land which they cultivated and they were generally insecure in their tenure. Suitable credit was scarce, so that many producers sold their crops at low prices prior to harvest. In recent years, many of the land

owners have migrated to the cities, giving little assistance in management of their lands.[4]

In the beginning, nearly all extension agents devoted a major part of their time to this program and some continue to do so. The land reform provided three alternatives to owners of large areas of agricultural lands:

- Lease their land to the cultivators for a 30-year period, on the basis of the average income during the last three years;
- Sell the land to the cultivators; or
- Distribute the land to cultivators on the basis of the share owned by each.

During the first five years of this land reform program, the land of 14,834 villages was sold to 631,769 families who had been cultivating these lands. In nearly all the remaining 38,000 villages of the country the lands have been leased to the cultivators for a 30-year period.[4] Thus, more than 2,338,000 households have benefitted from this program.

At the same time (to May 21, 1968) 8,686 cooperatives were formed including 1,121,718 farmers in 24,000 villages, about 40 percent of all farm families in Iran. The members have contributed 1.3 billion rials of capital, and 2.6 billion rials were contributed as original loans by the Plan Organization and the Agricultural Bank. The Agricultural Bank has a policy of loaning to the Central Agency of the Cooperatives up to 400 percent of their capital and the government contributes funds for an annual budget of 250 million rials. Each cooperative has three men who are responsible for its management, assisted by a supervisor and assistant supervisor, who have a jeep for visiting the 15 cooperatives under their jurisdiction. There are now 550 supervisors and as many assistants, all of whom have had seven months of training in the management of cooperatives. Also, the cooperatives are organized into 81 unions, which, in turn, have assistance from the National Federation of Cooperatives.

The cooperatives are of the multipurpose type, buying some of the products of their members, as well as providing them needed supplies of fertilizer, other chemicals, seeds, farm equipment, etc. In 1967, there were 1,600 cooperatives that sold fertilizer to their members, but only a small number were able to buy any farm products from their members. About 1,200 of these own buildings used as stores and warehouses, while others use leased facilities. Very few have trucks or other types of equipment. Each cooperative union,

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4. "An analysis of Iranian Agricultural Production, 1960-66," by Nosratollah Khatibi, Ph. D., Plan Organization, Iran.

however, has a truck (owned or rented) which it uses to deliver supplies to the cooperatives for which it is responsible, insofar as this is feasible. Probably a third of all villages, however, cannot be reached by truck, even in the dry season, and many others are accessible only by "dry weather" roads. Thus, many farmers must transport their supplies rather long distances by oxcart or on the backs of animals. This increases substantially the cost of the fertilizer and other supplies and often reduces the prices received for the products.

Nevertheless, much progress has been made by the cooperatives in providing the services needed by their members. In 1967, for example, the cooperatives sold to their members 11,598 tons of fertilizers, nearly 10 percent of all fertilizer used in the country (Table 3). At the same time, members of cooperatives, of course, bought fertilizer from sugar factories, cotton associations, and other public or semipublic groups, as well as from private dealers. Thus, the sales of fertilizer by cooperatives are primarily in places where supplies are not available from these other sources. This is true also of other farm supplies, such as seeds and insecticides, which the cooperatives provide for their members in many places. The decline in sales by cooperatives in 1967 was due to the change in the national agency which is responsible for making supplies available to the cooperatives, and it is anticipated that the volume of these sales will be expanded rapidly in the future (Table 3). The new agency is the National Fertilizer Distribution Company.

The improvement and expansion of the services of cooperatives is continuing, with the strong leadership of the Shahanshan and other government officials. This is evidenced by a recent statement by the Shahanshah, and published in the daily newspaper *Kayhan*, in Tehran on July 22, 1968: "The attainment of economic democracy depends, more than anything else, on the establishment of the principle of cooperatives in the country."

THE ECONOMICS OF FERTILIZER USE

The fertilizer demonstrations in Iran indicate that the benefits from fertilizer are worth at least 2.00 rials for each 1.00 rial spent on fertilizers for most crops. Usually the ratio is above 3.00:1.00, although wheat, cotton, and barley with or without irrigation are notable exceptions (Table 4). Where the ratio of benefits to costs is more than 2.00:1.00, major increases in use of fertilizer can be realized if the farmers are properly informed about these benefits through educational meetings, and if the farmers can get the fertilizer when they need it.

Turkey's recent experience in the introduction of Mexican wheat may be a useful example to illustrate what may be done in Iran. During the summer of 1967, the Ministry of Agriculture of Turkey conducted an intensive program in the villages, presenting information about the planting and care of Mexican wheat. In many cases, these farmers were hesitant about accepting the program because of its "high cost," but often these skeptical ones were convinced when they were told about the anticipated benefits of the new "package" program. As a result, more than 60,000 farmers planted the imported seed and nearly all applied 120 kilos of nitrogen and 80 kilos of P_2O_5 per hectare. Probably no more than 10 percent of these farmers had seen Mexican wheat before and few had used fertilizer. The harvest of 1968 was so good that the "package" wheat program is expected to be applied by at least three times as many farmers for the 1969 crop as for the 1968 crop.

In Iran, the Soil Institute has cooperated with the FAO in conducting more than 10,000 fertilizer demonstrations during the years of 1961-66. The results of more than 9,000 of these trials have been published indicating the relative value of costs and benefits of fertilizer applications on various crops throughout the country, except in areas with no irrigation and with less than 400 mm precipitation per year. These data show that fertilizer is very profitable on all of the major crops, except wheat, barley, and cotton (Tables 4 and 6). It is reasonably profitable on irrigated wheat and not so profitable on irrigated cotton. In general, a return of two rials for each rial invested in fertilizer (percent of return) is considered satisfactory but any less, as an average, is not enough to give reasonable assurance that a majority of the farmers will realize enough benefit to induce them to use fertilizer as a regular practice.

Fertilizer has been highly profitable on rice, sugar beets, tobacco, tea, grapes, potatoes, and alfalfa, with increases in value of these crops being between 349 and 957 rials for each 100 rials spent for fertilizer. The highest (957 rials) was for burley tobacco and, in this case, the increased value of the crop resulted largely from increased proportions of the crop being in the higher grades, i.e. an increase in average quality (Table 4).

In regard to wheat, the data show that income on irrigated land was increased 207 rials per 100 rials spent for fertilizer, but the increase was only 149 percent of the cost of fertilizer on rain-fed land in the Caspian Sea region. Some preliminary studies have been made in the drier parts of the country (less than 400 mm of rain), showing generally unprofitable results from applications of fertilizer on wheat and barley. Further studies are being made with the

possibility of finding amounts of fertilizer and associated practices that will make it profitable to use fertilizer on wheat, barley, and cotton in all parts of the country. Improvements in village practices, such as planting in rows, use of improved varieties, and moisture conservation may cause substantial increases in benefits from fertilization of grains and cotton. It is known, for example, that phosphorous fertilizer is much more effective when it is placed in bands near the rows of the crop than when it is broadcast, as it is now. Also, a substantial part of nitrogen fertilizer is often lost when it is broadcast on top of the soil without quick and proper covering with soil. It may be significant that both nitrogen and phosphorous have been found to be profitable on wheat in Turkey, including areas with less than 350 mm of annual precipitation.

Furthermore, there usually is a residual effect of fertilizer on the next crop. Studies of wheat yields after fertilized cotton show that the increase in value of the wheat may be enough to pay for the fertilizer used on the cotton (Table 5). In Mazandaran the increase in value of the wheat was 217 percent of the cost of the 45 kilos of fertilizer nutrients that had been applied on the cotton. Relatively lower benefits in relation to fertilizer costs were realized when 90 kilos of nutrients were applied on the cotton. These benefits are significant and farmers should be made aware of them and their value. This will require additional studies and demonstrations.

Studies of the response of new varieties of wheat demonstrate that they give substantially higher returns from fertilization, especially from the heavier applications. Most of the published data, however, are from trials in which inferior varieties were used; since these trials were on farms where the farmers were asked to make no change in their practices, except to use fertilizer, i.e., data on Tables 4 and 6.

Thus, future demonstrations with wheat and cotton may show much higher rates of return for applications of fertilizer than those derived from studies in 1961-65 (Table 4). In fact, improved varieties of wheat already have given greater benefits from fertilizer than the varieties in common use in Iran. Also, on well irrigated land, an application of 30-30-0 in 88 wheat demonstrations in 1966 gave a benefit of 265 rials per 100 rials spent for fertilizer, while the heavier application of 60-60-0 gave a benefit cost ratio of 2.05:1.00 (Table 6). Fertilizer did not give satisfactory economic returns, however, where it was applied on wheat with inadequate irrigation or without irrigation. It seems important, therefore, that future demonstrations should include the package of practices, so as to provide the best opportunity for this crop to respond to fertilizer applications. This package should include good seed, planting in rows, application of phosphorous ferti-

lizer in rows, proper covering of nitrogen fertilizer, proper irrigation or moisture conservation, etc.

The response of cotton in 1966 was similar to that of wheat, in that the economic returns were satisfactory where the crop was irrigated, but less satisfactory where irrigation was not used (Table 6). For cotton, the application of 45 kilos of nitrogen was profitable on dry land, but other applications proved unsatisfactory on dry land. Again, it seems very important to conduct demonstrations using a package of practices in future years, rather than using fertilizer as the only improved practice, as it has usually been done in the past.

The 1966 fertilizer demonstrations generally serve to verify the results of previous years, except that the benefit-cost ratios for wheat and cotton were somewhat higher and the ratios for tobacco were much higher than in 1961-65 (Tables 4 and 6). The benefit-cost ratios for fertilization of tobacco in 1966 varied from 12.87:1.00 to 17.65:1.00 with the highest return per hectare reaching 22,275 rials for the application of a mixture of 15-30-30 (Table 6). These benefits were largely from improved quality, since the volume of production of tobacco was increased only 10 to 30 percent, whereas the volume of other crops was increased generally from 20 to 50 percent by the use of fertilizer.

Possible changes in prices of both fertilizers and agricultural products must be considered in planning future programs to increase the use of fertilizer in Iran. If prices of fertilizers should decline substantially as a result of production by the Shahpur plant, this could cause an increase in the demand for fertilizer for wheat and cotton. It is not likely that this decline in fertilizer prices will affect significantly the demand for fertilizer for other major crops, since the profit rates are already quite high for these crops.

On the other hand, declines in prices of agricultural products can discourage farmers from using fertilizer on some crops. In the case of wheat, for example, many farmers, and perhaps most of them, sold wheat in 1968 at prices substantially below the six rials per kilo which has been assumed in the evaluation of the benefits from use of fertilizer (Tables 4 and 6). The range of prices received for wheat in 1967 was 3.5 to 6 rials (Table 7). No doubt, many producers received no more than 4.5 rials in 1968. This gives a fertilizer-wheat price ratio of about 4.8 instead of the ratio of 3.6 which was used to calculate the values in Tables 4 and 6, i.e. 6 rials per kilo of wheat and 21.7 rials per kilo of N and P_2O_5. Even if the price of fertilizer declines 20 percent, the price of wheat at 4.5 rials gives the rather unfavourable fertilizer-wheat price ratio of 3.8.

Thus, there is also a serious need for study of prices received by farmers to determine what measures, if any, are justified to encourage increased production. The lowest prices probably prevail in not only villages that do not have access to good roads, but also in many other areas in years when there is a relative surplus of the crop in question. Again, this seems more likely to be a problem for producers of wheat, cotton, and barley than for other crops, because of the relatively lower benefit-cost ratios for these crops. The Ministry of Agricultural and Consumers Goods is studying the need for government action to stabilize and promote uniformity in the prices of these and other crops.

FERTILIZER SUPPLIES, MARKETING, AND DISTRIBUTION

Production and Importations

The Government of Iran has strongly promoted the increased use of chemical fertilizers since 1957, including the installation of a government owned fertilizer plant at Shiraz which began operations in 1963. As a result, the use of chemical fertilizer in Iran has increased from 4,890 tons in 1957-58 to 160,000 tons in 1967-68, an increase of 30-fold in 10 years (Table 8). Private companies and individuals have participated by importing and distributing more than half of the total supply during the years of 1961 to 1965, inclusive.

The Shiraz plant produced only 3,578 tons of nitrogen in urea and ammonium nitrate in 1963 (Table 9). This was increased to 26,200 tons of nitrogen in 1967-68, when an additional 13,800 tons of nitrogen were imported. The imports and use of P_2O_5 have increased rapidly, from 9,914 tons in 1963-64 to 29,000 tons in 1967-68. The Shiraz plant does not produce P_2O_5.

In 1956, the Chemical Bongah was established in the Ministry of Agriculture, with the responsibility for importation and distribution of fertilizers. It also distributed the products of the Shiraz Fertilizer Plant, beginning in 1963. The Bongah authorized limited imports of fertilizers by private persons and groups and it has imported fertilizers for its own distribution. The Bongah was replaced in late 1967 by the Fertilizer Distribution Company (FDC), a new agency of the National Petro-Chemical Company of Iran, a wholly government owned concern.

FDC's functions are to market in-country produced fertilizers within Iran. They are currently distributing the production from the Iranian Fertilizer Company at Shiraz, and eventually will market

the production of Shahpur Chemical Company at Shahpur, on the Persian Gulf. FDC is also responsible for the direct importation of fertilizer products, as it sees fit and for allocation of import permits to private fertilizer importers. FDC is currently in the early phases of organizing its marketing and distribution organization, establishing sales districts, locating and renting warehouse spaces, and establishing pricing schedules and sales policies.

WAREHOUSING IS A PROBLEM-- *Good warehousing can reduce losses of fertilizer in storage. A loss of 0.1% of 5000 tons of diammonium phosphate in a warehouse is a loss of 51, 800 rials.*

Methods of Distribution

Sales through State and Semi-State Economic Enterprises— This has been one of the most efficient means and expected to handle 7 to 10 percent of the fertilizer distributed in Iran. These enterprises sell fertilizers to the farmers whose products they buy. They include companies which process sugar beets, sugar cane, tea, oil seeds, tobacco, cotton, and other products. These enterprises have had enough technicians to give adequate instructions to farmers and also have been able to obtain a high rate of compliance with these instructions. Other improved practices also usually have been applied along with appropriate fertilization.

The distribution through cooperatives— This began in 1963, with the advent of the land reform program. In 1967 to 1968, there were about 1,600 cooperatives handling 13,000 tons of fertilizers for their members or 8 percent of the total fertilizer consumed in that year. There are about 7,000 other coops which have not participated in this business. Many of the later are in areas without irrigation and where rainfall in insufficient to permit profitable use of fertilizer under present knowledge or technology. In this program, the Fertilizer Distributing Company delivers the fertilizer to cooperative unions each of which provides fertilizers to about 15 coops.

Extension Service package programs— Another procedure for distribution of fertilizers is through the Extension Service (probably 5 to 10 percent of the total fertilizer distributed in Iran in 1968-69), which is known as the "package" program. This program is becoming reasonably well organized, and provides to farmers credit for fertilizer, seed and other inputs along with technical assistance. The package program on rice has received good reception from farmers and is resulting in adoption of the package concept by the farmers. Plans are being prepared for similar programs for other crops.

REPACKAGING CALCIUM AMMONIUM NITRATE– *Proper manufacturing, packaging and warehousing of fertilizer can prevent much of the losses of projects in storage. These losses give a product a bad reputa- among dealers and farmers.*

The private sector— In Iran, the private sector has made a major contribution toward increasing fertilizer use and probably will continue to do so. The private distributors and dealers sell the

remainder, currently estimated at 70 percent of the total retail sales of fertilizers, sold to farmers.

Several private organizations have been active in the distribution of fertilizers to farms and their ability to meet the fertilizer needs of farmers has been growing rapidly. In fact, their rate of growth seems to have been restricted primarily by available credit and the limited volume of fertilizers which they have been permitted to import. FDC's major outlet for sales is through these private distributors and dealers of which there are several hundred in Iran.

There are at least three very active and capable private fertilizer importers in Iran. Two of them are sales agencies for European manufacturers and the third imports from the best available source. Each sells directly to several district distributors (up to 20) and each of these sells to several village dealers (usually 10 or more) who sell to the farms. The importers handle other agricultural chemicals and as do most of their dealers and agents. Some also handle seeds and farm equipment.

Prices — Prices of fertilizers are established at the wholesale level by FDC, including imported products as well as domestic products. The cost per ton of nutrients varies from 14,000 rials for the nutrients in diammonium phosphate to 22,870 rials for the nutrients in the 20-20-0 complex fertilizer (Table 10). These variations indicate the need either for some adjustment in price relationships, or for increased education of farmers in regard to the relative economy of the various products.

Private fertilizer importers were allowed to import urea and diammonium phosphate last year, although in quantities below effective demand levels. As a result, in several instances urea was sold during the peak shortage period in Tehran to dealers at 11 rials per kilo, or 10 percent above the suggested retail price of 10 rials per kilo to farmers. In turn, farmers, in some instances, paid as high as 14 to 16 rials per kilo, delivered to the villages. It is hoped that under FDC guidance, adequate stocks of fertilizer will be made available on a timely basis to meet farmer demand, so as to keep the prices at more reasonable levels. On the other hand, in-country produced calcium ammonium nitrate (26 percent of N) and 20-20-0 compound fertilizer, both produced at Shiraz, received very poor acceptance at the farmer level. This was due partly to the physical characteristics of these fertilizers, caking, poor particle size, and the difference in colour of the compound fertilizers compared to those to which the farmers had been accustomed. Another complaint heard was the inadequate support for calcium ammonium nitrate and 20-20-0 in the educational programs of the extension service.

The sales of fertilizers at "high" prices probably have not affected net farm incomes as much as the late deliveries and failure to deliver the needed fertilizers. A farmer may expect a benefit from fertilizer equal to at least 200 percent of the cost of the fertilizer, so that a small increase in the price is relatively unimportant (Table 3 and 6). A delay of a week in his receipt of fertilizer may cause a substantial reduction in the yield of the crop for which it is used or the fertilizer may arrive too late to be used at all in the current season.

The following is an example of how the retail price for urea is built up from FDC's wholesale price to a farmer retail price.

- FDC sells to a provincial distributor at 8.3 rials per kilo delivered.
- The distributor adds 1.08 rials to cover his cost for interest (13 percent) and 0.02 rials for warehouse handling and delivery to a village dealer. He also adds 0.5 rials (5 percent) for overhead costs and profit resulting in a selling price of 9.9 rials per kilo to the village dealer.
- The village dealer adds 1.1 rials for overhead costs, handling, interest and profit = 11.0 rials per kilo to the farmer.
- In summary, the gross margin between FDC and the farmer is 11.0-8.3 = 2.7 rials or 32 percent.

This example may or may not be typical. It is known that farmers sometimes have paid as much as 16 rials per kilo for urea, although prices above 11.5 rials probably have been paid only where farmers have had difficulty in obtaining the supplies of urea that they needed. Thus, adequate supplies from two or more sources are the best guarantee of fair prices for farmers.

Planned Product Supplies for 1968-1969

FDC is planning to have available in Iran for 1968-69, about 100,000 tons of phosphate fertilizer, 96,500 tons of nitrogen fertilizer product, and 10,000 tons of compounded fertilizer (20-20-0), the latter to be produced at Shiraz. Fertilizer inventories are currently estimated at 30,000 tons, primarily compound fertilizer. All of the phosphate product is to be imported while only 46,500 tons of the nitrogen fertilizer will be imported, the difference obtained from in-country production.

As shown in Table 10A, Iran is planning to import during 1968-69 an estimated 12,950,000 rials worth of fertilizer and to distribute

in-country production valued at 4,720,000 rials. These quantities seem adequate to meet farmers' effective demand for this year. Current estimates are that FDC will increase the above quantities of imports by 20 to 30 percent to cover the 1969-70 season needs.

Dealer Problems

Fertilizer distribution is still in the state of change with many small fertilizer dealers not aware of FDC's role. In time, FDC will be able to make contact with these dealers and assist them in procurement and timely fertilizer deliveries. In the past, fertilizer dealers have relied very heavily on supplies from fertilizer importers.

FDC plans to sell Iranian fertilizer, as well as imported fertilizers, directly to fertilizer distributors, cooperatives, the Extension Service, processors of agricultural products, dealers, and farmers. The private importers will sell their fertilizers to the same types of organizations and, in some instances, to large farm operations. Largely because of inadequate financing, dealers at provincial and local levels often have not been able to obtain the quantities of fertilizers that they were capable of selling to their farmer customers. Dealers reported that if they could obtain adequate credit and timely delivery of fertilizers, they could increase fertilizer sales by 50 to 100 percent. Dealers emphasized the importance of the problem of their inability to obtain fertilizers in time to make timely delivery to farmers to meet the fertilizer needs of a particular crop. This, in many instances, has been due to the inability of the dealers to obtain adequate financing and to schedule shipments of fertilizer sufficiently in advance of the time of its use. Another problem is the shortage of fertilizer warehouses in provincial towns and villages and the resulting necessity of relying on stocks at distant ports of entry or at the fertilizer plant.

The Government's fear of excessive profits by private dealers seems to be largely a result of misunderstanding. For example, some government officials think that a gross margin of 5 to 7 percent is enough to cover interest and all other expenses of sales, not including transportation. Distributors and dealers, however, need a total gross margin of at least 15 to 25 percent under current financing and product handling costs. The difference is due largely to the high interest costs which they must pay to buy on credit from FDC and from importers and credit losses from bad debts. It may be assumed that unexpected circumstances will prevent some farmers from paying for the fertilizer that they buy on credit (death, natural disasters, etc.). The private dealers must include these losses as costs of their operations. Also, there are other factors that cause variations in costs of fertilizer distribution, such as the ability of

the farmer to repay what he purchases on credit, the volume sold, and the time and place of the sales. These variations require that distributors and dealers be allowed some flexibility in the prices that they may charge for fertilizers.

It is often found that private dealers are better collectors of accounts receivable than are government agencies under similar circumstances. This is because the private dealers have more flexibility for making adjustments in credit terms, when needed, and because they give more consideration to the credit standing and repayment ability of their clients. Where there are adequate supplies of fertilizers and if there is competition between two or more dealers, or between a dealer and a government agency that sell fertilizer, the farmers are not likely to pay "high" prices. Restrictions on the activities of the private sector, therefore, should be at a minimum in order to promote adequate distribution of fertilizers to all farmers at fair prices.

CREDIT FOR FERTILIZER DISTRIBUTION - DEALERS AND FARMERS

The most important factor limiting the expansion of fertilizer consumption in Iran probably is the current inadequacy of the credit for distributors, dealers, and farmers. A distributor or dealer has three methods to purchase fertilizers from FDC, as follows: 1) cash payments, 2) credit, giving a real estate mortgage as security or, 3) credit, giving an IOU, known locally as a "check" endorsed by the local bank. The ability of a dealer to obtain ready-cash to procure fertilizers is limited partly by his need of cash to finance procurement of pesticides and other items for sale. The use of ready-cash is limited and closely controlled for those items of rapid turnover.

The use of mortgages for procuring fertilizer products is limited to those dealers with property not currently obligated to banks or other borrowers. Many dealers are small and do not have sufficient property with which to procure their fertilizer requirements by this method.

The use of a co-signed check (IOU) is currently in wide use by distributors and dealers. However, it is very expensive, resulting in a total interest charge to the distributor or dealer of approximately 13 percent on his purchase price. Banks charge a fertilizer dealer 3 to 5 percent for co-signing his check and require the dealer to deposit 10 percent of the face value of the check in the bank without interest. FDC then charges the fertilizer buyer 6 percent interest for 12 months for purchasing with the "check."

Today's interest payments, sales and handling costs, and profit margins increase the cost of fertilizers to farmers 30 to 40 percent

above FDC's delivered cash prices to fertilizer distributors. In addition to the 13 percent interest charge which a fertilizer reseller must pay to procure fertilizer on credit, he must add 10 to 15 percent mark-up to cover his operating expenses and profit. Distributors in large towns who are in a position to procure directly from FDC or private importers sell approximately 60 to 80 percent of their fertilizer to village dealers. Village dealers, in turn, add 5 to 10 percent for cash sales and 10 to 20 percent for 9-month credit sales. Credit sales by village dealers represent 80 to 95 percent of their total sales. Sales are normally paid for by the farmer with crops which in many instances are sold at prices below market prices as a result of pre-harvest agreements with buyers of the crops.

RETAIL POINT OF SALES– Village fertilizer dealers handle most of the fertilizers sold to farmers. About 80% of their sales involve crop-term credit agreements.

FDC is currently receiving four months of credit from the Iranian Fertilizer Company at Shiraz. This type of credit needs to be lengthened in order to allow FDC to lift products for warehousing near the points of sale to farmers, and additional capital needs to be made available to FDC. Most fertilizer plants have warehouses with a capacity for only 30 to 60 days of production. Thus, orderly and continuous movement of fertilizers from the production plant to warehouses in the market place is essential in order to maximize the economic advantages of domestic manufacturing.

FDC is aware of the problems of the distributors, dealers and farmers and is in the process of developing a marketing distribution

program that will place fertilizer in the hands of the farmers at reasonable prices and in time for proper crop fertilization.

The Agricultural Bank of Iran recently had nine billion rials for agricultural production loans and it is expected that this will be doubled by 1972. The Bank has 169 branch offices throughout the agricultural areas of the country and each branch has several loan agents for contacting farmers. Production loans have increased rapidly since the beginning of the land reform program in 1962, but it is estimated that private money lenders still provide 75 percent of the loan funds used by farmers, for which high rates of interest are charged.

In 1965 the Bank loaned 14.5 million rials for fertilizer purchases by farmers and in 1967 the total value of all new loans to farmers was 5 billion rials. In recent years the Bank has been making rapid progress toward integration of its services with the technical assistance that is provided by the Extension Service. This is being done now for the package program on major crops in some villages in each of six provinces and others are being added each year. In this activity, the bank agent and the extension technician go together to villages where the package program is to be applied on one or more crops. After explaining the program to the farmers in a meeting, the names of interested farmers are recorded and a visit is made to see the land that is to be planted in the program. Then the extension workers and farmers agree on the practice to be applied and plans are made to provide the needed fertilizer, seed, and other inputs. If the farmer wants credit, he may be given authorization to go to a private supplier for some items. For the package program, however, these inputs generally are supplied by a cooperative or by the Extension Service, and the farmer signs a note promising to pay for them at harvest time. He also pays 6 percent interest for these loans, although the cooperative pays interest to the Bank at the rate of only 4 percent. The 6 percent rate seems very low under the circumstances, and consideration should be given to a higher rate, especially for short-term loans.

Mortgages are required as security only for medium and long-term loans, short-term loans being secured generally by one or two co-signers, or only by the signature of the member-borrower. The members of cooperatives contribute capital for its operations, after which the Bank loans to the cooperative an amount not to exceed 400 percent of the capital provided by its members. These coops were mostly formed as a part of the land reform program, beginning in 1962, and their services are being rapidly expanded. Some of them employ technicians who give instructions to farmers in regard to the use of improved practices.

Loan collections are relatively good. Nevertheless, the bank agents visit the villages at harvest time to give the borrowers every opportunity to make their payments in order to reduce the possibility that they might spend the money for other things. In 1967, about 94 percent of the loans due were collected and a part of the remaining 6 percent is expected to be collected in 1968.

It is estimated that the total farm value of fertilizer to be utilized in Iran in 1972 will be nearly 3 billion rials, an increase of about 2 billion rials above the level of 1967. It may be estimated that 50 percent of the increase in sales to farmers will need to be with credit from the Agricultural Bank, or an increase of about a billion rials in five years. This will require a very rapid increase in the volume of credit for this purpose, considering the fact that bank loans for fertilizer purchases were only 14.5 million rials in 1965. On the other hand, the needed credit expansion seems feasible, in view of the paid-in capital of cooperatives amounting to 1.3 billion rials and the Bank's authority to loan 400 percent of the paid-in capital.

Suggestions on How to Create More Credit

As pointed out earlier in this report, more than 60 percent of the retail sales of fertilizer are made by private dealers and distributors. These sales are nearly always required credit to be extended by the retailer. This system functions about as follows.

Village dealers obtain IOU's from the farmers for fertilizers extended on credits. In many instances these checks are co-signed by neighbours or friends of the farmer. The village dealer, in turn, obtains his fertilizer on credit by use of his personal check. The provincial fertilizer distributor creates his own credit instrument, a check (IOU) and obtains a co-signature from his local bank and presents it to FDC or to a private importer as security for his fertilizer loan.

It is suggested that one way to expand fertilizer credits would be for the provincial distributor to co-sign his village dealers' checks and present these along with a 10 percent cash deposit to FDC as security for a fertilizer loan. If FDC would accept these co-signed village dealer checks from the distributors at 75 percent of their face value advancing credit to the distributors accordingly. This would provide major increases in the volume of credit available for fertilizer purchases by distributors, dealers and farmers. This system also would reduce interest charges and fertilizer costs to distributors, dealers and farmers. Perhaps it would be more appropriate for the Agricultural Bank to provide this credit, rather than FDC.

A PROVINCIAL FERTILIZER DISTRIBUTOR– His main limitation for increased sales is the shortage of funds. He is limited in the amount of available credit and its high cost. He usually pays 10-13% interest and this increases the cost of fertilizer to dealers and farmers.

Credit needs to be expanded so that dealers and distributors may purchase larger quantities of fertilizer to meet their customer demands. It is suggested that dealers' checks (IOU), when co-signed by distributors, be accepted as collateral. Distributors would deposit an amount equal to 10 percent of their fertilizer procurements in cash and the balance would be covered by dealer checks. This would reduce the cost of credit to distributors and dealers and it would reduce costs of fertilizer to the farmers at the same time making available larger quantities of fertilizer on credit.

TRANSPORTATION

The major agricultural and industrial areas of Iran are connected by hard surfaced roads and railways. Roads from provincial towns to villages are primarily dirt roads passable by truck in good weather only. Approximately one-third of the villages in Iran are inaccessible by ordinary wheeled vehicles, and many of these villages are in marginal farming areas. Recently there has been a reduction in hauling charges for rail shipments of fertilizer, and the new rail rate of 0.75 rial per ton-kilometer is significantly lower than the truck rates of 0.97 to 1.10 rials per ton-kilometer. FDC, however, has been able to enter into contracts with truckers for long hauls

at 0.87 rial per ton-kilometer. Short hauls by truck (20 miles and under) are quoted at 400 rials per ton including loading and unloading.

The past policy in Iran for pricing of fertilizer has been to offer each fertilizer product at the dealer level on a one-price basis in all parts of the country. These prices include the approximate average cost of freight charges. FDC is continuing to follow the same procedure. The cost of shipping a ton of fertilizer from Shiraz to points of consumption varies from 300 rials per ton to 2,000 rials per ton. The average cost per ton of product sold by FDC will vary as product sources change from importations to local production, and as fertilizer consumption increases in the Caspian and Gorgan areas. Current indications are that average costs per ton for transportation are about 1,200 rials per ton. As fertilizer production in Iran increases, FDC should be in a position to enter into more freight-rate contracts with truckers and railroad officials to move fertilizer products from the production points of Shahpur and Shiraz to provincial warehousing locations at rates that will be advantageous to FDC and to the truckers and rail carriers as well.

Truckers involved in shipping rice, cotton, tea and other products from the Caspian Sea area to the Persian Gulf area for local consumption and export, should be in a position to backhaul fertilizer from Shahpur and Shiraz at advantageous rates. By scheduling fertilizer movements on a year-around basis these truckers can be assured of cargoes on return trips to the Caspian and Gorgan areas.

It is suggested that contracts be negotiated with truckers to transport fertilizer from Shiraz and Shahpur on uniform monthly basis to provincial warehousing points. Truckers who are currently hauling agricultural products for consumption or export to the Persian Gulf should be approached. The State railroad company should also be approached for the carrying of fertilizer on a similar basis.

IRANIAN WAREHOUSE FACILITIES AND REQUIREMENTS

Warehouses for fertilizers are needed at several levels within a country's distribution program: at the point of production, at the port of entry, at key provincial distribution centers such as sugar factories, cotton gins, distributors' and dealers' locations, in villages, and ultimately on the farms. Currently, approximately 50 percent of Iranian fertilizer needs are supplied by imports. These imports are normally made 60 to 90 days prior to the season of use. This has resulted in highly efficient use of Iranian warehouses. Warehouses have been used for other commodities during the balance of the year when not in use for fertilizer. This reduces the warehousing cost per

ton of product handled. However, any error in import scheduling or delay in product delivery can have a drastic effect on product availability at the farm which may be more costly than less efficient warehousing.

It is currently projected that the Shahpur Chemical Company production will have nearly its full impact on imports during the 1970-71 season. Imports of nitrogenous fertilizers will not be needed in that year but imports of phosphates and potash will be required. Also it will be necessary to depend on imports for certain special materials such as ammonium sulphate for the tea growers and possibly some compound fertilizers to meet specific agronomic requirements.

Beginning in 1970-71, warehouses at the production level will store 30 to 60 days of the annual domestic production, while provincial and village warehouses will be required to store a minimum of half of all Iranian fertilizer needs. Some provinces that have only one major crop will be required to accumulate and store nearly their entire annual fertilizer requirements before this crop is planted. This will reduce current efficiency in warehousing as certain warehouses will have to be set aside specifically for fertilizer on a 12-month basis. Under good supply logistics it should be anticipated that about 10 percent of the annual volume of fertilizer used will be carried over from one season to the next. If overall country inventories run below 10 percent at the end of a year, farmers in several locations undoubtedly will have been shorted on their fertilizer needs.

Provincial fertilizer distributors report that, under their current financial condition, it has not been possible for them to accumulate stocks of fertilizer 3 to 4 months in advance of anticipated sales, as they should do. Most provincial and dealer stocks of fertilizer are procured and warehoused only 30 days prior to anticipated sales. They also report that about 30 percent of the fertilizer distributed annually is delivered directly to village dealers or large farms. This has resulted in reducing the current amount of warehouse space that distributors have found necessary to have available. In provincial cities and towns, distributors have currently been able to obtain the use of warehouses on a rental basis without difficulty. However, this still results in a ratio of annual sales to warehouse space for most distributors of 5 to 1 and in some instances 3 to 1. An average of 3 to 1 has been used in computing future Iranian warehouse needs at the provincial level (Table 11). Using this ratio, it is estimated that 53,300 tons of fertilizer were stored temporarily at the provincial distribution level in 1967-68. This was in addition to warehouses at producing plants, at ports of entry and in villages. With sales anticipated to grow to 835,000 tons of product by 1981-82, 185,000 square meters of

warehouse space will be needed at the provincial town level. Each village dealer normally has space available in his store or nearby to warehouse only 5 to 10 tons of fertilizer and his sales depend on being able to procure fertilizer from provincial distributors as needed.

Currently, fertilizer warehouses at the provincial level consist of storage space at rice mills, cotton gins, stores, and other places in which a few bags of fertilizer can be protected from the hazards of the weather. Current construction costs for fertilizer warehouses at the provincial level are reported to be 1,000 to 1,500 rials per square meter. This is exclusive of land cost. Land costs are estimated to vary from 200 rials per square meter to as high as 1,500 rials per square meter depending on the size of the city and whether the warehouse is to be located on the outskirts of the town or city or in the heart of the industrial area. Naturally, a fertilizer warehouse does not need to be in the center of a city or town and can well be located in a suburban area, provided it has access to a hard surfaced road and preferably it should be near a railroad.

Warehouse rental costs are currently quoted at 75 to 150 rials per ton. Distinction is not made as to length of time that the fertilizer may stay in storage at this rate. Rates vary from area to area and normally include unloading of the transport vehicle and reloading out of the warehouse. Warehousing practices, as witnessed in provincial towns and villages, are extremely poor. Fertilizers in some instances are stocked 20 to 23 bags high resulting in product caking and broken bags. Use of inventory cards at warehouses are not in evidence and housekeeping is generally very poor. The manner in which fertilizer is warehoused indicates that little thought has been given to proper stock rotation. As fertilizer warehousing needs increase more emphasis will have to be placed on care of warehouse stocks.

Forty five million rials is a small fortune; this is the value of 5,000 tons of fertilizer in a warehouse. Warehouses of good quality and warehouse practices that reduce product loss by 0.1 to 0.2 percent can save 45,000 to 90,000 rials. Current warehouse conditions as witnessed are causing product damage and losses of an estimated 1 to 3 percent.

In order to maximize production from Iranian fertilizer plants, it will be necessary to establish storage at provincial towns, so as to maximize liftings from fertilizer plants on a uniform monthly basis. The question remains as to who will pay the costs of warehouse construction and fertilizer storage? Who is to own the materials stored in the warehouses and how are they to be financed? It is clear that economic incentives will have to be created if FDC and the fertilizer distributors and dealers are to assume these expenses. One

thought would be for fertilizer producers to offer products to FDC on a consignment basis. FDC in turn could establish off-season discounts to fertilizer distributors and dealers with delayed billing. These incentives must be of sufficient magnitude to encourage the distributor to build or lease a warehouse in his provincial town. A 2 percent off-season discount with the billing delayed until 30 days from the start of the fertilizer use period would sufficiently compensate the distributors and dealers for these costs. Annual quantity discounts will also provide some incentive for early purchases and storage for longer periods.

The question of where the distributor and dealer will obtain financing to build needed warehouses is one that still needs to be resolved. Taking 1967-68 as a base year, by 1981-82, 150,000 square meters of additional warehouse space at the provincial level will need to be constructed. This will result in an expediture over the next 14 years of 200,000,000 to 300,000,000 rials to meet fertilizer warehouse needs in 1981-82 (Table 11). A financing program of this magnitude needs the government's attention and assistance.

A system of preseason discounts needs to be established to encourage fertilizer distributors and dealers to procure fertilizer during the offseason. A delayed billing system (not billing the preseason fertilizer deliveries until 30 days prior to the use period) is needed on these procurements to encourage warehousing at points of sale by distributors and dealers (see section on pricing).

It is suggested that a committee be established comprising FDC, the Agricultural Bank, the Ministry of Agriculture, and the Plan Organization to develop, prepare and implement a plan whereby private distributors and dealers may procure credit at low interest rates with government assistance for the purchase of land and construction of fertilizer warehouses.

PRICING SUGGESTIONS

FDC, no doubt, will want to establish prices of fertilizer which will not only promote adequate distribution and minimum prices to farmers, but which also will encourage maximum participation in fertilizer distribution by private distributors and dealers. FDC may also suggest prices for sales by other government agencies and cooperatives, but it seems impractical for FDC to try to provide direct control over prices for sales by private persons.

It seems desirable that FDC establish a series of prices for each fertilizer product, including a specified minimum quantity of the

product to be sold at each price, when delivery is taken directly from FDC. These prices would apply at all FDC warehouses in all parts of Iran.

This suggested pricing system is only for cash sales by FDC. Credit sales to distributors and dealers, if made by FDC, should reflect actual credit costs. Credit sales to farmers by dealers should also reflect credit risks and costs.

This pricing system is intended to develop a strong distributor-dealer organization. This organization should reduce to a minimum the work done by FDC and improve responsiveness to market changes and farmer demands.

Distributors and dealers have functions to perform. The following cash pricing system would compensate them for these functions and still allow dealers and farmers to buy from FDC. This would provide insurance against the possibility that distributors and dealers would not perform their assigned tasks and/or try to overcharge for their services.

FDC's functions of product procurement, forecasting, warehousing, credit, logistics, control of import allocations, etc., is a difficult one to perform well. All assistance and support of the private sector must be encouraged. Policies should be established and carried out to earn and build confidence and support.

A three level pricing system is suggested, establishing one price at each level for fertilizer delivered anywhere in Iran. These levels are:

1. Sales to distributors (authorized FDC agents) in provincial towns and cities
2. Sales to dealers
3. Sales to farmers.

Authorized FDC distributors should be selected in major provincial towns who are capable of 1) providing adequate warehousing; 2) giving agronomic services to their dealer and farmer customers, 3) being able to purchase fertilizers in minimum truck and trailer or rail car-load quantities and, 4) have sufficient financial resources to allow them to establish sizeable credit limits.

A quantity pricing schedule should be included that would establish for distributors a price incentive to increase their volume of annual sales and to cover the additional costs and risks that are involved. A preseason discount with delayed billing also is needed.

A dealer price should be established so that any dealer with adequate cash or credit may buy directly from FDC.

A price should be established for each fertilizer product no matter where it is sold to the farmer in Iran by FDC. This price should be for a minimum of 20 bags of 50 kilos each at FDC provincial warehouses. This would establish a ceiling price for one ton cash retail purchases. The FDC cash prices and village dealer selling prices, thus, can be readily compared by the farmer. The farmer would then have an opportunity to buy directly from FDC if the prices charged by the village dealer for delivery, service and credit were not satisfactory.

Suggested Price Schedules

FDC AUTHORIZED DISTRIBUTOR CASH PRICE SCHEDULE
(Minimum truck load or car load orders only)

Schedule 1[5] Up to 5,000 tons per year	Cash Price (Rials per ton delivered)
Urea (46 % N)	7,855
Calcium Ammonium Nitrate (26 % N)	3,943
Complex (20-20-0)	8,693
Triple Super Phosphate (46 % N)	8,292
Di Ammonium Phosphate (18-46)	8,856
Ammonium Sulphate (21 %)	3,943

Schedule 2 — 5,000 tons to 10,000 tons per year. Schedule 1 less 3 percent discount.

Schedule 3 — 10,000 tons to 20,000 tons per year. Schedule 1 less 4 percent discount.

Schedule 4 — 20,000 tons or more per year. Schedule 1 less 5 percent discount.

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5. Schedule 1 is set 5 percent lower than the dealer price schedule. Schedule 2, 3 and 4 discounts would be paid at the end of the year on the basis of annual purchases. An additional 2 percent discount to be allowed on fertilizer shipped to a distributor a minimum of 90 days prior to use period and billing set for 30 days prior to use period.

FDC DEALER CASH PRICE SCHEDULE
(Minimum truck load orders only)

	(Rials per ton delivered)
Urea (46 %N)	8,300
Calcium Ammonium Nitrate (26 %N)	4,150
Complex (20-20-0)	9,150
Triple Super Phosphate (46 %P_2O_5)	8,728
Di Ammonium Phosphate (18-46-0)	10,360
Ammonium Sulphate (21 %N)	4,150

FDC RETAIL CASH FARMER PRICE SCHEDULE
(Minimum 20 bags of any combination of products
FDC Warehouse cash sales only)

	Rials in 50-kilo bag	
	Per bag of 50 kilos	Per kilo
Urea (46 %N)	46.00	9.20
Calcium Ammonium Nitrate (26 %N)	22.80	4.60
Complex (20-20-0)	50.00	10.00
Triple Superphosphate (46 %P_2O_5)	48.00	9.60
Di Ammonium Phosphate (18-46-0)	52.50	10.50
Ammonium Sulphate (21 %N)	22.80	4.60

Note: - A gross margin of 10 percent is used between the dealer's cash price and the farmer's cash retail price schedule.

- Kilo prices are for comparison purposes only and it is not suggested that less than 20 full bags be sold at a time by FDC at retail.

FUTURE FERTILIZER PRODUCTION AND REQUIREMENTS

The future volume of production and utilization of fertilizer in Iran may be estimated on the basis of the above information. The estimates of production in future years can be calculated more accurately than those for utilization, but the estimates of both will be accurate enough to be useful for planning national programs related to foreign trade in fertilizers, as well as for needed programs to promote increases in production and use of fertilizers in Iran. Obviously, there will be need for continuous study for revision of these projections on the basis of all available information, so that

the best possible plans will be made for national programs related to the supplies and utilization of fertilizers.

Fertilizer Production

Estimates of production of fertilizers in Iran are based on the probable production of two plants, the Shiraz plant and the Shahpur plant, although it is recognized that it is possible, and perhaps probable, that one or more other plants will be installed in Iran before 1981. The estimates presented here may be useful in determining the need for additional plants in the intervening years.

Iran has one of the world's greatest reserves of natural gas. This has stimulated the decision to install in Iran a major fertilizer producing plant. It is being installed by the Shahpur Chemical Company, a subsidiary of the Allied Chemical Company of the U.S.A. The new plant is being built at Bandar Shahpur on the Persian Gulf, which is conveniently located for imports of phosphate rock and for exports of finished products. A 150-kilometer pipeline will bring natural gas to the plant from the underground reservoir at Masjid-i-Soleyman.

Early in 1970, the Shahpur Plant will begin production of seven important chemical compounds, including some fertilizers. The daily capacity will be:[6]

Intermediate Products		Products for Market	
Ammonia	1000 tons	Urea	500 tons
Sulphur	1500 tons	Diammonium phosphate	380 tons
Sulphuric acid	1300 tons	Triple superphosphate	450 tons
Phosphoric acid	450 tons	Ammonia	600 tons
		Phosphoric acid	55 tons
		Sulfur	112 tons

The diammonium phosphate and triple superphosphate cannot be made simultaneously, so that the annual production of each of the fertilizer materials is expected to be 165,000 tons of urea and 125,000 tons of diammonium phosphate or 141,000 tons of triple superphosphate (Table 12). In addition, the present plant at Shiraz will continue in production with a capacity to produce each year 46,000 tons of urea and 40,000 tons of ammonium nitrate.

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6. See Brochure by Shahpur Chemical Company

This plant may produce up to 20,000 tons of 20-20-0 fertilizer, using its own ammonium nitrate and purchased triple superphosphate. The latter would be either imported or obtained from the Shahpur plant.

The surpluses of ammonia and phosphoric acid at the Shahpur plant might be used to increase the production of finished fertilizers. Without this, the total planned annual capacity for production of fertilizers in the two plants will be 376,000 tons, or about 2.5 times the amount used in Iran in the year ending in March 1968. The new plant also may participate in the production of mixed fertilizers in plants to be located in consumer areas.

Estimates of probable production by these two plants are needed for each year in the foreseeable future. For this purpose, it is assumed that the Shiraz plant will operate at 85 percent of capacity which is slightly above past operations. The Shahpur plant is assumed to begin production on January 21, 1970, thus having two months of production in fiscal year, 1969-70. Also it is assumed that the Shahpur plant will operate at 50 percent of capacity during the first six months and 85 percent thereafter. Thus, the production of fertilizers by these plants is expected to reach the maximum annual level in fiscal year 1971-72, when the total production should be about 110,400 tons of nitrogen and 48,900 tons of P_2O_5 (Table 13).

Area Fertilized

The use of fertilizer in the future in Iran will depend upon the implementation of planned programs. The Fourth Five Year Plan anticipates an increase of 157 percent in fertilized area during the period 1967-68 to 1971-72 (Table 14). This would require an increase of 845,000 hectares of fertilized crop land from 541,000 hectares in 1967-68 to 1,386,000 hectares in 1971-72. It is planned that fertilization of crops will be limited to irrigated land, except for 200,000 hectares of wheat near the Caspian Sea, the tea and half of the tobacco. This will involve increasing the proportion of this suitable land that is fertilized from 15.9 to 37.6 percent in the Plan period (Table 14).

The program for each major crop must be studied separately in order to appraise the feasibility of realizing the goals for increasing the area of land to be fertilized. The largest increase is planned for wheat for which the fertilized area is to be increased from 150,000 hectares in 1967-68 to 500,000 hectares in 1971-72. Wheat and barley would have the largest proportionate increases in fertilized area, amounting to an increase of 233 percent for wheat and 317 percent for barley (Table 14). In view of the slow start in 1968, and the many problems discussed above, it seems likely that these goals for wheat and barley will not be realized. The purchase

of 1,500 tons of Mexican wheat seed in 1968 for planting in the higher rainfall area near the Caspian Sea and on irrigated lands in mild climatic areas, should increase the profitability of wheat, so as to realize the planting of this type of wheat, possibly on as much as 100,000 hectares in 1971-72. Even so, the plan projections would require the use of fertilizer on 400,000 hectares of other varieties of wheat, for which the economic benefits are relatively lower than for most other crops.

It appears, therefore, that the areas of land that will be fertilized for wheat and barley in 1971-72 will be somewhat less than projected by the Fourth Five Year Plan. It is suggested that the increase in area to be fertilized for wheat and barley in 1971-72 may be only about half as much as that projected by the Plan. This reduces the projected area to be fertilized for wheat to 325,000 hectares in 1971-72, or 20.1 percent of the "suitable" land, compared to 30.9 percent which has been projected by the Plan for 1971-72 (Table 15).

There is some doubt about realization of the projected increase in area to be fertilized for cotton, because of the relatively low return resulting from use of fertilizer on the crop. (Tables 4 and 6). Nevertheless, no change is suggested in the projected area of land to be fertilized for cotton, because already about 20 percent of the irrigated cotton is fertilized compared to only 9.4 percent of the wheat, and the cotton associations seem better prepared to promote the increased use of improved practices than those who are responsible for the wheat and barley programs. Also the plan anticipates a relatively slower rate of increase in fertilized land for cotton 150 percent compared to the increase on wheat land 233 percent.

There also is doubt about the feasibility of the projected increase in fertilized area for forage crops. This is in spite of the fact that the benefits from fertilizing alfalfa have been good (Tables 4 and 6). The reasons for the doubt are the following:

- The projected increase in area to be fertilized in 1971-72 is 300 percent of the area fertilized in 1967-68, a very high rate increase (Table 14).

- This increase assumes a 50 percent increase in area planted in forage crops, which may be difficult to realize.

- Farmers are usually slow to adopt improved practices for forage crops, as indicated by the fertilization of only 10.6 percent of these crops in 1967-68.

It is suggested, therefore, that the projected increase in area to be fertilized for forage crops should be reduced to two-thirds of the Plan amount, i.e. to an increase of 30,000 hectares instead of 45,000 hectares. This would require fertilization of 21.3 percent of the area that is to be planted in forage crop in 1971-72 (Table 15).

Miscellaneous crops ("other" in the Plan) were only 22 percent fertilized in 1967-68 and the Plan anticipates that this will increase to 54.9 percent in 1971-72. The Plan does not specify these crops, but it appears that they are minor crops for which not much information is available in regard to the benefits from the use of fertilizer. Also, it seems likely that organized programs for improving these minor crops may not function as well as the programs for more important crops. It is suggested, therefore, that the projected increase in area to be fertilized for these miscellaneous crops should be only two-thirds of the increase that is projected by the Plan. This would reduce the fertilized area to 40,000 hectares for these crops in 1971-72, compared to 20,000 hectares in 1967-68 (Table 15).

For all of the other crops listed in the Plan, it appears feasible to fertilize the Plan areas as projected for 1971-72. This includes rice, sugar beets, sugar cane, vegetables, tree fruits, tea, tobacco and oil seeds.

These crops have some important advantages over wheat, barley and cotton:

- They provide higher levels of economic benefits from use of fertilizer (Tables 4 and 6).
- They are generally grown with higher levels of technology, most of them already having fertilizers used on more than 20 percent of the planted area (Table 14).
- Most of them are produced under rather good conditions of credit and technical assistance which are provided by their producers' associations or State Economic Enterprises.

The expansion of fertilizer use on these "other crops" is not without some doubts, even with these advantages. The projected levels of fertilizer use in 1971-72 require, for example, the use of fertilizer on nearly all the land planted in sugar beets, sugar cane, tea, and oil seed crops. Furthermore, it is assumed that there will be major increases in areas planted in three of these crops. The realization of these goals, therefore, is assumed to be feasible, but this will require strong and coordinated efforts by all responsible agencies, so that the package program can be applied to the extent that is required.

Rates of Use of Fertilizer

The above paragraphs refer only to the areas of land fertilized and to be fertilized. The rate of fertilizer use per hectare is of equal importance in determining the total amount used. The Plan Organization has selected a specific application rate for each crop, and these rates have been used to calculate the total use of fertilizer, the same rates being used for 1967-68 and 1971-72. Recent studies by the Soil Institute and FAO have determined "optimum" rates for most of these crops. This information, presumably, was not available when the Fourth Five Year Plan was prepared, since these optimum rates are based on crop responses in 1966. It may be expected, however, that the rate of fertilizer use in the future will be strongly influenced by these optimum rates, although generally the average rate for any crop will be less than the known optimum rate. On the other hand, the optimum rates are increased each year as a result of the increased use of other improved practices, especially more water for irrigation and more responsive varieties.

Thus, it seems reasonable to expect that the average rate of fertilizer use on each crop in 1971-72 will be close to (and may exceed) the present optimum rates, which were determined from studies of crop responses in 1966 (Table 16). The optimum rates are not known for all crops, so that studies of other crops are needed, as well as research to determine the benefits from fertilizer when the "package" of practices is applied to each crop.

It is significant, therefore, to compare the available optimum rates of fertilizer use with those used to determine the projected fertilizer requirements in 1971-72 in the Plan. These data indicate that the optimum rates require more fertilizer than the Plan rates for wheat, barley and cotton and less than the Plan requirements for other crops (Table 17). In the absence of optimum rates for some crops, the Plan rates are used to determine total fertilizer use for these crops. The Plan rates for these crops are estimated to be as follows:

Sugar cane	90-90-0	Tree fruits	90-90-0
Vegetables	90-92-20	Oil seeds	60-53-0
Pulses	40-75-0	Miscellaneous	52-40-0

These rates were used, along with available optimum rates for other crops, to estimate the total fertilizer requirements in 1971-72, (Tables 16 and 17). It is perhaps, incidental that the total calculated use of fertilizer in 1967-68 is not changed significantly by substituting the optimum rates for those used in the Plan, the total difference being only 1,175 tons or less than 1.0 percent of the amount used in

that year. Nevertheless, the projected usage of fertilizer in 1971-72 is increased 5,370 tons by using the optimum rates instead of the Plan rates on the same (Plan) areas of land. This increase is due largely to the higher level of the optimum rate on a large area of wheat for which the Plan estimates that 500,000 hectares will be fertilized in 1971-72 (Table 14).

The Plan does not contain detailed information about the basis for selection of the rates used for determining the total usage of fertilizer. In view of this and since the optimum rates are based on the latest available information, it is suggested that the optimum rates be adopted for use in calculating the total amount of fertilizer that will be required in 1971-72.

Volume of Fertilizer to be Used in the Future

There are two types of adjustments, therefore, that seem to be needed in the Plan projections of the fertilizer requirements in 1971-72, as follows:

- Decreases in the estimated hectares of land to be fertilized for wheat, barley, forage crops and miscellaneous crops (Table 15).

- Increases in the estimated use of fertilizer per hectare for wheat, barley and cotton and decreases in the rates per hectare for rice, sugar beets, vegetables, tea, tobacco and forage crops (Table 17).

The net result of these changes indicates a total nutrient requirement of 142,753 tons in 1971-72, or about 317,220 tons of fertilizer products assuming that the average content of nutrients is 45 percent (Table 18). The Plan does not include estimates of nutrient requirement in 1971-72, but it projects total product requirements to be 351,250 tons in that year. Thus, the "adjusted" estimate of 317,220 tons of product is 90.3 percent of the Plan estimate. Also, these data indicate that the nitrogen requirement of 73,825 tons in 1971-72 will be about 51.6 percent of all nutrients used, while P_2O_5 will be about 46.3 percent and the potash will be 2.1 percent.

LONG-TERM PLANNING

For longer term planning, it is necessary to project these estimates farther into the future. For this purpose, data have been prepared to indicate possible fertilizer use in two additional five-year periods, ending in 1976-77 and 1981-82 respectively. Again the estimates of total volume of fertilizer needed have been based on

estimates of the area of land to be fertilized for each crop and the rate of the application per hectare of each crop (Tables 19 and 20). Thus, it is estimated that fertilizer will be applied on 1,781,000 hectares in 1976-77 and on 2,425,000 hectares in 1981-82. These areas involve increases in land to be treated in each five-year period that are only about equal to the increase of 635,000 hectares, which has been estimated for the current period (ending with 1971-72). The fertilization of land for wheat is expected to increase at an accelerating rate, while the fertilization of some other crops is rapidly approaching the maximum area suitable for fertilization (Table 19). In 1981-82, fertilizer is expected to be applied on all, or nearly all, of the land planted in sugar beets, pulses, sugar cane, vegetables, tea, tobacco, oil seed crops and miscellaneous crops.

The probable rate of fertilizer use for each crop also has been estimated for 1976-77 and 1981-82. These estimates are based on recommended (goal) rates prepared by Dr. Garth W. Volk, although it is expected that these "goal" rates will not be realized for some crops, even in 1981-82 (Table 20). The average amount of nutrients per hectare of land fertilized is estimated to increase from about 121 kilos in 1971-72 to 155 kilos in 1981-82. Considering these estimated rates and the estimated areas of land to be fertilized (Table 19), it has been calculated that the total amount of nutrients used in Iran will be 375,600 tons in 1981-82. This volume may be compared to the 142,825 tons, which is the estimated requirement for 1971-72, an increase of about 163 percent in ten years. This volume of nutrients in 1981-82 would indicate a need for about 835,000 tons of fertilizer products, assuming that the nutrients constitute 45 percent of their weight.

A comparison of the projected production and use of fertilizer nutrients indicates that there will be a surplus of 34,960 tons of nitrogen in Iran in 1970-71 (Table 21). This surplus would increase to 36,600 tons in 1971-72, but there will be a deficit of perhaps 25,100 tons of nitrogen in 1976-77. The Shahpur plant, however, will not come into production soon enough to meet the total need for P_2O_5 in any fiscal year. It will be in full production in 1971-72, but the volume of production of P_2O_5 in that year will be about 17,000 tons less than the requirement.

The use of a chart of graph shows more specifically the comparison between projected production and the projected requirements for nitrogen and phosphorus nutrients during each year. This indicates that there will be a surplus of nitrogen each year during the period of 1970-71 to 1973-74, inclusive (Chart 1). Again it is quite clear that there will be no fiscal year in which there will be a surplus of

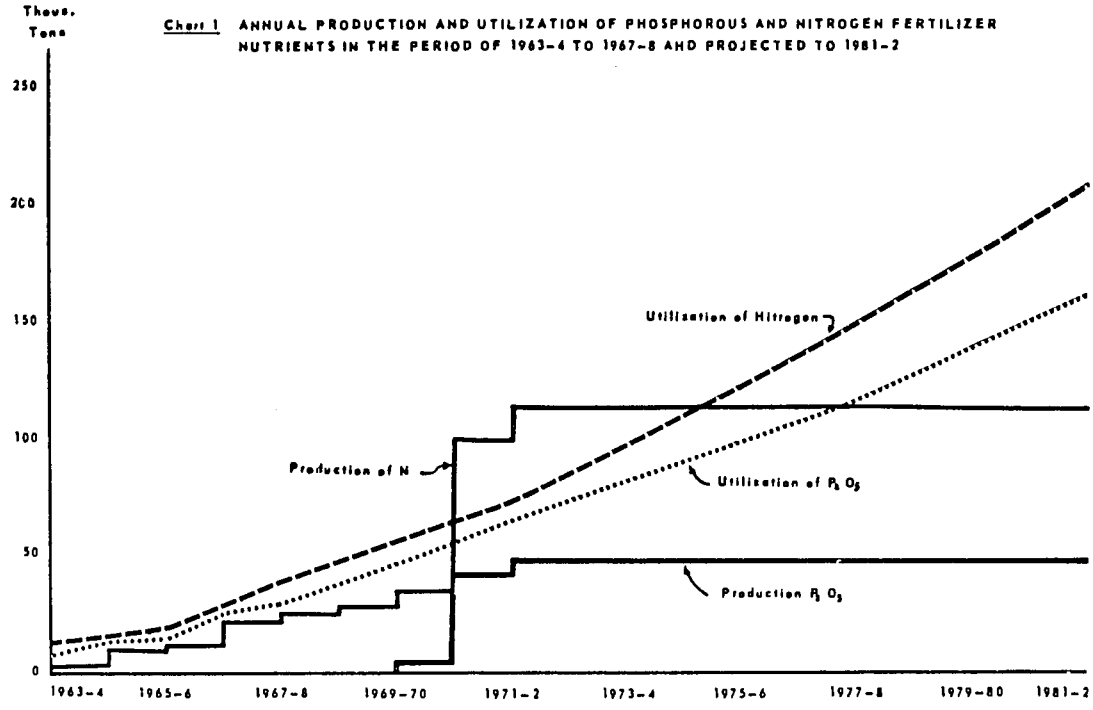

Chart 1 ANNUAL PRODUCTION AND UTILIZATION OF PHOSPHOROUS AND NITROGEN FERTILIZER NUTRIENTS IN THE PERIOD OF 1963-4 TO 1967-8 AND PROJECTED TO 1981-2

Source: Tables 11, 12, 13, 17, 20&21

phosphorous fertilizers unless the production is increased substantially above the volume that has been planned.

In conclusion, there are many factors which must be kept continuously under study, especially credit, educational programs, and distribution organizations and facilities. The future effectiveness of such factors will determine whether the use of fertilizer in the future will be greater or less than the projected amounts. The analysis of all factors therefore must be a continuous part of the planning process, which must provide both short-term and long-term appraisals of future fertilizer needs of any country, with annual revisions of estimates. For these reasons, the procedures used in the above analysis may be as useful as the estimates of fertilizer requirements that have resulted from this analysis.

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TABLE 1

AREA PLANTED, PRODUCTION AND NUMBERS OF FARMS, BY CROPS, 1960 and 1968[a]
(Area in 1000 has.: Production in 1000 tons)

Crop	Area planted 1960	Area planted 1968	Production 1960	Production 1966	Yield/Ha. (kg) 1960	No. Farms 1000 [b]	Area has. each
Wheat-Irrigated	1183	1400	1425	4200	1204	905	1.3
Rainfed	2480	2600	1163		469	1029	2.4
Barley-Irrigated	280	330	317	1035	1132	397	0.7
Rainfed	798	870	367		460	660	1.2
Rice-Irrigated	313	355	651	700	2080	257	1.2
Pulses-Irrigated	68	90	39	130	574	123	0.6
Rainfed	55	20	24		350	119	0.5
Potatoes-Irrigated	16	20[*]	39	N.A	2438	N.A	-
Cotton-Irrigated	147	200	135	160	918	134	1.1
(w. seed)Rainfed	137	155	101		737	68	2.0
Sugar beets-Irrigated	335	115	648	2830	19343	41	0.8
Sugarcane-Irrigated	1.2	5	41	500	34166	1.2	1.0
Tobacco-Irrigated	20.6	10	7.6	15	369	39	0.5
Rainfed	7.4	10	4.6		622	12.3	0.6
Oilseeds-Irrigated	22.7	25	6.2[c]	31.5[d]	273[c]	35.6	0.6
Rainfed	23.5	20[*]	1.2		51	18.8	1.2
Vegetables-Irrigated	22.4	25	194.5	N.A	8683	121.3	0.2
Rainfed	6.0	7	14.8		2467	37.5	0.2
Melons-Irrigated	37.3	40[*]	237	N.A	6353	93.0	0.4
Rainfed	55.9	60[*]	115		2057	50.0	1.1
Forage-Irrigated	48.0	142	208	500	4333	234	0.2
Rainfed	6.0	35	1.2		2000	4.0	0.2
Tea-Rainfed	15.0	26	6.6		440	N.A	-
Other-Irrigated	87.0	100[*]	97.3	-	1183	143.4	0.6
Rainfed	81.0	85[*]	76.1	-	940	142.6	0.6
TOTAL-Irrigated	2280	2857	-	-	-	2525[b]	0.9
Rainfed	3845	3888	-	-	-	4668[b]	0.8
ALL CROPS:	6125	6745	-	-	-	7193[b]	0.9

a/ Data are from the Fourth Five Year Plan, except numbers of farms are from the 1960 Census of Agriculture.

b/ These totals are more than 100% of all farms because most farms produce more than one crop.

c/ Vegetable oils.

*/ Estimated by author.

TABLE 2

PRODUCTION AND HUMAN CONSUMPTION OF MAJOR CROP PRODUCTS 1964-66 AVERAGE AND PROJECTED LEVELS FOR 1971-2 a/

Product	Production		Consumption		Per cap. Con. b/		Imports	
	1964-6	1971-2	1964-6	1971	1964-6	1971	1964-6	1971-2
Wheat	3921	4700	3613	3698	152.5	127.5	167	-(352)
Barley	1017	1135	100	100	4.2	3.4	-(neg)	-(neg)
Rice	690	934	686	908	29.0	31.3	24	0
Cotton	153	219	51	57	2.2	2.0	-(102)	-(162)
Sugar	298	775	505	583	21.3	20.1	173	8
Tea	17	28	30	39	1.3	1.3	7	11
Tobacco	17	14.4	16	14	0.7	0.5	0	-(1)
Veg. Oils	39	125	114	150	4.8	5.2	78	25
Vegetables	1170	1980	1122	1830	47.4	68.3	-(44)	-(150)
Pulses	119	170	104	159	4.4	5.5	-(4)	0

a/ Estimated total amounts are from the Plan Organization of Iran

b/ Assumed population is 23,700,000 in 1964-6 and 29,000,000 in 1971.

TABLE 3

SALES OF FERTILIZER, SEED AND INSECTICIDES BY COOPERATIVES IN IRAN 1963-67 (Metric tons)

Year	Fertilizer	Improved Seeds	Insecticides
1963	5000	0	100
1964	7134	1998	300
1965	7914	2927	73
1966	15496	3656	392
1967	11598	1585	109

Source: Mr. Mohamad Kemaly, State Planning Organization, Iran.

TABLE 4

COSTS AND RETURNS FROM FERTILIZER APPLICATIONS ON THE PRINCIPAL CROPS IN IRAN[a]

(Average responses of the principal crops to specified applications of fertilizer, 1961 - 5)

Crop	Region	Per Ha. (kg)	Production per Ha. (kg) Check (kg)	Demons. (kg)	% incr.	Percent of Return [b]
Wheat	Irrigated	30-30-0	1667	2116	26.9	207
	Caspian	30-30-0	1836	2159	17.6	149
Rice	Plateau	30-30-0	3227	3939	22.1	437
	Caspian	30-30-0	2948	3640	23.5	425
Cotton	Plateau	45-45-0	1352	1603	18.5	180
	Caspian	45-45-0	1328	1414	6.5	(38)
Sugar Beets	Caspian	45-45-0	29120	39790	36.6	507
Tobacco	Barley	15-30-30	1263	1463	15.8	957[d]
	Turkish	15-30-30	1498	1563	4.3	487[d]
Tea	(fresh)	90-30-0	4555	5415	14.4	364
Grapes	(fresh)	45-45-0	15710	18720	19.1	549
Potatoes	Plateau	45-45-0	13780	17820	29.3	516
Alfalfa	Irrigated:					
(1)	First year	15-45-0				
(2)	Other years	0-45-0	8720	10560	21.1	490

a/ Data are from publications of the Soil Institute of Iran with the cooperation of FAO, United Nations, Rome, 1966, and are based on 6917 farm demonstrations in the years 1961-5

b/ Percent of return is the increase in value of the crop expressed as percent of the cost of the fertilizer used.

c/ Cost of fertilizer is at the rate of 10,000 rials per ton of urea and the same price for triple superphosphate, or 21.7 rials per kilo of nutrients. Prices of products are in Table 7. (75 rials = $ 1.00).

d/ Tobacco benefits are from improved quality, and the resulting increases in average prices.

TABLE 5

RESIDUAL EFFECT OF FERTILIZER ON WHEAT YIELD PER HECTARE, WHEN WHEAT FOLLOWED FERTILIZED COTTON
(Data per hectare)

Item	Kazerun	Fassa	Mazandaran	Three Regions
No. of Trials	4	19	6	29
Wheat yield (kg)				
Check plot	497	1084	2058	1213
Increase: a/				
45 kg. fert.	-(7)	152	354	166
90 kg. fert.	35	182	414	210
Value of Increase (rials)				
45 kg. fert.	-(42)	912	2124	998
90 kg. fert.	210	1092	2484	1262
Return as % of Cost: b/				
45 kg. fert.	-(4)	93	217	102
90 kg. fert.	11	56	127	65

Source: Technical Report No. 10, "Results of Fertilizer Field Experiments in Iran, Winter Season, 1965-66," Soil Institute of Iran and FAO, cooperating.

a/ Increase in yield of wheat planted after fertilized cotton compared to unfertilized cotton. Fertilizer is stated in kilos of nutrients per hectare.

b/ Cost here is the cost of fertilizer for cotton during the previous year.

TABLE 6

ECONOMIC RESULTS OF FERTILIZER EXPERIMENTS WITH MAJOR CROPS IN IRAN, 1966
(All amounts are for one hectare)

Crop and Region	No. of Trials	Fertilizer Nutrients(kg)	Yield (kg)	Profit[a/] (rials)	% Return
Wheat					
Good Irrigation	88	0-0-0	1948	-	-
		30-30-0	2525	2158	265
		60-60-0	2841	2750	205
Inadequate Irrigation	111	0-0-0	7622	-	-
		30-30-0	1895	334	126
		60-60-0	2122	392	115
Caspian Rainfed	25	0-0-0	1808	-	-
		30-30-0	1992	-(200)	85
Rice-(Paddy)					
Champa Variety	36	0-0-0	3647	-	-
		30-30-0	4813	8024	715
		60-30-0	5258	10932	659
Sadri Variety	64	0-0-0	3168	-	-
		30-30-0	3862	5636	532
		60-60-0	4036	6724	444
Sugar Beets	200	0-0-0	31630	-	-
		90-45-0	40650	6086	307
		90-90-0	42940	7398	289
Cotton with Seed					
Irrigated	177	0-0-0	1359	-	-
		45-45-0	1659	2244	215
		90-45-0	1777	2918	199
Unirrigated(Gorgan)[b/]	40	0-0-0	1686	-	-
		45-0-0	1833	1080	210
		0-45-0	1790	428	149
		45-90-0	1993	1364	146
Potatoes	63	0-0-0	10400	-	-
		45-0-0	12680	5862	679
		45-45-0	13325	6919	449
		90-90-0	15135	11661	363
Tobacco (Rasht)[c/]	14	0-0-0	916	-	-
		0-30-0	1114	10861	1765
		0-0-30	1103	7148	1589
		0-30-30	1162	13439	1287
		15-30-30	1262	22275	1628
Alfalfa (Rezaieh)[d/]	20	0-0-0	4700	-	-
		0-45-0	6310	3852	494
		15-45-0	6540	4216	423
Tea (Fresh)	17	0-0-0	5195	-	-
		45-30-0	5727	9333	494
		90-30-0	6045	14936	497

Sources: Wheat data are from Technical Report No. 10. "Results of Fertilizer Field Experiments. Winter Season, 1965-66." Data for other crops are from "Results of Fertilizer Field Experiments in Iran, Summer of 1966." Both are published jointly by the Soil Institute of Iran and the FAO, United Nations.

a/ Prices of fertilizer nutrients are 21.7 rials per kilo of N and P_2O_5, and 16 rials per kilo of K_2O. Prices of products in rials per kilo are: wheat 6, rice 8 for champa and 10 for sadri, sugar beets 1, seed cotton 14, potatoes 3, alfalfa hay 3, and tea leaves 20.

b/ Best results on cotton were in Gorgan.

c/ The price of tobacco varies for the four grades. Benefits resulted largely from increases in proportions of the higher grades. Profits were similar in Rezaieh, but not as good in Gorgan.

d/ Results for alfalfa were generally unprofitable in Maragheh.

TABLE 7

PRICES RECEIVED BY PRODUCERS FOR AGRICULTURAL PRODUCTS IN IRAN, 1967

(Rials per kilo when 75 rials = $1.00)

Product	Maximum	Minimum	Typical
Wheat	6	3.5	6
Barley	5	3	5
Cotton Lint	33	49.5	14 a/
Alfalfa Hay	5	2.5	3
Rice (Polished)	32	15	8 - 10 b/
Dry Peas	12.5	7	
Dry Beans	18	10	
Lentils	12.5	6	
Tobacco	63	42	
Potatoes	6	3	3
Grapes	10	4	
Citrus Fruit	18	10	
Sugar Beets	1.0	0.85	1.0
Canteloupe	3	2	
Watermelon	3	2	
Tea (fresh)	20	15	

Source: Maximum and minimum prices are from a survey of 300 randomly selected villages in 1967 by Ahmad Jalali, MinAg, Iran. Typical prices are those used by the Soil Institute to evaluate the benefits of fertilizer.

a/ Seed cotton, or about 4.2 rials for a kilo of lint.

b/ Paddy rice: 8 rials for champa and 10 rials for Sadri variety.

TABLE 8

SUPPLIES AND UTILIZATION OF FERTILIZER PRODUCTS IN IRAN 1957-8 to 1967-8 a/
(Metric tons of product)

Year a/	Domestic Production	Imports Govt.	Imports Private	Total	Export	Utilization Tons	Utilization %Increase
1957-8	0	N. A.	N. A.	4,890	0	4,890	-
1958-9	0	8,200	6,800	15,000	0	15,000	223
1959-60	0	10,750	9,700	20,450	0	20,450	36
1960-1	0	26,000	10,145	36,145	0	36,145	77
1961-2	0	9,000	29,980	38,980	0	39,980	11
1962-3	0	6,500	40,806	47,306	0	47,306	18
1963-4	9,579	9,500	40,042	49,542	4,000	54,820	16
1964-5	23,661	13,750	33,791	47,541	14,000	57,202	4
1965-6	26,778	8,500	50,181	58,681	0	81,459	42
1966-7	51,650	20,000	52,650	72,650	0	124,310	53
1967-8	80,000	N. A.	N. A.	80,000	0	160,000	30

Sources: "Fertilizer Production Exports, Imports, Distribution, Consumption and Future Plans in Iran," Eng. A. Assadallahi, and unpublished data by Plan Organization of Iran (To convert to nutrient tons, multiply by 0.45)

TABLE 9

FERTILIZER NUTRIENTS PRODUCED, IMPORTED AND USED ANNUALLY, 1963-4-1967-8

Item	1963-4	1964-5	1965-6	1966-7	1967-8
Production:					
Nitrogen	3578	10042	11193	21491	26200
Imports:					
Nitrogen	9512	5958	8703	7578	13800
P_2O_5	9914	9914	14363	15036	25134
Utilization:					
Nitrogen	13270	16000	19896	29069	40000
P_2O_5	9914	14363	15036	25134	29000

a/ The fiscal year of Iran begins March 21.

Source: See source for Table 8.

TABLE 10

WHOLESALE AND RETAIL PRICES OF FERTILIZERS
(Wholesale prices rials per ton: retail prices per kilo)

Item	Wholesale[a/]		Retail[b/]	
	Product	Nutrients	Product	Nutrients
Domestic Products:				
Urea (46% N)	8300	18040	11.0	23.9
Calcium ammonium nitrate (26% N)	4150	15960	5.0	19.2
Complex fertilizer (20-20-0)	9150	22870	12.5	31.3
Imported Fertilizers:				
Triple Super Phosphate (46%)	7328	15930	10.0	21.7
Diammonium Phosphate (18-46-0)	8960	14000	11.0	17.2
(Note: 75 rials = $1.00 U.S.)				

a/ Wholesale prices of domestic products are for products delivered to dealers in any part of Iran. Wholesale prices for imported products are FOB ports.

b/ Retail prices are approximations of typical prices based on a few interviews with dealers.

TABLE 10A

FDC PLANNED FERTILIZER AVAILABILITY AND COST ESTIMATES FOR 1968-1969

Product	Amount (tons)	Cost C&F[a/] (rials per ton)	Total rials[b/] (000)
Nitrogen Products:			
Shiraz Urea 46% N	42,000	70	2,940
C.A.N. 26% N	8,000	35	280
Imported (FDC) Urea 46% N	40,000	70	2,800
Imported (FDC) Am. Sulfate 21%	6,500	30	1,950
	96,500		7,970
Phosphates and Compound Fertilizers:			
Imported (FDC) TSP 46% P_2O_5	40,000	78	3,120
Imported (FDC) DAP 18-46-0	10,000	86	860
Imported (Private) TSP 46% P_2O_5	10,000	78	780
Imported (Private) DAP 18-46-0	40,000	86	3,440
Shiraz Compound 20-20-0[b/]	20,000	75	1,500
	120,000		9,700
TOTAL	216,500		17,670
Total value of fertilizers to be imported			12,950
Total value of domestic fertilizers			4,720

a/ Estimate J. M. Hill

b/ Made with imported TSP and Shiraz CAN.

TABLE 11

PROJECTIONS OF PROVINCIAL WAREHOUSE NEEDS FOR FERTILIZER STORAGE IN IRAN (1967-8 to 1981-2)

Fiscal Year	Products Needed(T.)	Capacity a/ Needed(T.)	New Space b/ Needed(M^2)	Investment c/ Cost (1000 rials)
1967-68	160000	53300	d)	d)
1968-69	190000	63300	6700	11400
1969-70	230000	76700	8900	15130
1970-71	273000	91000	9600	16320
1971-72	317000	105600	9700	16500
1972-73	360000	120000	9600	16300
1973-74	405000	135000	10000	17000
1974-75	450000	150000	10000	17000
1975-76	495000	165000	10000	17000
1976-77	547000	182300	11500	19550
1981-82	835000	278300	64000	108800
Increase	675000	225000	150000	255000

a/ Warehouse capacity needed is estimated at one-third of annual sales of fertilizer. See Table 20.

b/ The square meters of warehouse capacity needed are estimated at one and one-half tons per square meter.

c/ The investment cost of warehouses is estimated at 1700 rials per square meter, i.e. 500 for land and 1200 for construction.

d/ It is assumed that enough storage space was available in 1967-68.

TABLE 12

THE FERTILIZER PRODUCTION CAPACITY OF THE SHIRAZ PLANT AND THE SHAHPUR PLANT IN IRAN
(Metric tons per year)

Product	Total	Nitrogen[a]	P_2O_5[b]
Shiraz Plant			
Urea	46,000	21,160	0
Ammonium Nitrate or 20-20-0[c]	40,000	10,400	0
Shahpur Plant			
Urea	165,000	75,900	0
Di-Ammonium Phosphate or	125,000	22,500	57,500
Triple Super Phosphate	141,000	0	64,860
TOTAL CAPACITY	376,000	129,960	57,500

TABLE 13

ESTIMATED PRODUCTION OF FERTILIZER NUTRIENTS IN IRAN (1969-70, 1970-1 and 1971-2)
(Tons)

	1969-70		1970-1		1971-2	
	N	P_2O_5	N	P_2O_5	N	P_2O_5
Shiraz Plant[d]	26,800	0	26,800	0	26,800	0
Shahpur Plant[d]	8,200	4,800	72,160	42,100	83,600	48,900
TOTAL	35,000	4,800	98,960	42,100	110,400	48,900

a/ Assumed percentage of nutrients in products are: urea 46; am. nitrate 26; di-am phosphate 18-46-0; and triple superphosphate 46.

b/ The Shahpur plant will begin production early in 1970

c/ To be manufactured with TSP, either imported or from Shahpur.

d/ The percent of annual capacity of production by the Shahpur plant is estimated at 8-1/3% in 1969-70, 73-1/3% in 1970-1 and 85% in 1971-2 and thereafter, assuming two months of production in fiscal year 1969-70, with operations at 50% of capacity during the first six months and 85% thereafter. The Shiraz Plant is assumed to operate at 85% of capacity.

TABLE 14

AREA SUITED TO BE FERTILIZED AND AREA FERTILIZED IN EACH MAJOR CROP IN 1967-8, AND PROJECTED FOR 1971-2 BY THE NATIONAL PLAN OF IRAN
(Areas in thousands of hectares)

Crop	Suitable Area a/		Area Fertilized			% Fertilized	
	1967-8	1971-2	1967-8	1971-2	%Increase	1967-8	1971-2
Wheat	1600	1620	150	500	233	9.4	30.9
Barley	330	330	6	25	317	1.8	7.6
Rice	335	380	100	200	100	28.2	52.6
Cotton	200	220	40	100	150	20.0	45.5
Sugar Beets	115	150	60	120	100	52.2	80.0
Sugar Cane	5	9	4	9	125	80.0	100.0
Vegetables	110	125	45	90	100	40.9	72.0
Pulses	87	109	18	40	122	20.7	36.7
Tree Fruits	280	300	40	60	50	14.3	20.0
Tea	26	31	12	25	108	46.2	96.2
Tobacco	20	20	5	12	140	25.0	60.0
Oil Seeds	25	95	25	95	280	100.0	100.0
Forage Crops	142	211	15	60	300	10.6	28.4
Misc.	91	91	20	50	150	22.0	54.9
TOTAL	3386	3691	540	1386	157	15.9	37.6

a/ Areas suited to be fertilized are limited to irrigated land, except that all tea, half of the tobacco and 200,000 hectares of wheat on non-irrigated land are estimated to be adapted to the use of fertilizer.

TABLE 15

SUGGESTED MODIFICATIONS OF PROJECTED AREAS TO BE FERTILIZED IN 1971-2, BY CROPS[a]

(Thousands of hectares of fertilized land)

Crop	1967-8	1971-2		% Fertilized		
	(Plan)	Plan	Adj.[b]	1967-8	Plan	Adj.
Wheat	150	500	325	9.4	30.9	20.1
Barley	6	25	15	1.8	7.6	4.7
Forage Crops	15	60	45	10.6	28.4	21.3
Misc.[c]	20	50	40	22.0	54.9	44.0
Other[d]	349	751	751	28.5	52.3	52.3
TOTAL	540	1386	1176	15.9	37.6	31.0

a/ Plan data are from Table 14.

b/ Adjusted (Adj) data are based on the following percentages of plan increases in area of land to be fertilized for selected crops: wheat and barley 50%; forage crops and miscellaneous crops 66.7%.

c/ Miscellaneous crops are those in "other" of National Plan.

d/ Other crops are those in Table 14 which are not listed here.

TABLE 16

OPTIMUM DOSES OF NITROGEN AND PHOSPHATE FERTILIZERS AND ECONOMIC RESPONSES OF MAJOR CROPS IN IRAN (1966)

(Amounts and values per hectare)

Crop, Variety, Region, etc.	Rate per ha. (kg)	Yield N	Response (kg) P_2O_5	% Return N	% Return P_2O_5 a/
Wheat					
Well irrigated	58-52-0	530	323	256	200
Inadequate Irrigation	36-25-0	260	204	202	186
Caspian rainfed	14-28-0	62	113	118	130
Rice					
Champa	65-48-0	1042	706	613	541
Sadri	64-42-0	646	314	433	343
Sugar beets b/	87-71-0	6040	6120	320	397
Cotton b/					
Irrigated	77-78-0	298	244	250	203
Non-irrigated	None	17	-	110	-
Tobacco c/	0-60-30	-	-	-	908
Potatoes	90-60-0 d/	2740	1145	420	241
Alfalfa	15-45-0 d/	330	1140	307	350
Tea	90-30-0 d/	704	164	720	503

Sources: Wheat data are from Technical Report No. 10, "Results of Fertilizer Field Experiments, Winter Season, 1965-6." Data for other crops are from "Results of Fertilizer Field Experiments, Summer of 1966." Both were published jointly by the Soil Institute of Iran and the FAO, United Nations.

a/ Percent return is the increase in value of the crop expressed as percent of the cost of the fertilizer used. All data are for irrigated land, except for tea and tobacco, and where indicated otherwise.

b/ Simple averages of regional results.

c/ Benefit to tobacco is largely from improved quality. Nitrogen is not profitable, but 30 kilos of K_2O gave a benefit of 42 rials per rial spent for potash.

d/ Estimated by author on the basis of responses to fertilizer.

TABLE 17

FERTILIZER REQUIREMENTS IN IRAN ON PLANNED AREAS AND AT OPTIMUM RATES BY CROPS

(1967-8 and 1971-2)

(Tons of product with 45% nutrients)

Crop	Planned Use a/		At Optimum Rates b/		Optimum Less Plan	
	1967-8	1971-2	1967-8	1971-2	1967-8	1971-2
Wheat c/	19,500	65,000	28,330	94,400	8,830	29,400
Barley c/	845	3,750	1,220	4,700	375	950
Rice	25,000	50,000	24,440	48,890	- (560)	- (1,110)
Cotton	12,000	30,000	13,780	34,440	1,780	4,440
Sugar beets	27,000	54,000	21,070	42,130	-(5,930)	- (11,870)
Sugar cane d/	1,800	4,000	1,800	4,000	0	0
Vegetables d/	20,250	40,500	20,250	40,500	0	0
Pulses d/	4,375	10,000	4,375	10,000	0	0
Tree fruits d/	16,000	24,000	16,000	24,000	0	0
Tea	6,250	12,500	3,330	6,660	-(2,920)	- (5,840)
Tobacco	1,250	3,000	1,000	2,400	-(250)	- (600)
Oil seeds d/	6,250	24,000	6,250	24,000	0	0
Forage crops	4,500	18,000	2,000	8,000	-(2,500)	- (10,000)
Miscellaneous d/	5,000	12,500	5,000	12,500	0	0
TOTAL	150,020	351,250	148,845	356,620	(1175)	5,370

a/ Planned fertilizer use estimates are from the Fourth Five-Year Plan of Iran.

b/ Fertilizer use at the optimum rate for each crop is based on area fertilized according to the National Plan, with rates per hectare in Table 16.

c/ The assumed optimum rate for wheat and barley is the average of optimum rates for wheat with adequate irrigation and wheat with inadequate irrigation (Table 16).

d/ Amount for these crops are estimated on the basis of the National Plan, because optimum rates are not available for them.

TABLE 18

PROJECTED REQUIREMENTS OF FERTILIZER IN IRAN BY CROPS, 1971-2: PLANNED AND ADJUSTED

(Metric tons)

Crop	Fertilizer Products		Fertilizer Nutrients[c]			
	Planned[a]	Adjusted[b]	Nitrogen	P_2O_5	Potash	Total
Wheat	65000	61400	15275	12350	0	27625
Barley	3750	2830	705	570	0	1275
Rice	50000	48890	13000	9000	0	22000
Cotton	30000	34400	7700	7800	0	15500
Sugar beets	54000	42130	10440	8520	0	18960
Sugar cane[c]	4000	4000	900	900	0	1800
Vegetables[c]	40500	40500	8100	8280	1800	18180
Pulses[c]	10000	10000	1600	3000	0	4600
Tree fruits[c]	24000	24000	5400	5400	0	10800
Tea	12500	6670	2250	750	0	3000
Tobacco	3000	2400	0	720	360	1080
Oil seeds[c]	24000	24000	5700	5035	0	10735
Forage crops	18000	6000	675	2025	0	2700
Miscellaneous[c]	12500	10000	2080	1600	800	4480
TOTAL	351250	317220	73825	65950	2960	142735
% of TOTAL	-	-	51.6	46.3	2.1	100.0
Kg. per ha. treated	253	270	63	56	1	120

a/ The Plan amounts are from the Fourth Five Year Plan of Iran

b/ The adjusted amounts are estimated on the basis of the assumption that the average nutrient content of all products is 45%.

c/ Fertilizer nutrients required in 1971-2 are estimated on the basis of the adjusted estimates of areas to be fertilized in Table 15 and the optimum rates in Table 16.

TABLE 19

LAND SUITED TO BE FERTILIZED, AND ESTIMATED AREAS TO BE FERTILIZED IN SELECTED YEARS BY CROPS (1971-2 to 1981-2)

(Areas in thousands of hectares)

Crop	Total Land a/		Land on which fertilizer is to be applied				
			Plan Estimates b/		Suggested Projections		
	1971-2	1981-2	1967-8	1971-2	1971-2	1976-7	1981-2
Wheat	1620	1640	150.0	500	325	550	850
Barley	330	330	6.5	25	15	30	50
Rice	380	420	100.0	200	200	290	370
Cotton	220	250	40.0	100	100	160	210
Sugar beets	150	160	60.0	120	120	140	160
Sugar cane	9	30	4.5	9	9	25	30
Vegetables	125	150	45.0	90	90	120	140
Pulses	109	140	17.5	40	40	60	100
Fruit trees	300	340	40.0	60	60	100	120
Tea	31	35	12.5	25	25	30	35
Tobacco	20	20	5.0	12	12	16	20
Oil seeds	95	120	25.0	95	95	110	120
Forage crops	211	300	15.0	60	45	80	120
Misc.	91	110	20.0	50	40	70	100
TOTAL	3691	4045	541.0	1386	1176	1781	2425
INCREASE	-	354	-	845	635	595	644

a/ Total land is all crop land that is suitable for use of fertilizer (Table 14).

b/ Plan estimates are from the Fourth Five Year Plan.

c/ The projections for area to be fertilized in 1971-2 are from Tables 14 and 15. Those for 1976-7 and 1981-2 are based on assumption of continued expansion of fertilizer use in Iran.

TABLE 20

ESTIMATES OF AVERAGE RATES OF FERTILIZER USE AND TOTAL USE BY CROPS IN SELECTED YEAR (1971-2 to 1981-2)

(Rates are in kilos per hectare; total data are in tons of nutrients)

Crop	Nutrients per hectare (kgs) a/				Total Nutrients Needed (T) b/		
	1971-2	1976-7	1981-2	Goal	1971-2	1976-7	1981-2
Wheat	85	110	120	120	27,625	60,500	102,000
Barley	85	110	120	120	1,275	3,300	6,000
Rice	112	130	150	150	22,000	37,700	55,000
Cotton	155	170	180	240	15,500	27,200	37,800
Sugar beets	158	170	180	300	18,960	23,800	28,800
Sugar cane	180	200	220	-	1,620	5,000	6,600
Vegetables	202	220	240	240	18,180	26,400	33,600
Pulses	115	125	130	130	4,600	7,500	13,000
Fruit	180	180	180	165	10,800	18,000	21,600
Tea	120	160	200	235	3,000	4,800	24,000
Tobacco	90	100	100	100	1,080	1,600	2,000
Oil seeds	113	150	180	180	10,735	16,500	21,600
Forage	60	70	80	70	2,700	5,600	9,600
Misc.	112	120	140	-	4,480	8,400	14,000
TOTAL	121	138	155	-	142,825	246,300	375,600

a/ The rates for hectare for 1971-72 are optimum rates based on crop responses in 1966 (Table 13). The "Goal" rates are those recommended by Dr. Garth W. Volk, Chr. Ohio State University Dept. of Agronomy, in undated report, "Iran's Agricultural Situation", about 1965. Estimated rates in 1976-7 and 1981-2 are related to the "Goal" rates.

b/ Total nutrients are the product of the rates in this table and the areas to be fertilized in Table 19.

TABLE 21

COMPARISON OF THE PROJECTED PRODUCTION AND USE OF FERTILIZER NUTRIENTS IN IRAN

(1967-8 to 1981-2)

	Production		Requirements		Difference	
	N	P_2O_5	N	P_2O_5	N	P_2O_5
1967-8	26,200	0	40,000	29,000	-(13800)	-(29000)
1968-9	26,800	0	47,000	37,000	-(20200)	-(37000)
1969-70	35,000	4,800	55,000	46,000	-(20000)	-(41200)
1970-1	98,960	42,100	64,000	55,500	+(34960)	-(13400)
1971-2	110,400	48,900	73,800	66,000	+(36600)	-(17100)
1976-7	110,400	48,900	135,500	105,900	-(25100)	-(57000)
1981-2	110,400	48,900	206,600	161,500	-(96200)	-(112600)

Sources: Tables 18 and 20. Nutrient requirements are assumed to be 55% nitrogen, 43% P_2O_5 and 2% potash in 1976-7 and 1981-2 (Table 18).

WEST PAKISTAN FERTILIZER PRODUCT HANDLING AND MARKETING

By
John M. Hill
Fertilizer Adviser
USAID/Ankara, Turkey

REPORT OBJECTIVES

This report was requested by USAID/Lahore, Pakistan, and by the Office of the Economic Coordinator for CENTO Affairs. CENTO's needs were to determine goals and problems of treaty countries for the forthcoming CENTO Ad Hoc Working Party on Fertilizers scheduled for September 1968 in Pakistan.

One USAID/Pakistan objective of this report was to determine how to improve handling and discharge of fertilizer at the ports of Karachi and Chittagong. The second USAID objective was to determine the problems affecting the intra-marketing structure in West Pakistan between the port or fertilizer plant and the farmer. In preparing this report it was necessary to rely heavily upon individuals in West Pakistan for detailed information. Without the valuable assistance given by many people in the private sector, government offices, and the able assistance of the West Pakistan Agricultural Development Corporation this report could not have been made.

Much of the statistical data collected did not correlate. These differences result from use of calendar years versus fiscal years, ammonium sulfate equivalent tons, product tons and nutrient tons, etc. In preparing this report fiscal years and nutrient tons have been used and adjustments made to bring numbers into agreement as much as possible.

SUMMARY OF PROBLEMS AND RECOMMENDATIONS

In order for fertilizer consumption growth to keep up with farmer demand, the following problems must be faced and solutions found. These solutions are within the capabilities of the Government of Pakistan.

I. TRANSPORTATION

A. Lack of an adequate transportation system. This is the most urgent problem in solving logistic food shortages and in maximizing the value of imported AID fertilizer and in-country fertilizer production.

RECOMMENDATION

For each ton of fertilizer used on the farm, ten tons of grain or farm product will be produced. Of this, four to six tons will move from farm to market. As farmers receive more cash, they in turn will be demanding greater amounts and variety of consumer goods. The result is that fertilizer's success creates its own competition for transportation facilities.

It is recommended that a transportation study in depth be initiated immediately. This study should determine the ton-miles per day that will be required each year, 1969 through 1890. It should emphasize the need for additional railroad boxcars, special type rolling stock, and possibly the need for additional rail trackage. It also should take into consideration the need for trucks and specialized vehicles. It should study transportation rates and their effect on the growth of the trucking industry and the need for rural roads. The study's recommendation should be given top priority.

II. BULK IMPORTS

A. Need to reduce cost of imported fertilizer by use of bulk mechanical product handling.

RECOMMENDATION

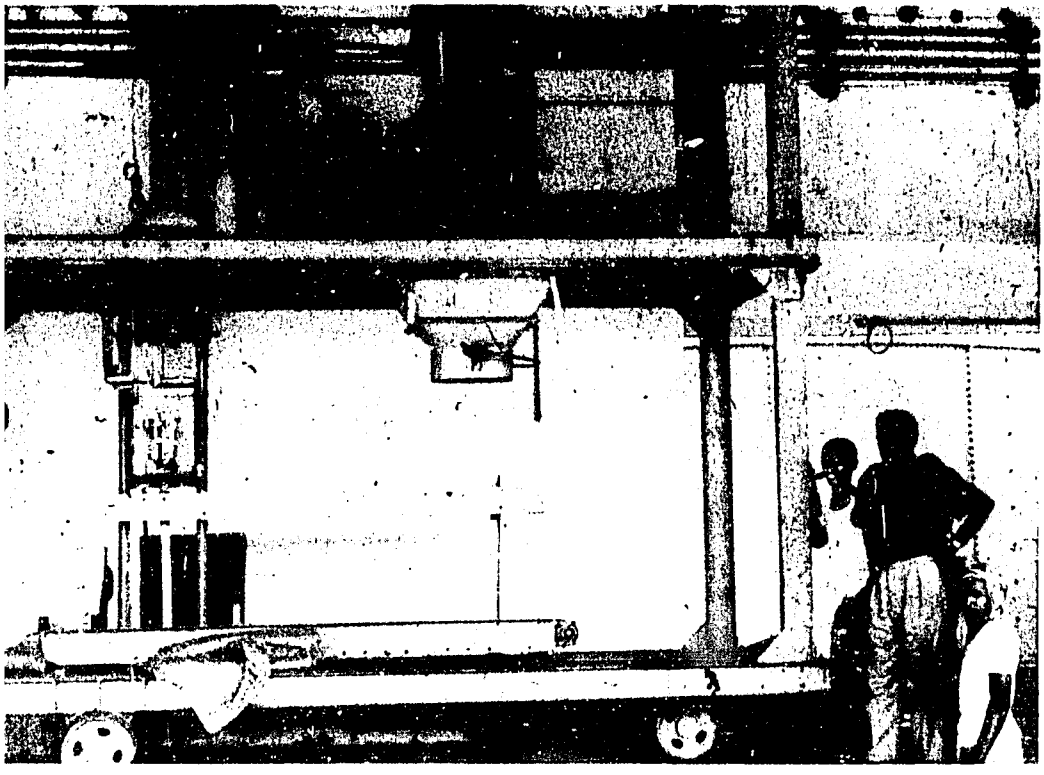
It is recommended that as much imported fertilizer as possible be bought and shipped in bulk.

Incentive for bulk shipments in U.S. vessels versus shipments in bags is a foreign exchange savings of $22.00 per ton of product,

or a net cash savings of $15.00 per ton. During the last six months one-third of all of East Pakistan's fertilizer imports through Chittagong was in bulk, with bagging by hand in the holds of the ships.

STEVEDORES BAGGING IN A SHIP'S HOLD– Bagging bulk fertilizer in a ship's hold results in non-standard weight bags and poor hand sewing of bags. Fertilizer contamination of jute outer bags will weaken the bag if bags are stored for long periods of time.

A trial program is recommended at Chittagong with portable mechanical bagging equipment. The trial would be at the hold of a ship while the rest o the ship load is being bagged by hand in the current manner. Mechanical bagging equipment at dockside will remove the objections currently encountered by farmers who are receiving products hand-bagged in the ship's hold. These objections are 1) nonstandard weights, some bags weighing more or less than 50 kilos and, 2) poor closure of the bag by hand sewing, resulting in product loss during shipping and warehousing. Based on the success of this trial, East Pakistan and West Pakistan can determine the degree to which bulk shipments and mechanical bagging should be employed in their ports.



PORTABLE BAGGING MACHINE– *This machine can receive fertilizer direct from a portable hopper on the dock. This semi-automatic unit performs three operations: weighing, filling and closing the bags by sewing..*

BAGGING MACHINE IN OPERATION– *This unit is rated at 30 tons per hour and can average 20 tons an hour on an 8-hour shift. This machine is filling 100 kilo sacks but can be adjusted to fill 50 kilos if desired.*

III. WAREHOUSES

A. A shortage of suitable space for fertilizer storage in villages and Mandi towns.

RECOMMENDATION

It is recommended that a program be established that will allow agents and distributors to borrow funds from banks at a low interest rate to finance fertilizer warehouses. Financing should be so that 75 percent of the building and land cost could be borrowed. This would leave the investor an equity of 25 percent in the warehouse.

IV. CREDIT

A. The current credit structure does not allow agents at the Mandi towns to buy and store the needed amounts of fertilizer prior to the use season.

A TYPICAL MANDI TOWN– *A Mandi town is a market place established by the British to serve villages in the area. Farmers bring produce to market to sell for cash. Currently they are buying 50 to 60% of their fertilizer needs directly from the Mandi town agents and taking it home in their oxcarts.*

RECOMMENDATION

It is essential that a credit program be established which will allow agents in Mandi towns to borrow funds to purchase and store fertilizer in quantities to meet sub-agents' (dealers) and farmers' demands prior to planting time. This credit should be at a sufficiently low rate (4 percent) to induce agents to take advantage of this credit media.

B. There is not a viable credit system to reach subsistence farmers.

RECOMMENDATION

A credit program is needed at the farmer level to allow subsistence and tenant farmers to participate in the purchase of required farm inputs. This system should be on a supervised farm inspection basis in order to ascertain that the farmer or tenant farmer in fact has need for this credit and that the credit is used to increase his production level, and his ability to repay the loan.

V. FERTILIZER KNOWLEDGE

A. Farmers have inadequate guidance and assistance on how to use fertilizer on various crops and how to get the greatest return from each rupee spent for fertilizer. The majority of dealers, agents, and distributors are not currently capable of performing this function.

THE NATURE OF CHEMICAL FERTILIZER– *"Allah gave us air, land and water. We take nitrogen from the air, phosphate and potash from mines in the ground. Farmers use this fertilizer, hard work and Allah's gifts get bountiful yields."*

RECOMMENDATION

Financial incentives for fertilizer education must be allowed for distributors, agents, and dealers, and the incentives protected from price cutting. Incentives must be protected, for their loss will result in short-changing the farmer on services and assistance he needs desperately. It is essential that close liasion be carried out between the agriculture extension service, distributors, agents, and sub-agents to make sure that the farmer receives correct, coordinated instructions.

VI. NEW PLANTS

A. Nitrogen supply from in-country plants will be inadequate by 1975.

B. Phosphate production will not catch up with consumption as currently planned.

RECOMMENDATION

On the basis of the consumption trend forecasts in this report, there is a present justification for construction of a fourth urea plant to meet demands of 1976 onward.

Similarly, the consumption pattern would justify a second phosphate plant to manufacture diammonium phosphate from phosphoric acid. This plant should be located at Shekhupura.

BACKGROUND

West Pakistan has been blessed by a deep rich soil, abundant water in her rivers, and intelligent, industrious people. By using the brains and hands that God gave, West Pakistan is turning her country into a land of plenty. At the current level of progress, West Pakistan will be able to feed her growing population by late 1969 or early 1970.

West Pakistan is showing other less developed countries the way toward self-sufficiency by her rapid utilization of new farm inputs, fertilizer, pesticides, plant varieties which respond to fertilizer, cultivation methods, intelligent use of water, etc. Her farmers are eager and willing to accept new methods of farming that will produce better and larger crops. West Pakistan's agricultural scientists and farm leaders must be congratulated and commended for bringing these new techniques to their farmers.

The current rabi crop of wheat will be the best West Pakistan has ever seen. It is anticipated that this year's bumper crop, FY-1968, will produce enough grain to meet the in-country demand. However, the problems of in-country distribution and storage will still result in the need for imported grain to build stocks and fill in the logistics-created shortages. West Pakistan, historically, has been an exporter of grain to India and Afghanistan. Due to the higher prices of grain in these border areas, West Pakistan must produce enough for her own needs and to cover that which is siphoned off into these border areas.

This year 3.5 million acres of high yielding wheat will be harvested. Next year there should be 6 to 7 million acres planted. Other high yielding varieties such as corn, rice, sorghum, and millet are helping to bring about the "Agricultural Revolution on Pakistan Farms." Scientists of all types have been working long and hard to cause this revolution.

As a result, changes in consumption and marketing patterns will occur. The current pattern is a trickle of goods, one way, to the farm. This revolution will bring a flood of agricultural products from the farm to market towns, generating cash for the farmer. He in turn will demand greater quantities of consumer goods and farm inputs.

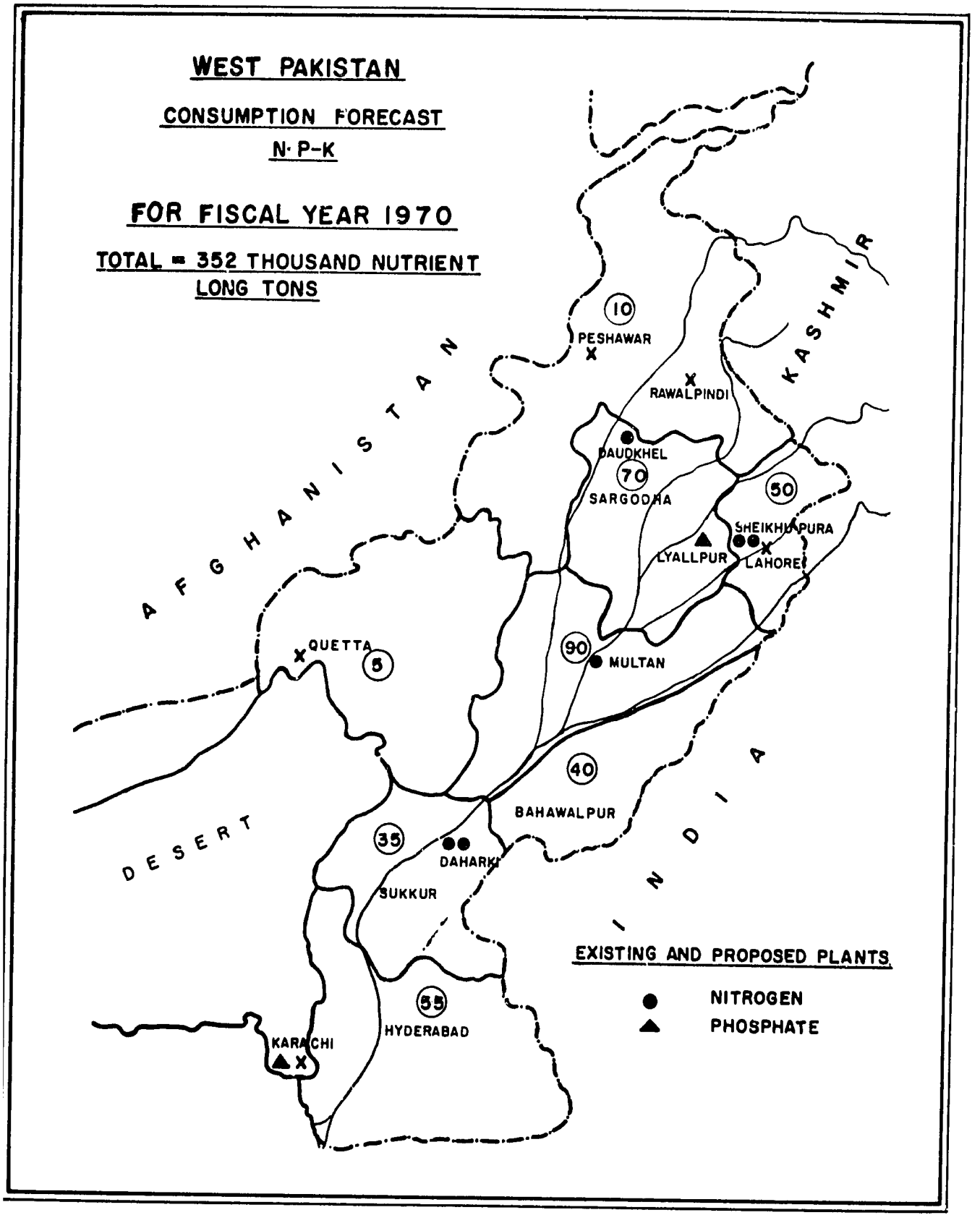
This report only touches on the fertilizer demands and pressures of this revolution. They are only one small part of the coming changes this revolution will cause.

This was due in part to delayed fertilizer application in January, but primarily to the large acreage of Mexican wheat demanding and receiving high rates of fertilizer.

When talking with farmers who are experiencing for the first time the increased yields of Mexican wheat (two to three times normal native wheat harvest), they are already asking questions of, "Can I use fertilizer on my potatoes, my cotton, mango groves, etc.?" Fertilizer experience is the best teacher and many farmers will be experimenting on other crops to try to obtain similar yield responses on the rest of their farm plots.

CONSUMPTION

In order to bring today's problems into focus, it is essential to establish guidelines as to what has happened in the past and what is anticipated in the future. Fertilizer Consumption Forecast (Chart I) starts with 1966 and runs through 1980. This forecast is the view of the writer, but is based on the opportunity to "second guess"


WEST PAKISTAN
CONSUMPTION FORECAST
N·P-K
FOR FISCAL YEAR 1970
TOTAL = 352 THOUSAND NUTRIENT LONG TONS
AFGHANISTAN
KASHMIR
INDIA
DESERT
10
PESHAWAR
RAWALPINDI
DAUDKHEL
70
SARGODHA
50
SHEIKHUPURA
LYALLPUR
LAHORE
QUETTA
5
90
MULTAN
40
BAHAWALPUR
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DAHARKI
SUKKUR
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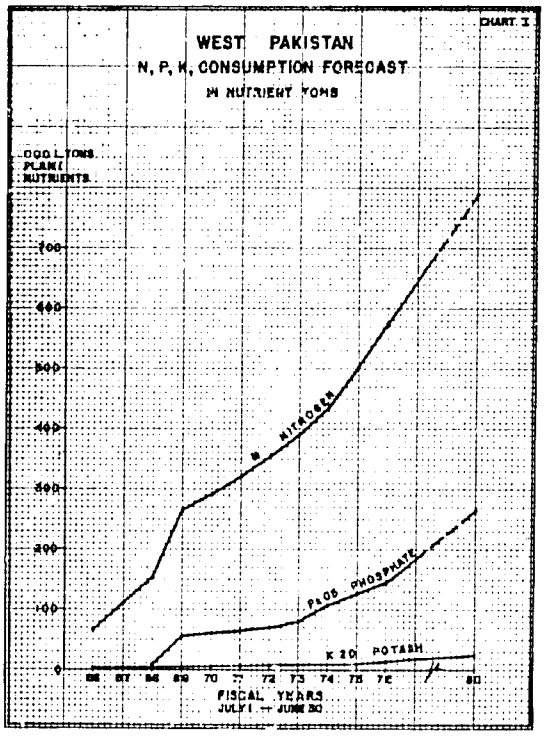
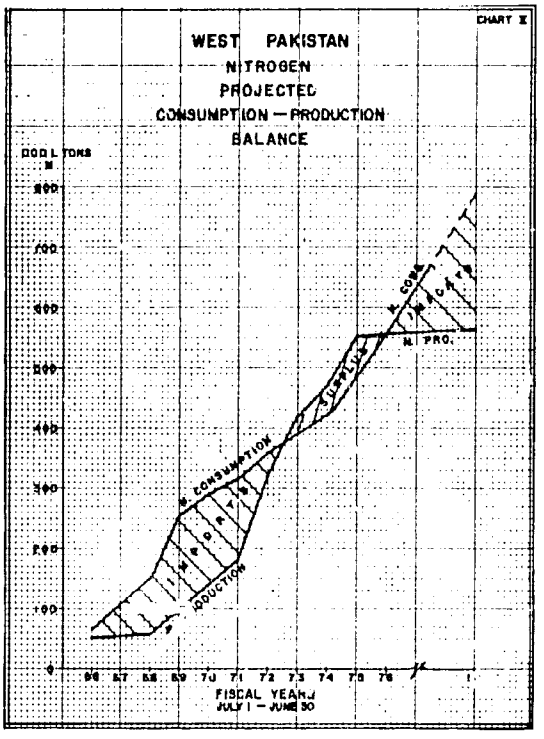
HYDERABAD
KARACHI
EXISTING AND PROPOSED PLANTS
NITROGEN
PHOSPHATE





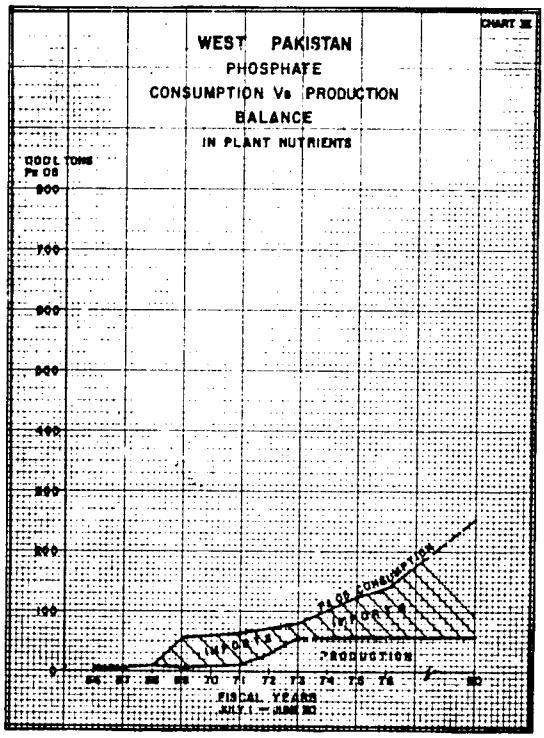
many noted agriculturists and fertilizer experts. This forecast is an attempt to determine what is likely to happen, rather than what is hoped-for or wished. Many problems that exist are within grasp and can be overcome within the framework of the existing economic climate of West Pakistan. It also brings into focus fertilizer acceptance at the farm level and market supply-demand factors.

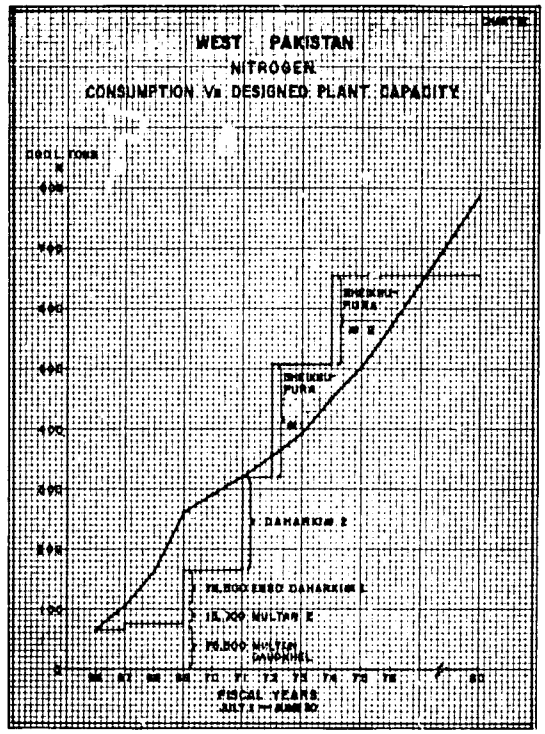
As noted in Chart I and Table 1, an increase in fertilizer use of 100 percent is forecast for FY-1969 over FY-1968. This is based on current targets which are realistic in light of current developments. For the succeeding years a growth rate of 10%, 15% and 10% was incorporated. This is a compounded rate and maintains a rate of increase that I believe is likely to happen.

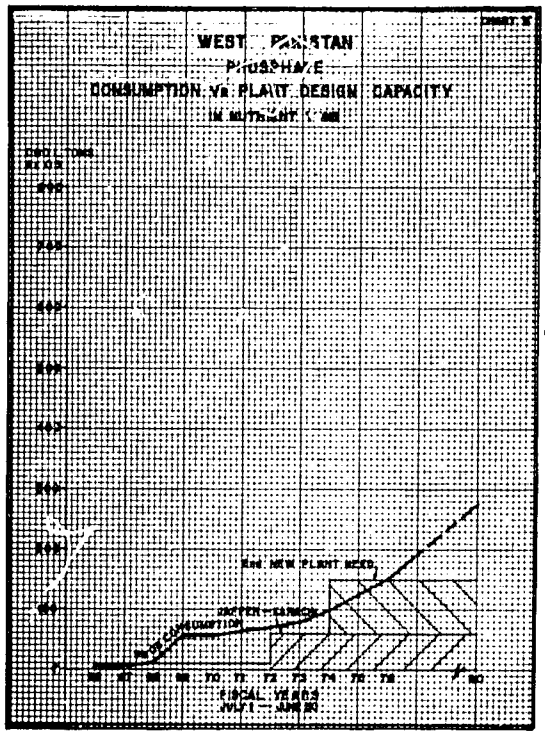
In FY-1968, three and one-half million acres of Mexican wheat were planted. This was a result of Mexican wheat seed produced in West Pakistan and the import of 42,000 tons of seed from Mexico. The success that this program is having is evident when visiting with farmers in West Pakistan. Fertilizer consumption in February 1968 was 166 percent higher than in February 1967.

PROJECTED CONSUMPTION PRODUCTION BALANCE

Based on anticipated actual production, nitrogen equilibrium will be reached in 1973. Surpluses will build up through 1975 with consumption outpacing production in early 1976.


WEST PAKISTAN
PHOSPHATE
CONSUMPTION Vs PRODUCTION
BALANCE
IN PLANT NUTRIENTS
PRODUCTION
FISCAL YEARS


WEST PAKISTAN
NITROGEN
CONSUMPTION Vs DESIGNED PLANT CAPACITY
FISCAL YEARS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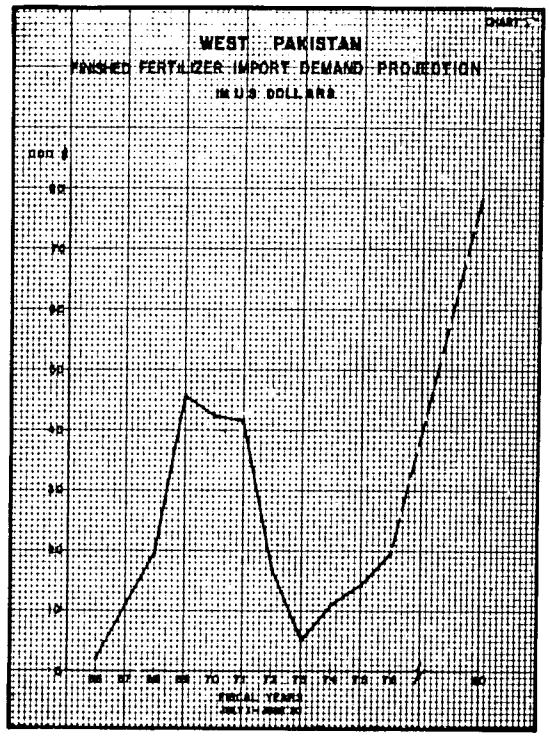
PHOSPHATE
CONSUMPTION Vs PLANT DESIGN CAPACITY
FISCAL YEARS


WEST PAKISTAN
FINISHED FERTILIZER IMPORT DEMAND PROJECTION
IN U.S. DOLLARS
FISCAL YEARS

As shown on Chart II, Consumption and Production Forecasts for Nitrogen, the fourth major urea plant, Shekhupura No. 2, should be brought on-stream around late 1975. It will allow this plant time to overcome production problems prior to having to meet the rapidly increasing consumer demand for nitrogen.

Based on forecasted P_2O_5 consumption, the proposed plant at Karachi is not adequate to take care of in-country demands. This plant should be doubled in size, or a second plant should be authorized to come on-stream as soon as possible to minimize phosphate imports.

Production from new plants coming on-stream is forecast at 25 percent of capacity for the first six months of operation and at 85 percent thereafter, based on 340 days' operation per year (Table 2). This seems conservative, but as experienced in other developing countries, it is realistic.

Table 3 shows types of product for West Pakistan. Urea makes up the main item to be produced in nitrogen plants and it is good to report that urea is currently the favorite type of nitrogen demanded by farmers. Bad experience was obtained by many farmers who were introduced to crystal urea produced at Multan. This product is like granular sugar. It is hard to broadcast by hand, and sticks to plant leaves, which causes leaf burn. The imported prilled (pelleted) urea, and that to be made in West Pakistan's new plants has taken first place in preference over "guwara" calcium ammonium nitrate produced at Multan. Dealers call urea "American guwara" to distinguish it from Multan urea. Almost 100 percent of the fertilizer used is applied by hand, and physical properties (size of particles, free flowing, etc.) are of prime importance to the farmer.

PRODUCTION

In comparing consumption against planned production for West Pakistan, it is interesting to note (Chart IV) that excess plant designed capacity will exist in 1972 for nitrogen. The fourth major urea fertilizer plant, Shekhupura No. 2, need not be constructed if all plants run at designed capacity. This is not a realistic picture, as even plants in developed countries have difficulty in meeting designed capacities in their early years of operation. Operational problems become severe in developing countries due to many factors: lack of skilled labor, spare parts, raw material supplies, communication, transportation, etc.; thus the use of 85 percent of design capacity in projecting plant production.

Chart V shows phosphate plant designed capacity as related to consumption forecast. The Jeffer-Karachi plant will not meet needs and should be enlarged or a second phosphate plant authorized now.

A second plant could meet the need for phosphate and N-P compound fertilizer by making diammonium phosphate (18-46-0) and/or ammonium-urea-phosphate (28-28-0). By structuring this plant on imported phosphoric acid 52% P_2O_5 or super-phosphoric acid 70% P_2O_5, freight, sulfur and plant costs can be saved. Acid can be saved. Acid can be easily discharged by tanker at Karachi and shipped by lead or rubber lined tank cars. The plant should be located at Shekhupura in the heart of the fertilizer consumption area. It should be located so as to take ammonia from adjoining nitrogen plants by pipeline. The suggested N-P compounded fertilizers are needed agronomically by various crops: wheat, sugar cane, rice, etc. Due to their high plant nutrient content of 56 to 64 percent, they will reduce handling costs.

IMPORT DOLLAR DEMAND PROJECTIONS

On Chart VI, Import Dollar Demand (Table 4) projections will reach a high of $45,780,000 for fertilizers during FY-1969. As urea and triple superphosphate plants come on-stream, the dollar demands to cover imports will constantly diminish until 1973. Demand will increase up to $78 million in 1980 unless recommended new plants are built. If these plants are not built, the Government of West Pakistan will be pressed into increasing allocations, monetary credits, and use of free currency for fertilizer imports.

Plants to reduce fertilizer import expenditures should be the goal of credit extenders and users.

THE IMPORTANCE OF BULK SHIPMENTS TO PAKISTAN

With the investment in adequate equipment to handle bulk fertilizer shipments, West Pakistan can save $22.00 on each ton of bulk imported product versus the same product imported in bags. Products that lend themselves to bulk shipping and handling are phosphate products, NPK compounded fertilizers, calcium ammonium nitrate, muriate of potash, and ammonium sulfate. These savings per ton are for USAID financed shipments. They result from savings on shipping from plant to port in the United States, U.S. bag and bagging costs, U.S. stevedoring charges, and lower freight rate per ton due to more efficient usage of ship cubic displacement.

The cost of discharging bulk fertilizer and bagging in Pakistani ports is estimated to be 35 rupees, or an equivalent of $7.00, resulting in a net saving to the Government of Pakistan of $15.00 per ton.

Table 5 compares the current cost of shipping in bulk versus buying in bags from United States.

Bulk Shipment Advantages

1. Each dollar will buy more product
2. More jobs for Pakistanis
3. One hundred percent Pakistani-made jute bags will be used
4. A net dollar savings of $15.00 on each ton of fertilizer imported in bulk.

AUTOMATIC BAGGING OF BULK FERTILIZER

In the last six months East Pakistan has received one-third of its total fertilizer shipments in bulk. Bagging was done in the ship's hold by hand. East Pakistan Agricultural Development Council recognized the savings that accrue from shipping in bulk. However, EPADC faces serious complaints from their farmers: non-standard weight bags and poor closure of the bags due to hand sewing by stevedores under adverse conditions in the ships' holds. Chittagong's Port Trust Authority is anxious for a trial demonstration of portable automatic bagging equipment.

By the use of clam shovels operated by ship's tackle or portable dock cranes, bulk fertilizer can be discharged from the ship's hold. Discharged fertilizer can be placed in portable leg hoppers of approximately five-ton capacity. Fertilizer would move by gravity flow spouts to the hopper of the automatic weighing-bagging equipment. Here the bags would be filled to standard weights, plastic liners sealed, and the outer bag sewn shut. Table 6 shows rough estimated costs for equipment to discharge 40,000 tons per month.

A second possible solution is to use the facilities of the proposed phosphate plants at Karachi and Chittagong to handle incoming bulk fertilizer shipments. As each phosphate plant will need discharging and handling equipment to convey phosphate rock from dockside to plant, warehousing space, bagging equipment, and transportation facilities, it is suggested that these facilities be built as the first phase of construction, rather than as the last phase as is the normal procedure. This will allow for immediate utilization of this investment, and will allow the plant staff to gain valuable experience in product handling and shipping. Funds can also be earned by the phosphate plant during its early stages of construction. Inasmuch as this plant would be serving AID cargoes, arrangements could possibly be made to help finance some of the foreign exchange cost of product handling equipment.

Bulk fertilizer importing is not new. It was tried once at Karachi without adequate experience and equipment, with poor results and many complaints. It is being carried out in Chittagong now, and has been used for the last five years in different degrees in Korea, Japan, India, Ceylon, Formosa, Norway, Chile, etc. Product handling engineers are available to assist in setting up bulk handling and bagging systems. One should be employed to assist in setting up the trial bulk bagging at Chittagong.

With over 120,000 tons of fertilizer suitable for bulk imports scheduled for West Pakistan in 1969, that would result in a net saving of $1,800,000, the economics demand immediate action.

TRANSPORTATION NEEDS AND COSTS

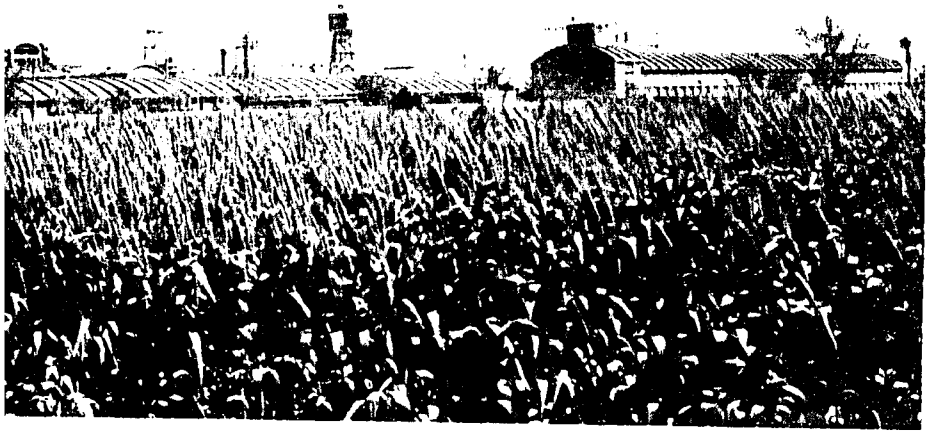
The map on page 102 depicts a use pattern for 1970. This forecast is made on the basis of available agricultural land, current fertilizer consumption, and projected demands. Existing and proposed plants are also shown on the map, which shows the advantage of Shekhupura in relation to fertilizer projected consumption.

Currently, 60 percent of the fertilizer consumed in Pakistan is imported through the port of Karachi. Ninety-five percent of this fertilizer moves by railway car, with an average turn-around per car of 20 days. Fertilizer and grain have first priority on dock space and first priority on railroad cars. Still, the shortage of railroad cars make it difficult to discharge more than 1,500 tons of fertilizers per day. This discharge rate at Karachi is via two stevedoring shifts. A third stevedoring shift could be utilized, reaching an average of 2,000 tons per day discharge rate, IF railroad cars were available. Material is stored at times on dock or plinth, but this results in double handling when railroad cars are made available. Due to the high truck rates or low rail rates, depending on your point of view, trucks cannot compete with railroad transportation economically beyond 50 miles. (See Table 9 in Appendix.) Trucks are currently used to move product from up-country railroad headings to Mandi towns, and in some instances to villages if roads exist.

Many villages in West Pakistan cannot be reached by roads or oxcart. Fertilizer must be carried in on animal backs (camels, donkeys) or human backs in some instances. The irony of the situation is that the West Pakistan agricultural area is predominantly irrigated, which means that canals go to almost every farm. Canal banks, which are suitable for use in most instances as a means of transportation by wheeled vehicles, are off limit to farmers. Large land owners, however, can obtain special passes to use these canal banks, and do so at a profit. A crying demand of major importance

must be met by rural roads of all types to meet the impact of West Pakistan's agricultural revolution.

It is essential that a transportation study be made of West Pakistan in depth by appropriate experts. Boxcar requirements for urea fertilizer plants alone will be 1,750 cars per day by 1975. In addition to this requirement, rail cars will be needed to service current existing fertilizer plants, as well as the proposed phosphate plant at Karachi. Today there are purported to be 34,000 rail boxcars in service for all demands.



A FERTILIZER PLANT– Fertilizer plants should be close to agricultural markets like this WPIDC plant at Multan.

HOME FERDINAND– Many villages cannot be reached even by oxcarts, even though their fields are irrigated from man-made irrigation canals.

One ton of fertilizer used properly on grain will produce ten tons of product. With a country-wide grain production increase of 50 percent anticipated, and with half of this consumed in the villages, one can easily estimate that for every ton of fertilizer used, five tons of produce will go to market in Mandi or large city towns. Today's tight transportation problems will be compounded by the success of improved form inputs and the use of fertilizer on the farm. In addition, as the farmer receives cash for his marketable produce, he in turn will demand consumer goods in increasing quantities. With Pakistan's people living mainly in rural areas, transportation of goods to and from these areas is a critical problem.

DEMAND FOR WAREHOUSE SPACE

As consumption of fertilizer increases, the demand grows proportionately for warehouses to store fertilizer prior to its actual use. Today every available type and means of storage for fertilizer is being used in the Mandi towns and villages; old abandoned buildings, rooms designed for storage of barreled petroleum products, back rooms of stores, sleeping quarters, flat grain storage areas, outdoors in yards (in some instances covered with tarpaulins), living and sleeping quarters in private homes.

INDOOR WAREHOUSING NEAR MULTAN–
More similar warehouses are needed now.

OUTDOOR WAREHOUSING– *One bag of fertilizer represents the total profit of the dealer, agent and distributor from the one ton of material. Twelve bags of urea are equal to the monthly salary of a local office clerk.*

Table 7 is based on five square feet of storage area per ton, and with three stock turnovers a year. In West Pakistan 533,000 square feet of storage space is currently being used. In visiting with ADC and RSSC agents it was found that their reported average warehouse stock turnover is 1.8 to 2.2 times per year. These stock turnovers are realistic since some fertilizers, both imported and locally manufactured, are consumed without going through warehouses.

Fertilizer sales for 1969 are planned and anticipated to increase 100 percent over sales in 1968. With the bottleneck at Karachi (rail car shortage) it will be necessary to import fertilizer farther ahead of the use period and warehouse larger stocks in locations where fertilizer consumption is anticipated. Square footage requirements for storage in 1969 are estimated at 1,066,000 square feet or double that used for fertilizer in 1968.

With the increased use of fertilizer, and the anticipated bumper wheat crop which will be harvested in June-July of this year, severe conflicts will be encountered in villages and Mandi towns for warehouse space.

Villagers historically produce wheat first for their own consumption. Any left over beyond their current needs is sold and delivered to the Mandi towns. With Mexican wheat producing two to three times the yield that native wheat produces, the farmer will have one crop equivalent of native wheat for his own consumption, and will have an

additional one to two native crop equivalents which he will sell to Mandi town grain dealers or to the government at the fixed wheat purchase price. As fertilizer consumption increases, in rural areas the storage problem becomes more and more severe. By 1976 it is estimated that 2,400,000 square feet of warehouse space will be required for fertilizer storage alone, without consideration of storage of grain, cotton, sugar, or other crops.

Currently, it is estimated that construction costs for warehouses in Mandi towns are 15 to 20 rupees per square foot, including land.

It is not practical to build warehouse space at manufacturing plants for more than 30 days' production. Planning, programing, and investments are needed for warehousing that adequately fill marketing sales forecasts. This takes time and experience. Warehouses are as essential as fertilizer plants, railroad boxcars, working capital, fertilizer education, demonstrations, etc. A general rule of thumb in determining the amount of money necessary to build and purchase intramarketing needs such as warehouses, transportation facilities, offices, sales training, etc., is 50¢ for every $1.00 invested in fertilizer plants. The investment in a fertilizer plant is easy to define as to who should make the expenditure and for lenders to recognize as assets. Warehouses scattered throughout Mandi towns and villages are a different story. Who should build them? Who should finance them? How many should there be? Where should they be? How big should they be? Fertilizer distributors, agents and dealers face this responsibility and these decision-making tasks; however, they need assistance in meeting their financial obligations and distribution responsibilities.

It is recommended that a credit system be established that will allow agents and distributors to borrow funds from banks at a low interest rate (5 percent). Financing should be made available so that 75 percent of the building and land cost could be borrowed. This would leave the investor an equity of 25 percent in the warehouse. With repayment spread over ten years, agents and distributors would find it profitable to meet fertilizer warehouse demands.

AGENT - SUB-AGENT INVENTORY CREDIT PROGRAM

In addition to a credit program to finance construction of warehouses in Mandi towns and villages, a credit program is needed to allow agents to borrow funds from the bank to finance inventory stocks. Currently, agents are paying cash for fertilizer deliveries and, as can be anticipated, stocks are kept at a level equal to the available cash that an agent can place profitably in the fertilizer end of his business. He in turn is forced to sell his fertilizer for

cash to the farmers and sub-agents, which in turn restricts the movement of fertilizer. Ninety-five to 98 percent of the retail sales of fertilizer to farmers is for cash. This is in keeping with the Muslim tradition of not charging interest. As a result, fertilizer is in short supply during the use period, and logistic imbalances occur.

It is recommended that an "Inventory Financing Program" be initiated to allow agents and dealers to borrow money from banks to finance fertilizer stocks. Interest rate should be low (4 percent), and this interest will act as a penalty for overstocking. Fertilizer loans should be reduced at the end of each month in relation to fertilizer inventory reductions.

MARKETING INFRASTRUCTURE

West Pakistan's increase in fertilizer consumption has not been by accident, it was planned. Fertilizer consumption in FY-1956 was 6,600 tons of plant nutrients and increased to 115,000 tons of plant nutrients in FY-1967.

This increase in fertilizer consumption has been a direct result of the work done by agriculturists in Pakistan, farmers' willingness to accept new methods based on demonstrations on their own agricultural lands, and by the creation of a distribution system that allowed fertilizer to move from ports and factories to the farmer.

Distribution of fertilizer in West Pakistan has been the sole responsibility of the Agricultural Development Corporation. ADC must be highly complimented on being able to construct within Pakistan a system that has effectively moved products to reach the farmer in a manner that has stimulated increased fertilizer consumption. The problems of product programing, the logistics of transportation and warehousing had to be solved with no previous guidelines or examples to follow. The success of ADC in increasing fertilizer distribution has made it possible to create an environment that now allows the private sector to enter fertilizer manufacturing, marketing and distribution on a profitable basis.

In the fall of 1967, three major private companies were invited to participate in fertilizer distribution in West Pakistan. These companies—Pakistan National Oil, Ltd., Esso Pakistan Fertilizer Company, Ltd., and Dawood Corporation, Ltd., are currently setting up agents in Mandi towns, and sub-agents or dealers at the village level.

The marketing distribution structure in West Pakistan prior to the fall of 1967 was made up of agents and sub-agents of ADC, and

Rural Supply Credit Cooperative agents and sub-agents. Fertilizer distribution in 1967 was approximately 50 percent by ADC and 50 percent by RSCC. Current plans are for the private fertilizer sector to handle all fertilizer imports and for RSSC and ADC to distribute in-country produced material.

Programing

The current fertilizer demand/supply and marketing distribution structure is as follows:

1. The Ministry of Agriculture receives consumption forecasts from its agricultural district office and advises the West Pakistan Planning Development Board.

2. The West Pakistan Planning Development Board in turn is advised by the Economic Affairs Division and the Ministry of Finance as to what funds and credits are available to cover fertilizer imports.

3. The West Pakistan Industrial Development Corporation (WPIDC) in turn advises the Planning Development Board as to its in-country fertilizer production forecast.

4. The Planning Development Board, armed with this data, then consults with and advises the Agricultural Development Corporation (ADC) to program WPIDC product and incoming supplies of fertilizer to meet in-country demand.

5. ADC schedules tenders, inviting bids in accordance with the requirements of the financial means to be used. When awards have been made for fertilizer shipments to the port of Karachi, notices are given to the private fertilizer distributors that product is available for lifting at the port.

6. ADC clears the shipment, unloads it, and uses its priority to arrange for railroad cars. When railroad cars are loaded, or when material is discharged from the vessel at Karachi, the problem of in-country movement and distribution rests with the distributor. In case of WPIDC fertilizer production, this material is scheduled for shipment by ADC. Pakistan National Oil has recently contracted to purchase some WPIDC urea for resale to supplement incoming imports.

Under the current system of distribution of the private sector, ADC is allowing private distributors four months' free credit from date that fertilizer is delivered to them at Karachi. Distributors, on the other hand, demand from agents either a deposit prior to shipment of the railroad car and/or full payment prior to the car's being released to the agent at the up-country railroad heading.

As a result of this system, distributors have no problems of financing fertilizer stocks. Agents, on the other hand, are required to put up a cash deposit with the distributor in varying amounts depending on the distributor with whom they are dealing, and to pay cash for railroad cars of fertilizer prior to their obtaining possession. This limits the quantity of material that an agent in a Mandi town can stock at any one time. Currently, banks are not loaning agents funds to cover fertilizer stocks and are merely acting as a collection agency for fertilizer distributors.

FERTILIZER VILLAGE SUB-AGENT– *Fertilizer education of dealers and agents must be the responsibility of distributor agronomists.*

MEXI-PAX WHEAT– *Three times the yield of his native wheat. One to eat, two to sell. New shoes for the children, a length of cloth for his wife, maybe a bicycle for himself and some more of that "American Guware" (urea) for the rest of his fields.*

If an agent is slow in going to the railroad to pick up his stock, he will be charged demurrage which amounts to 70 rupees per day per railroad car. One of the problems that fertilizer agents and distributors are faced with is that railroad cars loaded directly from the ship at the ports of Karachi are showing up with incorrect bag counts.

ADC has set up a system of allocations for "incidental costs" and commissions. It is interesting that each distributor has a different financial agreement with ADC. This must be standardized as soon as possible to prevent friction and disputes.

It is ADC's belief that allowances for fertilizer handling and distribution currently given to private distributors are more than inadequate. The difference, of course, lies in what each one believes the function of the distributor should be and what his responsibility should be to his agents and sub-agents and to the farmer.

Subsidies

It is interesting that projections for 1968-1969, subsidy or government rupee losses on fertilizer, are expected to be 33.7 percent of total costs. The subsidy on imported fertilizers runs 25 percent, and on WPIDC 46.3 percent. These costs as shown on Table 8 do not include ADC operation expenses or unforeseen losses. Appropriations to WPIDC are not included and would bring total cost up if the true cost of production were reflected in their product's selling price.

West Pakistan's fertilizer subsidy is the difference between total product cost and fixed selling price. As product costs go down, as they have on a ton of product or ton of plant nutrient, the subsidy goes down proportionately.

With the construction of efficient in-country plants, subsidies should be done away with as soon as possible, and supply and demand allowed to establish market prices.

It is the wish and plan of the Government of West Pakistan to move out of fertilizer distribution and marketing as soon as feasible. The rate at which the private sector can move in and fill this function will depend on the cooperation between ADC and the private sector, the margin of profit, and the assistance it gives private distributors. It is essential that ADC and the government relinquish all control as fast as possible, but in a manner that creates a healthy, effective private distribution system.

At the March 1968 Fertilizer Review Committee meeting, attended by all distributors and producers, a standing working committee was appointed. The committee will handle in-country distribution problems, fertilizer pricing problems, in-country logistic shortages, and other problems that will arise from time to time.

This committee will prove to be an important step in settling intercountry price and distribution disputes. The most difficult problem that will be facing this committee is the essential job of making distributors and agents maintain their profit margins; these margins are the incentives that will perpetuate fertilizer distribution. If the margins are dissipated in price cutting, discounts, free delivery,

etc., distributors will not be able to fulfill their functions of distributing fertilizer effectively throughout Pakistan.

Price Cutting

In a spot check in the Multan Bahawalpur area, distributors are already giving their sub-agents discounts, price incentives, and free delivery. Agents are selling directly to farmers at reduced prices. Retail selling prices of urea in the village level, which are posted at 26 rupees per 50 kilo bag, and 25 rupees in Mandi towns, regardless of delivery point were 24.5 rupees to as low as 24.2 rupees per bag.

One distributor, on receipt of his first cargo of urea, authorized his agents to sell urea at 24.5 rupees per kilo bag, while in these same Mandi towns ADC agents were selling urea at the posted price of 25 rupees per bag. This initial price break then led to the sale of fertilizer in the villages at the Mandi town price. The distributor is now having to absorb the freight from the Mandi towns to the villages. While farmers are elated at being able to buy urea for the first time below government posted prices, and without having to pay a one to two rupee premium per bag to encourage speedy delivery, the farmer in the long run will lose. A distributor or dealer cannot continue to give adequate service when profit is lacking.

Every effort must be made to maintain a healthy market with profit incentives to assure widespread fertilizer distribution and to insure the education of the farmer, dealer, sub-agent, and agent on the proper use and value of fertilizer.

Price wars result in agents and distributors short-changing their customers, country, and eventually themselves.

Diversification

Private distributors must be encouraged to broaden their line of products in order to maintain full utilization of their agent and dealer facilities. Items such as soil amendments (gypsum), pesticides, seeds, agricultural equipment, etc., will earn additional profits and provide needed service to Pakistani farmers.

Gypsum is indigenous in West Pakistan. Estimates are that two to six million tons could be used annually to correct salinity problems and to treat high sodium tube well water. Distributors are in a good position to supply agricultural gypsum to farmers in bulk.

FERTILIZER DISTRIBUTION AUDIT

In the time allotted it was not possible to make an in-depth study of fertilizer distribution conditions. Based on a sampling of agents and dealers representing five distribution organizations, the following evaluation was made. Ratings were on the basis of 0 to 10, 10 being perfect. As seen from the rating sheet, much improvement is needed in the quality and service that distributors are currently giving. This will improve in time, but only with hard work.

WEST PAKISTAN DISTRICT DEALERS: RATING 0 TO 10

BASIC FACTORS AFFECTING FERTILIZER DISTRIBUTION AND SALES

1.	Dealer locations and accessibility to farmers		8
2.	Degree of effective profit margin to		
	Distributor	6)	
	Agent	7)	
	Sub-agent	5)	
3.	Ability to finance (credit, cash) inventory at desired levels to maximize sales		
	Distributor	9)	
	Agent	3)	6.5
	Sub-agent	1)	
4.	Adequacy of warehousing, space, condition		
	Distributor	4)	
	Agent	6)	5
	Sub-agent	3)	
5.	Degree of supply to meet demand		6
6.	Timeliness of delivery		3
7.	Influence on type of fertilizer specification, packing		0 +

8. Adequacy of transportation from dock to farmer (10 mile radius) 7

Rail	8	Ox Wagon	10
Truck	3	Animal Back	10

9. Level of knowledge and ability to educate and assist farmer on agronomic problems concerning fertilizer and soil amendments.

Distributor	3)	
Agent	0)	1
Sub-agent	0)	

FERTILIZER CONSUMPTION AUDIT

Ten factors were used in determining the level of fertilizer consumption and understanding at the farm level. The ratings are generally good, which would be anticipated in a country where fertilizer consumption is growing at the rate that it is in West Pakistan.

The major problems revolve around the difficulty the farmer has in obtaining fertilizer when he wants it, his ability to pay for it in cash, and a lack of knowledge concerning the various types of fertilizer, application rate, and how best to get the maximum return for each rupee invested.

With Mexican wheat being planted on three and one-half million acres in West Pakistan this year, one million farmers or more will demonstrate to themselves that big dividends can be derived from use of fertilizer, a variety of seed that responds to fertilizer, and accompanying cultural practices. As one farmer responded when asked, "Why are you using fertilizer and growing Mexican wheat?": "Because I will get a big increase." When questioned, he estimated a fourfold increase over his previous native wheat. He in turn rationalized that for every rupee of fertilizer he purchased and used (40 rupees per acre), he would receive (360 rupees increase) nine rupees to one in return. These types of returns are possible on the deep soils of West Pakistan, and when nitrogen is used as the sole fertilizer on the first or second wheat crop, successive cropping will demand greater quantities of other plant nutrients, such as phosphate, potash, etc.

The Pakistani farmer recognizes cause and effect; he has demonstrated it to himself or seen it demonstrated on his neighbor's field. He will sacrifice valuable cash to buy fertilizer and haul it on his back, if necessary, to get it to his village and field.

WEST PAKISTAN MAJOR FERTILIZER CONSUMPTION FACTORS AT THE FARM LEVEL RATING 0 TO 10

1.	Farmers' degree of personal knowledge and experience with value of fertilizer	8
2.	Percent of cropped land responsive to N-P-K, receiving some degree of commercial fertilizer	3
3.	In-country fertilizer supply to current farmer demand	8
4.	Timeliness of delivery to the farmer	4
5.	Accessibility of supply (within 20 miles) to farmer	8
6.	Type product supplied re farmers' wants	5
7.	Financial ability to buy amount desired	3
8.	Availability of fertilizer information to farmer re rates, methods of use, types, timing, etcetera	3
9.	Utilization of needed agronomic inputs to maximize fertilizer response--variety, pest control, water, etcetera	7
10.	Other influencing factors: government inducements, sociological factors, market for farm produce, price incentives, transportation, market information, consumer goods to purchase, etcetera	7

TABLE 1

WEST PAKISTAN

TOTAL PLANT NUTRIENT CONSUMPTION FORECAST
(N, P_2O_5, K_2O in 000 Long Tons)

FY	N	P_2O_5	K_2O	Total N-P-K	
1966	68	2	-	70	actual from USAID/Lahore
1967	112	3	-	115	actual from USAID/Lahore
1968	154	6	.5	160	estimate based on 7 mo report through Jan. 1968
1969	265	54	1	320	100% increase factor over 1968
1970	291	60	1	352	10% rate of increase of total
1971	322	64	1	387	10% rate of increase of total
1972	354	71	1	426	10% rate of increase of total
1973	390	78	2	470	10% rate of increase of total
1974	436	109	9	554	18% rate of increase of total
1975	501	125	10	638	15% rate of increase of total
1976	576	144	12	732	15% rate of increase of total
1980	789	264	26	1071	10% per year increase over 1976

Ratio of N to P to K

1969 - 25N to 5P to .1K or N to P - 5 to 1

1974 - 24N to 6P to .5K or N to P - 4 to 1

1980 - 30N to 10P to 1K or N to P - 3 to 1

TABLE 2
WEST PAKISTAN FERTILIZER PRODUCTION FORECAST FISCAL YEARS 1966-1976
NUTRIENT TONS

Plant	Completion Year FY 2/	Annual Rated L. T. Capacity 3/	PRODUCTION FORECAST Fiscal Years 1966	1967	1968	1969	1970	1971	1972	1976
EXISTING PLANT 1/										
Lyallpur	1957	3,600 P_2O_5	3,060	3,060	3,060	3,060	3,060	3,060	3,060	3,060
Daudkhel	1958	10,500 N	8,925	8,925	8,925	8,925	8,925	8,925	8,925	8,925
Multan	1961	56,833 N	48,308	48,308	48,308	48,308	48,308	48,308	48,308	48,308
Daudkhel 3/ (Expansion)	1967	8,400 N	-	2,100	7,140	7,140	7,140	7,140	7,140	7,140
Lyallpur (Expansion)	1968	4,400 P_2O_5	-	-	1,100	3,740	3,740	3,740	3,740	3,740
Multan (Expansion)	1969	15,570 N	-	-	-	3,893	13,235	13,235	13,235	13,235
PROPOSED NEW PLANTS 3/										
Daharki #1 (ESSO)	1969	76,500 N	-	-	-	36,000	65,025	65,025	65,025	65,025
Karachi (Jaffer)	1972	55,800 P_2O_5	-	-	-	-	-	-	13,950	47,430
Daharki #2	1971	153,000 N	-	-	-	-	-	38,250	130,050	130,050
Shekupura #1	1972	183,600 N	-	-	-	-	-	-	45,900	155,060
Shekupura #2	1974	153,000 N	-	-	-	-	-	-	-	130,050
T O T A L		721,203	60,293	62,393	68,533	111,066	149,433	187,683	339,333	613,023

1/ Production for existing plants based on 85 percent of rated capacity.

2/ Government of Pakistan Targets adjusted by USAID to allow normal time for negotiation, construction and schedule start up date changes based on current information 3/1968.

3/ Production estimated 25 percent of capacity for first 6 months production: 85 percent thereafter, 340 days per year operation.

TABLE 3

WEST PAKISTAN FERTILIZER PLANTS
PRESENT AND PROPOSED CAPACITY

	PRODUCT	CAPACITY Percent	CAPACITY Proposed by 1976 (000 nutrient tons)
WEST PAKISTAN			
Lyallpur WPIDC	Superphosphate 20% P_2O_5	3.6	8.0
Daudkhel WPIDC	Ammonium Sulfate 21%	10.5	18.9
Multan WPIDC	Calcium Ammonium Nitrate 26% 300 to 460	27.1	41.2
	Urea 46% Crystal 190 to 200 tons per day 45% N prilled	29.7	31.2
Daharki (Esso)	Urea 500 tons per day 45% N prilled	-	76.5
Daharki 2 (Kaiser)	Urea 1000 tons per day 45% N prilled	-	153.0
Shekupura 1 (Am. Cy.)	Urea 1200 tons per day 45% N prilled	-	183.6
Shekupura 2 (Hercules)	Urea 1000 tons per day 45% N prilled	-	153.0
Karachi (Jaffer)	Triple Superphosphate 46% P_2O_5	-	55.8
	TOTAL	70.9	721.2

TABLE 4

WEST PAKISTAN

FINISHED FERTILIZER IMPORT DOLLAR DEMAND PROJECTIONS 1/

1000 Nutrient Tons and $ in 1000's

Fiscal Year	N Demand Tons	Local Production Tons	Tons	Imports $ Value C&F $210/NT	P_2O_5 Demand Tons	Local Production Tons	Tons	Imports C&F $210/NT	Total $ Value Imports
1966	67	57	10	2,100	2	2	-	- -	2,100
1967	112	59	53	11,130	3	3	-	- -	11,130
1968	154	64	90	18,900	6	4	2	2 420	19,320
1969	265	105	160	33,600	54	6	48	12,180	45,780
1970	291	142	149	31,290	60	7	53	11,130	42,420
1971	322	181	141	29,610	64	7	57	11,970	41,580
1972	354	318	36	7,560	71	24	47	9,870	17,430
1973	390	428	-	-	78	54	24	5,040	5,040
1974	436	466	-	-	109	56	53	11,130	11,130
1975	501	558	-	-	125	56	69	14,490	14,490
1976	576	558	(18*)	-	144	56	88	18,480	18,480
1980	784	621	168	35,280	264	56	208	43,680	78,960

1/ Potash not included. All potash needs will be imported. Value per ton C&F for K_2O can be calculated at $100 per ton of plant nutrient.

* From inventory stocks.

TABLE 5

CURRENT COST COMPARISON VIA USAID
BULK VERSUS BAGGED
(per metric ton)

Product	U.S. Cost Bulk FOB Vessel	Frt. U.S. Vessel Bulk	Total $ C&F Karachi	Paid in Rupees Discharge Bag & Bagging	Total Cost In $	BAGGED C&F Purchased and Shipped in Bags & Discharged
Triple Super-Phosphate Granules 46% P_2O_5	$ 45.00	$ 29.00	[illegible]4.00	35R or ($7.00)	$81.00	58.00 FOB U.S. Port $ 37.00 U.S. Frt. $ 95.00 1.00 Paid as 5 Rupees $ 96.00 Total
Diammonium Phosphate 16-48-0	64.00	29.00	93.00	35R ($7.00)	100.00	77.00 FOB 37.00 U.S. Frt. 1.00 Paid in Rupees $115.00 Total
Ammonium Sulfate 21% N	29.50	29.00	58.50	35R ($7.00)	65.50	42.50 FOB 37.00 U.S. Frt. 1.00 Paid in Rupees $ 80.50 Total

TABLE 6

PORTABLE DISCHARGE AND BAGGING EQUIPMENT
TO HANDLE 40,000 TONS PER MONTH CAPACITY

Investment in equipment to handle discharge:

				U. S. Cost Estimate Plus Transportation
A.	20 ton leg tanks - mobile	6	@	$ 5,000
B.	High speed bagging and weighing lines - mobile	6	@	20,000
C.	Clam shovels for discharging vessel used by dock cranes	6	@	2,500
				27,500
				x 6
				165,000
D.	Other equipment — office trailer, 2 pickup trucks, lights, tarpaulins, shovels, scales, parts, office equipment, etc.			60,000
			TOTAL ESTIMATE	$225,000

SECOND BULK HANDLING POSSIBILITY

Use proposed phosphate plants to handle bulk shipments.

A. Phase construction to build pier, warehouse, bagging and product handling first.

B. Plant can obtain experience with product handling and shipping prior to having to handle full putput of their plant.

C. With AID financing foreign exchange cost of bagging and handling equipment - phosphate project obtain needed USAID assistance.

TABLE 7

WEST PAKISTAN

SQUARE FEET OF TOTAL WAREHOUSE SPACE NEEDED
(TSP or urea equivalent 5 sq. ft/ton, 3 stock turnover per year)

FY	
1966	233,333 sq. ft.
1967	383,333
1968	533,333
1969	1,066,666
1970	1,173,333
1971	1,290,000
1972	1,420,000
1973	1,563,333
1974	1,820,000
1975	2,093,333
1976	2,406,666
1980	3,520,000

TABLE 8

WEST PAKISTAN

PROJECTED FERTILIZER SALES AND COSTS IN RUPEES
FISCAL YEAR 1968-69

In-Country Production	Product Weight	C&F Cost/Ton	Distribution Cost Per Ton	Total Cost Per Ton	Total Cost (000)	Recovered Selling Price/Ton from Distributer 1/	Total Recovered (000)	Subsidy or Actual Govt. Loss (000)
Ammonium Sulfate	100,000	462	59	521.00	52,100	220.00	22,000	30,100
CAN 26%	99,500	417	59	476.00	47,362	231.00	27,959	19,463
Urea	75,500	713	78	791.00	59,720	487.00	36,768	22,952
S/Phosphate	50,000	363	58	421.00	21,050	200.00	10,000	11,050
	325,000				180,232		96,727	83,505 4/
Imports								
Urea	243,000	540	110	650.00	157,950	500.00	121,500	36,450
TSP	67,000	450	98	548.00	36,716	380.00	25,460	11,256
A.S. Nitrate	58,000	350	91	441.00	25,578	280.00	16,240	9,338
DAP	60,000	540	110	650.00	39,000	520.00	31,200	7,800
Nitro/Phos	10,000	450	98	548.00	5,480	400.00	4,000	1,480
	438,000				264,724		198,400	66,324 3/
Grand Total	763,000				444,956		295,127	149,829 2/

1/ Distributors cost at agents Mandi location.
2/ Actual Subsidy GOWP excluding unforeseen losses and appropriations to WPIDC through private sector distribution is 33.7% of costs.
3/ Subsidy on imported fertilizer 25%
4/ Subsidy on fertilizer from WIPDC 46.3%

Source: WPADC, March 1968

TABLE 9

WEST PAKISTAN

RAIL AND ROAD FREIGHT COMPARISON
(rupees ton)

MILES	RAIL	ROAD
25	5.24	6.00
50	6.67	9.52
60	7.25	11.40
65	7.52	12.35
75	8.15	14.50
100	9.58	19.00
125	10.70	22.50
150	11.61	27.00
175	12.75	31.50
200	13.61	36.00
300	17.34	-
400	19.94	-
500	22.30	-

ADDITIONAL HANDLING BY RAIL .... Rs. 3.85 PER TON

March 1, 1968

TABLE 10

WEST PAKISTAN

FERTILIZER IMPORTS
(in product tons)

	1962-63	1963-64	1964-65	1965-66	1966-67
Amm. Sul.	102,464	24,403	15,256	204,600	329,060
Urea	20,925	-	-	13,000	57,861
T.S.P.	-	-	-	-	35,633
A.S.N.	-	-	-	-	41,069
M.O.P.	-	-	-	-	1,000
TOTAL:	123,389	24,403	15,256	217,600	464,623

FERTILIZERS PRODUCTION W.P.I.D.C.
(in product tons)

Year	Ammonium Sulphate 21% N	Ammonium Nitrate 26.5% N	Urea 46% N	Super Phosphate 20% P_2O_5
1959-60	34,378	-	-	-
1960-61	54,103	-	-	8,843
1961-62	51,906	9,095	733	7,913
1962-63	51,630	64,328	27,942	5,960
1963-64	49,116	60,494	39,816	6,591
1964-65	34,852	75,325	44,228	8,040
1965-66	38,424	74,764	41,424	7,860
1966-67	42,167	79,443	48,788	960

Source: ADC Lahore, March, 1968

TABLE 11

WEST PAKISTAN

FERTILIZER IMPORT PROGRAMME 1968-69

Country	Amount Allocated Millions Dollars	Type and quantity to be imported					
		Urea	A/S/N	Diammonium Phos.	N/Phos.	T/S/P	Total
USSR	1.05	10,500	-	-	-	-	10,500
Bulgaria	2.10	21,000	-	-	-	-	21,000
Romania	0.95	9,500	-	-	-	-	9,500
U.K.	0.85	8,500	-	-	-	-	8,500
France	2.00	20,000	-	-	-	-	20,000
Italy	3.00	20,000	14,300	-	-	-	34,300
Japan	2.44	24,400	-	-	-	-	24,400
Canada	3.70	41,000	-	-	-	-	41,000
W. Germany	4.00	-	44,000	-	10,000	-	54,000
U.S.A.	18.68 (Loan 127) 6.00 (Loan 121)	88,000	-	60,000	-	60,000	208,000
Netherlands	0.60	-	-	-	-	6,600	6,600
TOTAL	45.37	242,900	58,300	60,000	10,000	66,600	437,800

Prepared January 1968

TABLE 12

WEST PAKISTAN

FERTILIZER CONSUMPTION HISTORY
(in 000 nutrient tons)

Pre-Plan Period	WEST PAKISTAN			
Year	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Total Nutrients
1952-53	1.0	-	-	1.0
1953-54	14.8	-	-	14.8
1954-55	14.1	-	-	14.1
FIRST FIVE YEAR PLAN				
1955-56	6.6	-	-	6.6
1956-57	9.0	-	-	9.0
1957-58	16.4	-	-	16.4
1958-59	18.0	-	-	18.0
1959-60	19.3	0.1	-	19.4
SECOND FIVE YEAR PLAN				
1960-61	31.0	0.4	-	31.4
1961-62	37.0	0.5	-	37.5
1962-63	40.0	0.2	-	40.2
1963-64	68.0	0.7	-	68.7
1964-65	85.0	2.2	-	87.2
THIRD FIVE YEAR PLAN				
1965-66	69.8	1.2	-	71.0
1966-67	112.3	3.9	-	116.2
1967-68				110.0 */
1968-69				
1969-70				

Source: Information received by the Planning Commission, Government of Pakistan

*/ Data obtained from WPADC, up to January 31, 1968.

TABLE 13

WEST PAKISTAN

LATEST CONTROL SALE PRICE OF FERTILIZER

Variety of Fertilizer	Weight in Lbs.		Nutrient in Lbs.		Price		Paisa Per Lbs. of Nutrient	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported
AMM. SULPHATE	112	122	22.2	32.2	Rs.11/-	Rs. 11/-	49	49
AMM. NITRATE	87.5	112	24.5	31.4	Rs.11/-	Rs. 14/-	45	45
UREA	50.6	112	23.0	51.5	Rs.11/-	Rs. 25/-	47	48.5
SUPER PHOSPHATE	112		21.3		Rs.10/-		47	
TRIPLE PHOSPHATE		112		50		Rs. 19/-		40.4

February, 1968

TABLE 14

WEST PAKISTAN

FERTILIZER IMPORTS AND COSTS

(Via loan or barter arrangements)

Country	Date	Product	Tons	Price
Poland	12-5-67	Urea	10,000	$99.00 C&F less $1.00 payable to ADC for unloading cost.
Hungary	12-67	Urea	5,900	90.00 C&F less $1.00 payable to ADC for unloading cost.
West Germany	8-21-67	ASN	37,500	49.54 FOB to $9.65 + freight $16.03
		NitroPhos	10,000	74.38 FOB + freight $16.03
		NitroPhos	6,600	68.90 FOB + freight $19.70
USSR	6-5-67	Urea	36,800	95.00 C&F via Suez ($7.00 surcharge if via Cape)
Holland	10-11-67	TSP	5,800	65.00 FOB freight via Cape $20.00
Belgium	2-9-67	TSP	7,000	68.00 FOB
USAID	8-15-67	TSP	37,000	53.09 FOB
		TSP	10,000	52.55 FOB
		TSP	10,000	51.58 FOB
		TSP	10,000	52.14 FOB
USAID	8-67	Urea (non-U.S.)	50,000	86.87 to 90.49 FOB

Source: WPADC, 3/1968

TABLE 15
WEST PAKISTAN
IMPORT PROGRAMME FOR 1968 - 69
(000 product tons)

Months	Urea		A/S/N		D/A/P	T/S/P	N/P	Total
April, 1968	10.5	USSR	-		-	-	-	10.5
May, 1968		-	-		-	-	-	-
June, 1968	21.0	Bulgaria	-		20. USA	-	-	41.0
July, 1968	20.0	USA	-		20. USA	-	-	40.0
August, 1968	11.0	Canada						
	10.0	USA	-		10. USA	10. USA	-	41.0
	21.0							
Sept. 1968	10.0	Canada						
	10.0	USA	-		10. USA	10. USA	-	40.0
	20.0							
Oct. 1968	10.0	Canada						
	15.0	USA						
	25.0		12	W. Germany	-	-	-	37.0
Nov. 1968	10.0	Canada						
	10.0	Italy						
	9.5	Romania	6	W. Germany	-	-	-	35.5
	29.5							
Dec. 1968	14.4	Japan						
	15.0	USA						
	29.4		6	W. Germany	-	-	-	35.4
Jan. 1969	10.0	Japan	14.3	Italy	-	-	-	24.3
Feb. 1969	10.0	Italy						
	10.0	France						
	20.0		10.0	W. Germany		-	-	30.0
March, 1969	10.0	USA						
	8.5	U.K.	-		-	-	10.0 W. Germany	28.5
	18.5							
April, 1969	8.0	USA	10.0	W. Germany	-	-	-	18.0
May, 1969	10.0	France	-		-	20. USA	-	30.0
June, 1969	-	-	-		-	20. USA		
						6.6 Dutch	-	26.6
						26.6		
TOTAL	242.9		58.3		60.	66.6	10.0	437.8

REPORT ON FERTILIZER AND TURKISH AGRICULTURE

By
John M. Hill
Fertilizer Adviser
and
Dr. Harold Lubell
Program Economist
USAID/Ankara, Turkey

INTRODUCTION

The purpose of this report is to review for CENTO the status of the Turkish Agricultural Industry and Fertilizer Sector.

A country's agricultural growth is mirrored by the degree of its fertilizer consumption growth rate. Turkey's fertilizer growth rate (40 percent on nitrogen and 20 percent on phosphate) has been sustained with its own buying power and is one to be proud of. The future of Turkish agriculture is solidly in the hands of dedicated Turkish scientists, government leaders and hard working farmers.

AGRICULTURE IN TURKEY

Turkey's current population is estimated at 32 million and is increasing at a rate of 2.7 to 3 percent per year. This means that Turkey will have to feed and employ some 90,000,000 people in the year 2000.

Turkey's land resources are limited; currently, they represent 78.1 million hectares of land. Of this, 18.8 million hectares are suitable for normal cultivation. Land not suitable for cultivation represents the majority of Turkey's land mass, 59.3 million hectares (Chart 1).

With the increase in Turkey's population and a limited agricultural base to produce her food requirements, the use of modern farming techniques and improved agricultural inputs, such as high analysis fertilizer, improved seed varieties, and improved use of water resources is essential.

Widely differing climate and soils throughout the country permit the production of a variety of crops. Among the most important are wheat, barley and other grains, grapes, citrus, tree fruits, sugar beets, nuts, tobacco and cotton. Sheep and goats are the most numerous farm animals.

Over 70 percent of the farm families own the land they work. Farm holdings are relatively small and fragmented. Over 60 percent of the farm families own less than 12 acres of crop land and over 85 percent own less than 25 acres. Only about one-quarter of the total area farmed is held in tracts of more than 125 acres. The agricultural sector has kept only a little ahead of population increase over the last five years. The volume of production by crop is shown in Table 1.

Ancient records show us that Turkey has been producing agricultural crops as far back as 2400 B.C. As the grain basket for the eastern Roman Empire, Turkey fed the legions of Rome, and contributed tributes of grain, wine, fruit, and livestock. Just as an army marches on its stomach, so does the health, welfare, and mental ability of a country depend on the agricultural land to provide nourishing food for its population. Turkey's arable land has been farmed for thousands of years with little or nothing returned to make up for the countless harvests. Turkey's arable land is one that is primarily calcareous (PH 7.5 to 8.5) in nature. Free limestone in her soils varies from 0.5 to 99 percent. A small portion of her soil along the Black Sea coast is acid, which makes it possible to grow tea and other acid-loving plants. Her soils are almost uniformly deficient in phosphate and nitrogen. Potash deficiencies are limited to small geographic areas, but will expand as more intensive agriculture practices are followed. Turkey's best agricultural land lies along the coastal region, diminishes in value in the interior of Turkey and from west to east, in direct relation to available rainfall and land suitable for irrigation.

In the late 1950's the use of fertilizer in Turkey was pioneered by Turkish scientists, with assistance from European and American scientists, and by Turkish institutions such as the Sugar Monopoly, Ankara University, and Soil Research Institute.

In 1959, Dr. Robert L. Fox, Soil Science Specialist with the University of Nebraska in Turkey, conducted a series of experiments and field trials with members of the Agricultural Faculty at the University of Ankara. This work clearly defined the importance of adding phosphate to Turkey's soil to overcome the low level of available phosphate in the soil due to depletion by thousands of years of harvests.

The Government of Turkey, recognizing the value of fertilizer in the late 1950's authorized the construction of two single superphosphate plants, one near Istanbul, the other at İskenderun, each with an annual production capacity of 120,000 tons. In conjunction with German manufacturers a plant was built at Kütahya to produce ammonium sulfate and 21 percent calcium ammonium nitrate from soft lignite coal and gypsum.

The consumption of fertilizer in Turkey developed rather slowly during the 1950's and early 1960's. The Turkish Government began to place more importance on fertilizer to raise its agricultural production, and sought the assistance of the United Nations Food and Agriculture Organization (FAO) to start a massive fertilizer demonstration program. The success of these activities is evident: total fertilizer plant nutrient consumption which was 20,000 tons in 1960, increased almost ten times to 209,000 tons by 1966 and nearly fifteen times by 1967 (Table 2). To meet this expanding use of fertilizer the Government of Turkey relied heavily on imports paid for with her valuable free hard currency. In the period between 1961 and 1966, over 15,000 farmer-field demonstrations had been carried out by the Ministry of Agriculture and the FAO. Report No. 11 "Report on Selected Results of the Fertilizer Program in Turkey" prepared

TURKEY CLOSES THE GAP BETWEEN FERTILIZER DEMAND AND LOCAL PRODUCTION BY IMPORTS– All paid for with Turkish hard currency.

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by R. Steiner, Soils Fertility Specialist, FAO, made clear the value of fertilizer for increasing yields in Turkey in all regions and with a multitude of crops. He showed that a return of 4 to 10 lira can be realized for each lira expended for fertilizer.

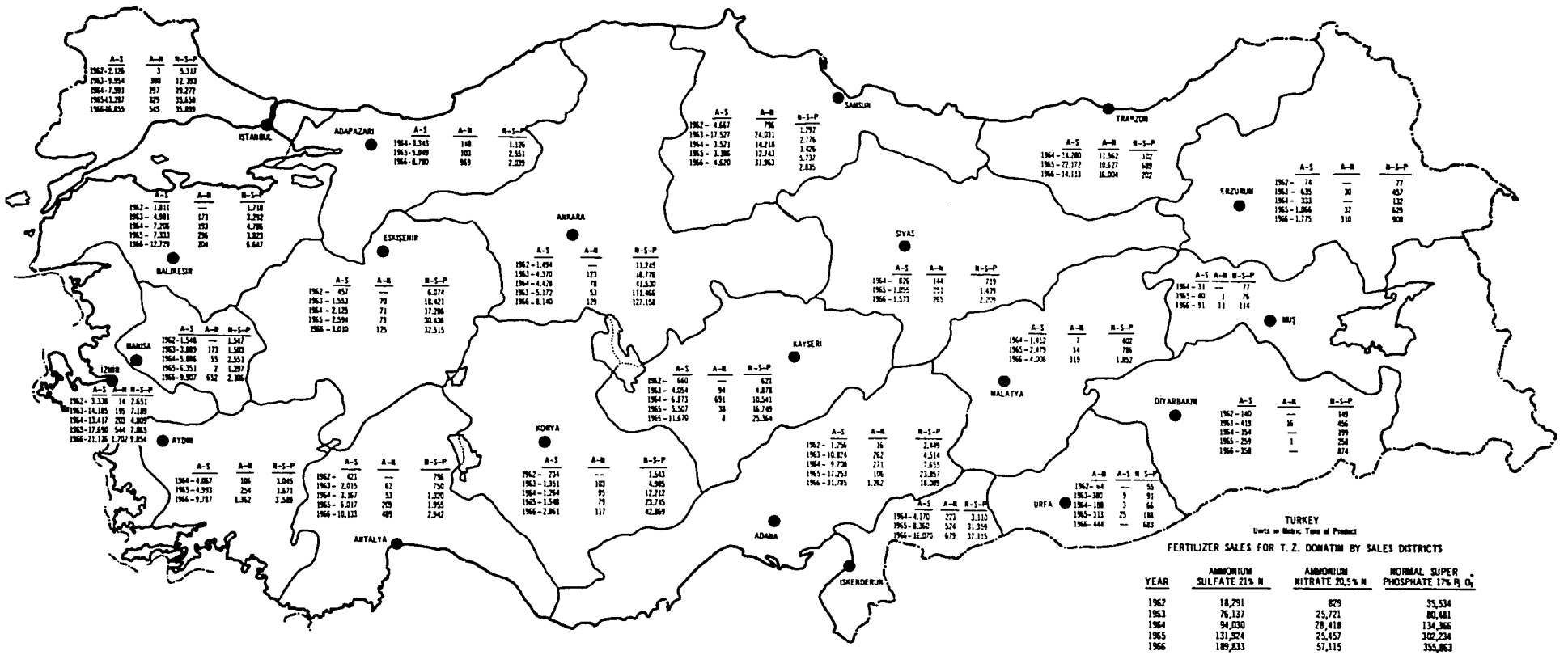
With the advent of Mexican wheat and the massive Mexican wheat introduction program started in 1967-1968, approximately 40,000 Turkish farmers planted Mexican wheat seed and used high levels of fertilizers with the appropriate accompanying agricultural practices. This wheat program brought to the farmers by the Turkish Agricultural Extension Service with assistance from U.S. agricultural experts, reemphasized the importance of fertilizer and introduced many of them for the first time to the value of a programmed approach to farming.

The coastal areas of Turkey suitable for Mexican wheat have in the recent past planted 1.6 million to 1.8 million acres of native type wheats. It is estimated that by 1969-1970 one million acres of the land in this coastal region will be planted to Mexican wheat. If 80 percent of the recommended amounts of fertilizer are used, Mexican wheat alone by 1971 will be consuming as much fertilizer as all of Turkey consumed in 1966.

Fertilizer has been used in the past on cash crops such as vegetables, cotton, sugar beets, and tea. The use of fertilizer for grain production is a practice that is beginning to take hold. Phosphate consumption on the Anatolian Plateau, the wheat bread basket of Turkey, has increased ten-fold in the last four years. For example, as shown on the map the Ankara area increased consumption of normal superphosphate from 11,000 tons in 1962 to 127,000 tons in 1966. These results have stimulated wheat production on the Anatolian Plateau and will eventually, through additional research and cultural program, also lead to the use of nitrogen.

TURKISH SUPPORT OF AGRICULTURE

Despite the rapid growth of industry in recent years, Turkey's net value added in agriculture still accounts for 40 percent on the average of the gross national product, so that the future growth of the entire economy depends to a considerable extent on the achievement of a respectable rate of growth by the agricultural sector. Over the period of the First Five Year Plan (1962-1967), net value added at factor cost in agriculture as a whole grew by 3.0 percent per year. Between 1962 and 1966, the gross value of crop production grew by 4.6 percent. Within crop production, cereals showed only a 2.8 percent per year increase while other crops grew at 6.5 percent, partly because of the far more intensive application of irrigation and fertilizers to the industrial crops.



TURKEY

Units in Metric Tons of Product

FERTILIZER SALES FOR T. Z. DONATIM BY SALES DISTRICTS

YEAR	AMMONIUM SULFATE 21% N	AMMONIUM NITRATE 20,5% N	NORMAL SUPER PHOSPHATE 17% P_2O_5 *
1962	18,291	829	35,534
1963	76,137	25,721	80,481
1964	94,030	28,418	134,366
1965	131,924	25,457	302,234
1966	189,833	57,115	355,863

* Note all phosphate sales shown in terms of simple super 17% P_2O_5 water soluble.

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The Turkish Government is well aware of the importance of agriculture for economic growth. The Second Five Year Plan, which projects a growth rate for net value added in agriculture at factor cost of 4.1 percent, takes a realistic view of the difficulties faced by agriculture and the technical inputs needed to overcome them, in particular new varieties of seed, improved application of existing supplies of water, and a vast increase in the use of fertilizer.

Investment in agriculture over the First Five Year Plan period is estimated at TL. 10.0 billion in 1965 prices ($1.1 billion) or 15.4 percent of aggregate gross domestic fixed capital formation over the period. Investment in agriculture during the Second Five Year Plan (SFYP) period (1968-1972) is projected at TL. 16.9 billion in 1965 prices ($1.9 billion), a small decrease in the share of total investment to 15.2 percent. The broad composition of the SFYP investment projection for agriculture (1968-1972) is as follows:

	Billion TL. 1965	Percent
Land and Water Resource Development	9.2	54.4
Machinery and Equipment	3.6	21.3
Other	4.1	24.3
TOTAL	16.9	100.0

The SFYP also includes large investments in industrial facilities whose output is required to support agriculture. In particular, an aggregate investment of TL. 4.2 billion ($470 million) for chemicals and fertilizers is projected for the 1968-1972 period.

For 1968, Turkey authorized the import of 920,000 tons of fertilizer products valued at $53.6 million. Nitrogen products have been procured for this year and delivery has been completed. Phosphate fertilizers are being procured and delivery will be made in late 1968 (Chart I, Tables 3 and 4.)

In calendar 1969, Turkey is planning to import 1,090,000 tons of fertilizer product with a total estimated cost of $61.17 million (Table 5).

FERTILIZER IMPORT PROCEDURES

The Government of Turkey does not import fertilizers directly. Fertilizers are imported by State Enterprises and private organizations. Single element fertilizers, such as ammonium sulphate, triple superphosphate or potash, can be imported only by certain State

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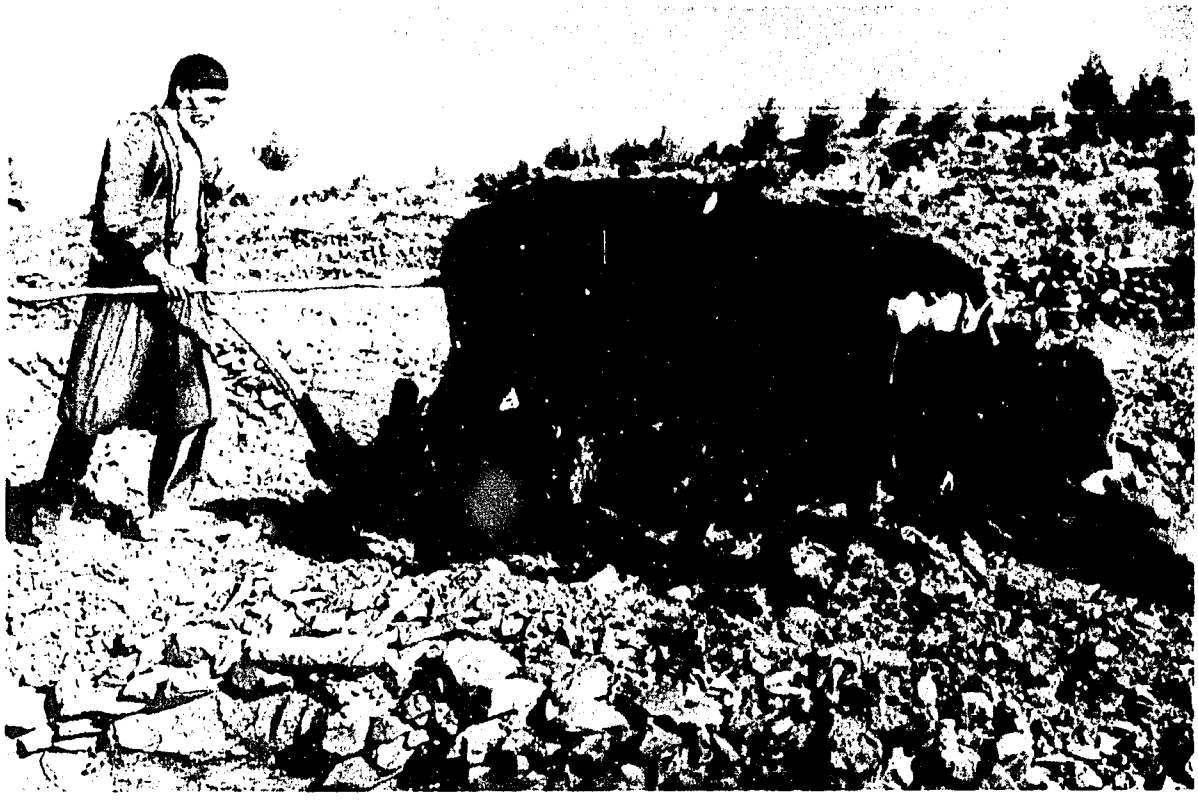
Economic Enterprises or government-sanctioned agencies including: T.Z. Donatım (agricultural supply company); Çukobirlik (cotton co-operative, Adana); Tariş (producers' cooperative, İzmir); Çaycılar Cooperative (tea cooperative); Akçaabat Tütüncülük Cooperative (tobacco cooperative, Black Sea area); Şeker Fabrikaları (sugar monopoly); Tarım Kredi Kooperatifi (agricultural credit cooperative). Mixed fertilizers, containing phosphate, nitrogen and potash, such as NP or NPK types, may be imported by the above companies and by the private sector.

SUCCESS OF FERTILIZER USAGE IN TURKEY

With 15,000 fertilizer demonstrations carried out in Turkey by the Turkish Ministry of Agriculture with the cooperation of FAO from 1961 through 1967, and with 40,000 to 50,000 Turkish farmers participating in the use of fertilizer in the Mexican wheat program, utilization of fertilizer has been well established in Turkey. This is evidenced by its consumption of over 339,000 metric tons of plant nutrients in 1967 (Table 2). This is in excess of plant nutrient consumption of East and West Pakistan for the same year.

AMMONIUM NITRATE READY TO BE APPLIED ON MEXICAN WHEAT IN THE ADANA AREA– *Fertilizer makes the difference of two to three times the yield over no fertilizer.*



FARMING MARGINAL LAND BARELY KEEPS HUNGER AWAY– *Population increases must be fed with the use of modern farming technology on the available farm lands.*

The southern and western coastal regions of Turkey have a Mediterranean type climate with rain occurring primarily in winter months. Types of crops grown in this area are cotton, citrus, olives, tobacco, fruit crops, wheat, barley, and sugar beets. The best agricultural lands in this area are under irrigation or about to be brought under irrigation by new projects. This area consumes large quantities of ammonium sulphate, triple superphospate, and is the main consuming area for BPN mixed fertilizers. As this region will be the main area where Mexican wheat is planted, fertilizer consumption will grow rapidly over the next two to three years.

The Anatolian Plateau currently produces 80 percent of Turkey's wheat and is the bread basket of Turkey. This area is farmed on a fallow system with approximately half of the agricultural land in fallow while the other half is being cultivated. The use of phosphate fertilizer in this area has been established and it is currently being used on a wide scale by Turkish farmers. The use of nitrogen for wheat on the Anatolian Plateau has not been established and research work is now going forward with new varieties of wheats and other grains and with cultural practices which will allow the use of nitrogen to increase yields. The main type of products used on the Anatolian Plateau are single superphosphate and triple superphosphate, with a small quantity of ammonium sulphate used primarily on sugar beets and rice in the small irrigated valleys.

The Black Sea area with rain primarily in the summer months grows primarily tea, corn, filberts, and wheat. This is the main consuming area for ammonium nitrate in Turkey and for large quantities of ammonium sulphate. Currently, a relatively small amount of Turkey's total phosphate fertilizer is used in this area. T.Z. Donatım sales for the past four years shown on the map indicate current fertilizer consumption trends. This map, however, excludes fertilizer consumed by the Sugar Company. This consumption of fertilizer is for sugar beets.

DISTRIBUTION OF FERTILIZER

One state economic enterprise and several cooperatives are involved in distributing Turkey's imports of fertilizers containing only one plant nutrient of nitrogen (N) or phosphate (P). Compound fertilizers, NP or NPK types, are also imported and distributed by these five organizations and by private fertilizer importers and dealers. The 1968 plan for fertilizer sales in Turkey is as follows:

1968 FERTILIZER SALES FORECAST

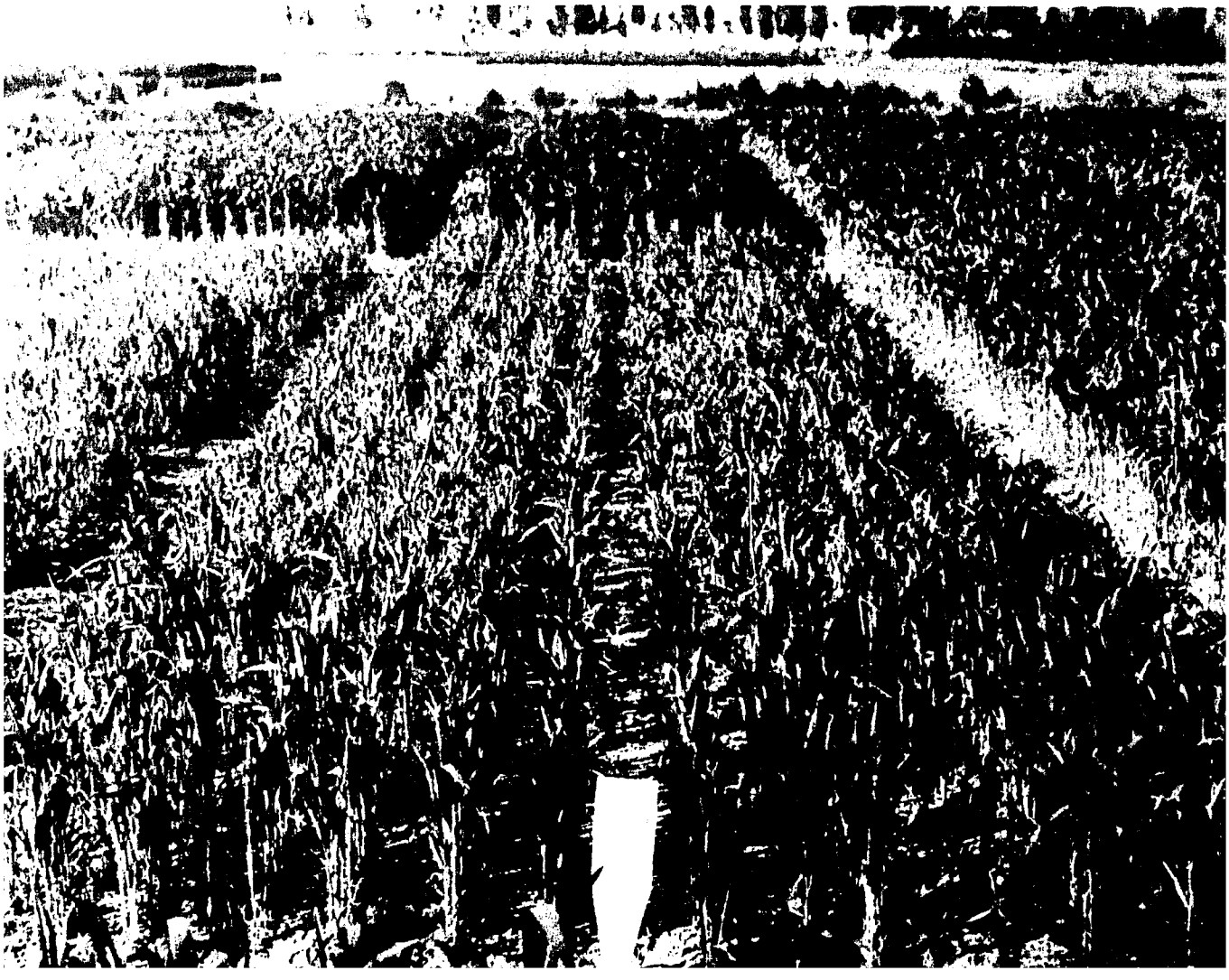
	Percent of Market
- T.Z. Donatım	51
- Agriculture Credit Cooperative Union	26
- Sugar Monopolies	11
- Tariş	1
- Resold through private dealers and other cooperatives	11
	100

T.Z. Donatım is a State Enterprise which receives instructions from the Ministry of Agriculture. It pioneered the distribution of seeds, pesticides and agricultural equipment throughout Turkey and is currently manufacturing some agricultural equipment. Donatım has 90 wholly-owned warehouses on a seasonal basis. Many of these rented warehouses are cotton warehouses, flat grain storage, etc., that are available a certain portion of the year for fertilizer storage. Fertilizer is sold for cash or against back orders, with the farmer coming to the Donatım warehouse to pick up his purchase. All instruction on use of fertilizer, rates of application, timing of fertilizer use, is provided by the Turkish Agriculture Extension Service and is not given out by the fertilizer distributing companies.

The Agriculture Credit Cooperatives have been buying fertilizer from Donatım in past years and redistributing it through their Credit Cooperative member organizations. These organizations represent about 2,000 small farm cooperatives scattered throughout Turkey. In 1967 these cooperatives banded together and formed an Agricultural Credit Union which imports fertilizer directly and resells it to the local credit cooperative.

Çukobirlik is an association of regional sales cooperatives located in Adana. Supplies for its growers are made available through the cooperative. Its influence in the cotton growing areas of Adana is of major importance. Its main concern is in ginning cotton produced by its members and the operation of a cotton oil mill. Tariş is a producers' cooperative association located primarily in the İzmir area. It also supplies agricultural inputs to its members. Its main activity is fruit processing and packing.

A FIELD OF MEXICAN WHEAT– Fertilizer trials with different kinds of Mexican Wheat give Turkish research workers clues for increasing future harvests.



The Sugar Monopoly is a State-owned enterprise and operates 16 sugar mills. Through a growers' association, fertilizer is sold to association members. It warehouses fertilizer at its sugar factories and supplies agronomic services to members, as well as information from its fertilizer research center.

Private importers and dealers are allowed to buy material containing nitrogen only or phosphate only from Donatim for resale at the government-controlled prices but are given only a two to three percent resale margin which discourages this practice.

Single element fertilizers in Turkey are sold at government-controlled prices. A free pricing system is used on compound grades of NP or NPK types. These controlled prices are uniform throughout Turkey (Table 6) with the distributor picking up any cost differences in transportation.

Private dealers in Turkey suffer from the lack of financing to handle imports and must compete with State Enterprises in the sale of products. Profit margins are kept low as a result of this competition.

IN-COUNTRY FERTILIZER PRODUCTION

Four plants are currently involved in fertilizer production in Turkey—two manufacturing nitrogen products and three manufacturing phosphate products. As a result of a study done in 1967 by TVA, the Second Five Year Plan (1968-1972) incorporates the expansion and conversion of three of these facilities and construction of new fertilizer plants. Production in 1967 was 32.4 thousand tons of nitrogen and 42.7 thousand tons of phosphates (P_2O_5). Table 7 shows current fertilizer production as well as forecast of new plants which have been authorized and dates they are anticipated to come on production. It shows that by 1972 Turkey is estimated to be producing 296,900 tons of N and 325,100 tons of P_2O_5. Based on current consumption forecasts for 1972, Turkey will still be importing nitrogen and phosphate materials to cover its needs. Current consumption forecasts (Table 2) indicate that the targets for nitrogen consumption in the Five Year Plan, of 300,000 tons of N and 407,000 tons of P_2O_5, are low. The Marmara Project, as listed in Table 7 does not have formal authorization from the government, although consideration is being given to its structure and financing. It is estimated that by the end of 1968 this plant will be given formal approval with the majority of its foreign exchange financing coming from Arab countries.

CREDIT SYSTEM AVAILABLE TO FARMERS FOR FERTILIZER

In 1968 the government established a 938 million Turkish lira budget in the Fertilizer Financing Fund to cover fertilizer credit needs. This fund had grown from TL. 150 million in 1963 to TL. 600 million in 1967. The fund is administered through the Agriculture Bank. In addition to this, the Sugar Monopoly through its growers association has capital available for members desiring to borrow money for fertilizer purchases. Dealers in Turkey in many instances extend credit to farmers on a crop term basis for cash or for a portion of their harvest.

During 1968 Mexican wheat program loans were made to growers for seed, fertilizer and pesticides. These bank loans were in addition to any other credits the farmer had outstanding from the Agriculture Bank.

RESEARCH FACILITIES

The Government of Turkey operates the Soil Fertility Research Center in Ankara, which performs fertilizer research on Turkey's agricultural soils. In addition, work is carried out at various experiment stations within Turkey on fertilizer demonstrations and crop responses. These research functions have been limited due to budgetary problems. Their work has been primarily on the use of low analysis fertilizer at relatively low rates of application. Work needs to be done on the use of high analysis fertilizer, such as DAP, triple superphosphate, and urea.

The Sugar Monopoly runs an extensive chemical laboratory and fertilizer research program. Their work is directed at improving sugar beet yields by the use of fertilizer, better cultural practices, and improved sugar beet varieties. They have good continuity, as their research and farmer experimental plots results can be applied directly through their own field men to farmer's fields. The University of Ankara and Atatürk University both carry on agricultural research on the use of fertilizer in a limited fashion. Their work is good, but limited by budget restrictions which do not allow them adequate access to farmers' fields and other research work being undertaken in Turkey and neighbouring countries.

EXTENSION

Turkey has an extensive agricultural extension service operating in every province of Turkey. These are staffed by college and school-trained agriculturists. In the Mexican wheat program these extension agents demonstrated their ability to carry a comprehensive program

A TURKISH FARMER INSPECTS HIS CROP– *New high yielding varieties like this J-1 corn are showing Turkish farmers what agriculture science fertilizer and hard work can produce together.*

to Turkish farmers and to get results. The confidence of the Turkish farmer has been strengthened as a result of this program, and given adequate budget support this institution will continue to perform these types of services to the Turkish farmer.

The United Nations, through its FAO program and in conjunction with the Turkish Extension Service, has carried out approximately 15,000 fertilizer demonstrations in Turkey over the past seven years. AID, through its integrated agricultural program, has also demonstrated the importance of good agricultural practices in conjunction with the use of fertilizer. The inputs of the American wheat team in 1967-1968 have also underlined the importance of a coordinated program of inputs to obtain maximum value from the use of fertilizer.

FERTILIZER AND AGRICULTURAL PRODUCTION

Over the last 15 to 20 years, Turkey has experienced a fairly rapid increase in production of the more profitable industrial crops, primarily because of the successful application of irrigation and fertilizer, but only a slow increase in production of cereals. Since the late 1950's, when Turkish agriculture reached and perhaps exceeded the economic limits of cultivated area, growth in total cereals production has been entirely dependent on increases in yields per unit of cultivated land; but these have been particularly low in cereals. Such increases as have occurred are due to the beginnings of the use of fertilizer in cereal growing on the Anatolian Plateau.

FOOD TO GROW, FOOD TO EAT, FOOD TO MAKE A NATION STRONG—*This is the end result of the farmer's work as well as the scientist's and agriculturalist's efforts. Fertilizer alone is of no value unless it brings food as its end result.*

In the light of Turkey's experience since the early 1950's, which has been of an average annual growth rate for cereals of about 1.9 percent, the projection of an annual rate of growth of 4.0 percent for cereals production in the Second Five Year Plan is an optimistic one. With the bulk of the Anatolian Plateau dependent on cereals production, however, achievement of higher rates of growth is vital.

In the coastal areas of Turkey, a major step in the direction of increasing cereals yields was taken in 1967 with the introduction on a large scale of Mexican wheat seed and the agricultural practices necessary to cultivate it. If the Mexican wheat program in the coastal areas is moderately successful, it should make a contribution of some 2.2 million metric tons of wheat production per year by 1970, keeping Turkey at least self-sufficient in wheat in a year of normal rainfall and probably providing an exportable surplus of wheat. At the same time, the fertilizer requirement of the coastal areas for Mexican wheat alone will have amounted to 180,000 metric tons of nutrient (120,000 MT of nitrogen and 60,000 MT of phosphate). In 1971, the fertilizer requirement for the Mexican wheat program will level off at 225,000 metric tons of nutrient (150,000 MT of nitrogen and 75,000 MT of phosphate).

A major increase in cereals production on the Anatolian Plateau can come about only with the introduction of new cultivation practices which will conserve water. These could permit adaptation of new seed varieties which will respond to higher levels of moisture and the addition of fertilizer, particularly nitrogen. Should a major program for increasing cereals production on the Anatolian Plateau develop, a further sharp increase in nitrogen fertilizer consumption (and in agricultural equipment) would result.

The increases in fertilizer consumption by major users over the Second Five Year Plan period are shown in Table 8. The agricultural output increases expected in the Second Five Year Plan are closely tied to the increases in fertilizer consumption shown. In cotton, both the increase in fertilizer consumption and the expected increases in output are a function of the planned extension of irrigation in the Çukurova and the southeast.

THE COST OF IMPORT REQUIREMENTS

Until new domestic production facilities come on-stream, the rapidly increasing demand for fertilizer will have to be met by imports. These will reach a peak in 1969 and decline sharply in 1970, but even in 1970 a level of fertilizer imports higher than in 1967 will have to be sustained. By 1970, domestic production of fertilizer will be 465,000 metric tons of nutrient (232,000 MT of nitrogen and

232,400 MT of phosphate) while total demand will be in the neighborhood of 596,000 MT of nutrient, leaving a gap of 131,000 MT of nutrient to be filled by imports. After 1970 imports will again rise.

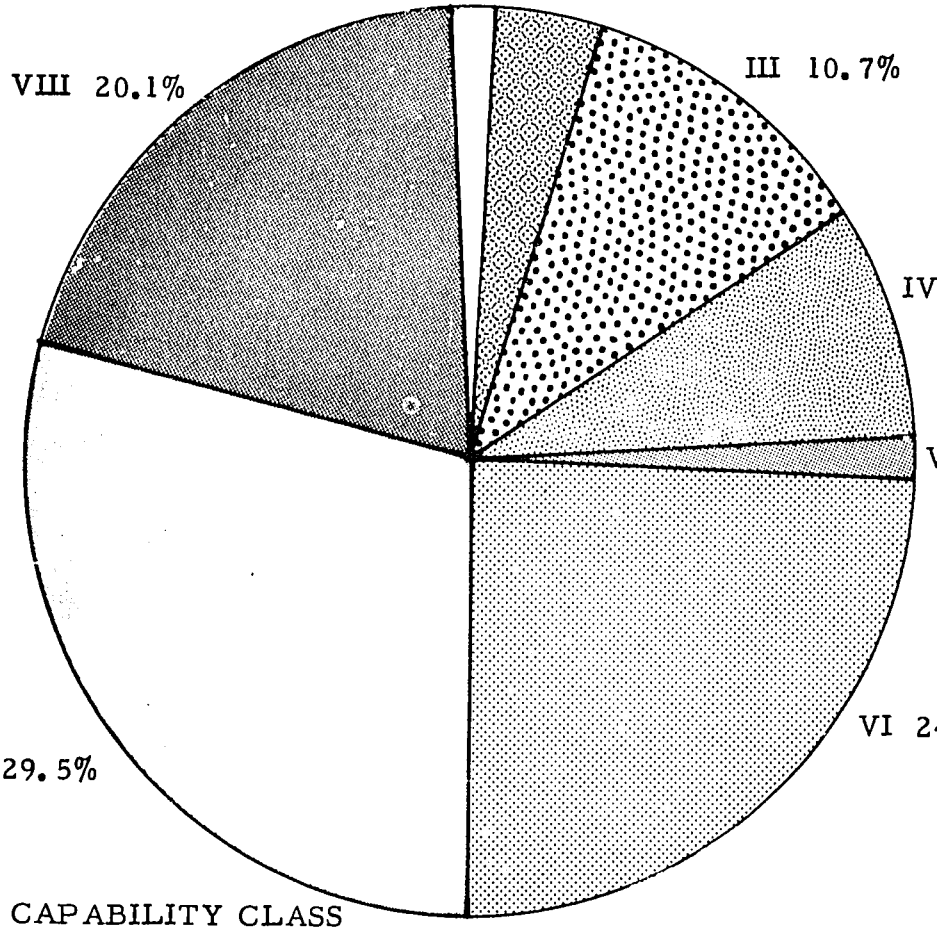
The total cost of fertilizer imports will rise to $61.5 million in 1969 but fall to $39.6 million in 1970 (Table 9). By 1972, however, it will reach $70.2 million. The net foreign exchange saved by local manufacture is projected to jump from $9.3 million in 1969 to $20.9 million in 1970, increasing gradually thereafter (Table 10).

ECONOMIC PROFITABILITY OF FERTILIZER USE IN TURKEY

A rough measure of the return on the use of fertilizer may be given by the expected results of the Mexican wheat program. Without fertilizer, Mexican wheat yields are the same as traditional varieties. With the application of fertilizer in proper amounts and in correct sequence, Mexican wheat yields are much greater than traditional varieties. In the coastal areas of Turkey, traditional wheat varieties yield 1,350 kilos per hectare, while a conservative forecast of the average yield of the Mexican wheat is 2,800 kilos per hectare, or an increase of 1.450 kilos per hectare. With this conservative increase in yield and a wheat price of $60/MT, as shown in Table 11, a return of 1.6 to 1 on the cost of fertilizer would be obtained. Results on controlled plantings in 1967-68 gave an average yield of Mexican wheat of 3,500 kilos per hectare for a return of 2.8 to 1 on the cost of fertilizer.

Field trial data have been presented by the FAO showing economic return (value-cost ratios) for the use of fertilizers on 11 crops in 8,872 farmer demonstrations in Turkey during 1963-1965. In Table 12, the results for these crops are arranged in descending order of the value-cost ratios, so that olives, legumes, rice and potatoes appear at the top of the list with ratios in excess of 4:1, whereas the grain crops and cotton have ratios mostly below 2.5:1. Even for cotton and wheat, returns are good. On some fields, Mexican (semi-dwarf) wheats return as much as 4.5:1.

CHART I LAND RESOURCES OF TURKEY



LAND CAPABILITY CLASS

Suitable for Normal Cultivation		Not suitable for Normal Cultivation	
Class	Million hectares	Class	Million hectares
I Management	1.0	V Management	1.2
II Simple practices	3.1	VI Simple protection	19.3
III Intense practices	8.4	VII Intense protection	23.1
IV Complex practices	6.3	VIII No economic return	15.7
TOTALS	18.8		59.3

Source: Dr. M.H. Taylor, USAID/Ankara

TABLE 1

VOLUME OF PRODUCTION BY CROP
(thousand metric tons and index)

Commodity	Average 1959-61	1963	1964	1965	1966	1967
		(thousand metric tons)				
Wheat	7,770	10,000	8,300	8,500	9,600	10,000
Barley	3,320	4,290	3,200	3,300	3,800	3,800
Corn	1,040	990	1,000	945	1,000	1,050
Rice	110	130	100	130	150	140
Other cereals	1,720	1,990	1,790	1,795	1,860	1,879
Total Cereals	13,960	17,400	14,390	14,670	16,410	16,869
Tobacco	123	132	194	133	164	182
Sugar beets	3,577	3,281	4,706	3,421	4,422	n. a
Cotton	194	258	326	325	382	396
Hazelnuts (unshelled)	80	88	195	62	190	71
Olives	506	619	694	394	841	n. a
Grapes	3,063	2,693	2,790	3,350	3,100	3,500
Figs (fresh)	168	208	206	210	215	232
Tea (wet leaves)	22	47	45	59	105	n. a
		(index: 1962 = 100)				
Agricultural Value Added (Index 1962 = 100)	97	108	108	104	116	118

Sources:

Commodities: 1963, 1964 : State Institute of Statistics, "Summary of Agricultural Statistics 1944-1965"

1965, 1966 : State Institute of Statistics "Agricultural Structure and Production 1967"

1967 : State Institute of Statistics

Agricultural Value Added: State Planning Organization.

TABLE 2

FINISHED FERTILIZER
PRODUCTION, IMPORTS, INVENTORY, CONSUMPTION,
CY 1960-1972

(In thousands of metric tons of plant nutrients)

	1960	1965	1966	1967	1968	1969	1970	1971	1972[a/]	1980
Nitrogen (N)										
Domestic Production	1.0	31.9	33.0	32.4	50.1	102.9	232.5	232.5	296.9	1200.0
Imports	8.3	32.6	69.5	112.8	131.9	147.8	55.5	142.5	173.1	-
Stock-Jan. 1	-	28.8	10.7	8.3	11.3	7.3	23.0	28.0	36.0	80.0
Less Stocks Dec. 31	-	-10.7	- 3.8	- 11.3	- 6.3	- 23.0	- 28.0	- 36.0	- 46.0	- 80.0
Consumption	9.3	82.6	109.4	142.2	187.0	235.0	283.0	367.0	460.0	1200.0
Phosphate (P_2O_5)										
Domestic Production	11.0	40.3	40.0	42.7	68.7	68.7	232.4	288.3	325.1	700.0
Imports	-	53.5	65.3	122.5	180.2	157.2	66.6	56.7	94.9	-
Stock- Jan. 1	-	15.5	11.3	22.0	44.2	63.1	30.0	30.0	40.0	70.0
Less Stocks Dec. 31	-	- 11.3	- 23.4	- 44.2	- 63.1	- 30.0	- 30.0	- 40.0	-50.0	- 70.0
Consumption	11.0	98.0	93.2	143.0	230.0	259.0	299.0	335.0	410.0	700.0
Potash (K_2O)										
Imports	-	5.4	6.0	7.5	12.0	13.0	14.0	16.0	18.0	50.0
Consumption	-	5.4	6.0	7.5	12.0	13.0	14.0	16.0	18.0	50.0
TOTAL										
Domestic Production	12.0	72.2	73.0	75.1	118.8	171.6	464.9	520.8	622.0	1900.0
Decrease in stocks (- = increase)	-	22.3	- 5.2	- 25.2	-13.9	17.4	- 5.0	- 18.0	- 20.0	-
Imports	8.3	91.5	140.8	242.8	312.1	318.0	136.1	215.2	286.0	50.0
Consumption	20.3	186.0	208.6	292.7	417.0	507.0	596.0	718.0	888.0	1950.0

a/ Second Five Year Plan projection for consumption in 1972 ('000 MT): nitrogen, 300; phosphate, 407.

Sources: 1960-1967 - Ministry of Agriculture
1968-1980 - USAID estimate based on information from State Planning Organization and Ministry of Agriculture.

TABLE 3

1968 PLANNED

DOLLAR IMPORT VALUE OF FINISHED FERTILIZER

Product		Amount (MT)	Unit Cost C&F ($/MT)	Total Cost C&F ('000$)
Nitrogen				
C. A. N.	26%N	30,000	40	1,200
C. A. N.	21%N	107,388	32	3,436
A. S.	21%N	357,662	32	11,445
Urea	46%N	10,000	70	700
Phosphate				
T. S. P.		341,031	62	21,144
Potash				
Sulphate of Potash		26,445	50	1,322
Diammonium Phosphate				
18-50		30,000	86	2,580
Compound Fertilizer				
N-P-K Types		125,000	75	9,375
			Total:	$ 51,202

TABLE 4 A

PLANNED IMPORTS OF FERTILIZER, 1968: BY PRODUCT AND IMPORTER

A. NITROGEN

(metric tons of product)

Importer	Calcium Ammonium 21% N	Nitrate 26% N	Ammonium Sulphate (21% N)	UREA[a/] (46% N)	Total
Donatim	76,887	14,728	153,774	-	245,389
Agricultural Credit Coop Union	23,289	8,691	109,896	-	141,876
Sugar Factories	3,461	4,346	63,127	10,000	80,934
Çukobirlik (Cotton Coop, Adana)	-	258	3,995	-	4,253
Tariş (Producers' Coop, Izmir)	430	473	6,895	-	7,798
Çaycilar (Tea Coop)	-		19,975	-	21,264
Akçaabat Tütüncülük Koop (Tobacco Coop Black Sea area)	3,329	215	-	-	3,544
TOTAL:	107,396	28,711	357,662	10,000	503,769

a/ If legislation can be passed to permit import of 45-46% material.

Source: Ministry of Agriculture, 1-18-68.

TABLE 4B

B. PHOSPHATE AND POTASH
(metric tons of product)

Importer	Triple Super Phosphate	Di-ammonium Phosphate	Potash	Total
Donatim	206,564	20,000	5,000	231,564
Agricultural Credit Coop Union	97,351	10,000	3,000	110,351
Sugar Factories	33,732	-	13,000	46,732
Çukobirlik (Cotton Coop, Adana)	619	-	-	619
Tariş (Producers Coop, Izmir)	2,765	-	-	2,765
Private Sector	-	-	5,445	5,445
TOTAL:	341,031 a/	30,000 a/	26,445 b/	397,476

a/ Total phosphate (TSP and DAP): 371,031 MT.

b/ From imported NPK (12,000 MT)

Source: Ministry of Agriculture, 1-18-68.

TABLE 5

FERTILIZER IMPORT FORECAST

(Calendar year 1969)

	Thousand (MT)	Bid Date	Award	Delivery Date	Estim. C&F Unit Cost $ Per MT	Estim. Total Cost ($ mill.)
Ammonium Sulfate 21% N	200	Aug. '68	Sept-Oct. '68	Dec.-Feb. '68-'69	@ 32.	6.4
Ammonium Nitrate 26% N	100	Aug. '68	Sept-Oct. '68	Dec.-Feb. '69	@ 40.	4.0
Urea 45 to 46% N	20	Aug. '68	Sept-Oct. '68	Dec.-Feb. '69	@ 70.	1.4
Single Superphosphate 20% P_2O_5	100	March '69	Apr.-May '69	July-Aug. '69	@ 30.	3.0
Triple Superphosphate 46% P_2O_5	300	March '69	Apr.-May '69	July-Aug. '69	@ 62.	18.6
Diammonium Phosphate 18-51	100	March '69	Apr.-May '69	July-Aug. '69	@ 86.	8.6
Potassium Sulfate 50% K_2O Potassium Chloride	20	Aug. '68	Sept-Oct. '68-'68	Nov.-Jan. '68-'69	@ 50.	1.0
NPK (20-20-0, 18-23-0, 17-17-17)	250	Aug. '68		Nov.-Jan. '68-'69	@ 75.	18.75
TOTAL:	1,090					61.17

Source: Ministry of Agriculture, 5-10-68.

TABLE 6

SELLING PRICE OF COMMERCIAL FERTILIZER TO FARMERS
(1968)

Unit: kr.s/kg.

Type of Fertilizer	Component	Type of Packaging	Year 1968 Selling Prices Fixed Under New Decree
Ammonium Sulphate	20-21 % N	Paper Bag	54
Ammonium Sulphate	20-21 % N	Jute Bag	58
Ammonium Nitrate	20-21 % N	Paper Bag	54
Ammonium Nitrate	20-21 % N	Jute Bag	58
Ammonium Nitrate	26% N	Polyethylene Bag	65
Superphosphate (Dust)	16-18% P_2O_5	Paper Bag	37
Superphosphate (Granulated)	21% P_2O_5	Polyethlene Bag	44
Superphosphate (Granulated)	16-18% P_2O_5	Paper Bag	37
Triple Superphosphate	43% P_2O_5	Polythlene Bag	85

TABLE 7

FERTILIZER PRODUCTION FORECAST

Plant	Design Capacity (thousand metric tons) Product	'000 MT	Nutrient	'000 MT	On Stream	Production (thousand metric tons of nutrient) Actual 1967	Estimated a/ 1968	1969	1970	1971	1972
Azot Sanayii Kutahya	21% NAS	100	N	21	Yes	31.4	31.5	31.5	31.5	31.5	31.5
	20% N CAN	80	N	16	Yes						
Azot Sanayii Kutahya Expansion	26% CAN	338	N	88	8-68	-	17.6	70.4	70.4	70.4	70.4
Karabük TAS	21% NAS	7	N	1.5	Yes	1.0	1.0	1.0	1.0	1.0	1.0
	20% P_2O_5	22	P_2O_5	4.4	Yes	1.4	1.4	1.4	1.4	1.4	1.4
Gübre Fabrikalari:											
Iskenderun	20% NSP	120	P_2O_5	24	Yes	18.0	-	-	-	-	-
Iskenderun Conv.	46% TSP	120	P_2O_5	55	6-68	-	44.0	44.0	44.0	44.0	44.0
Izmit	20% NSP	120	P_2O_5	24	Yes	23.3	23.3	23.3	23.3	-	-
Izmit Conversion	46% TSP	120	P_2O_5	55	1-71	-	-	-	-	44.0	44.0
Azot Sinayii Samsun	46% TSP	220	P_2O_5	101	1-70	-	-	-	90.9	90.9	90.9
	or		or								
	(18-46 DAP	155)	(P_2O_5)	71		-	-	-	(56.8)	(56.8)	(56.8)
			(N)	28		-	-	-	(22.4)	(22.4)	(22.4)
Akdeniz Gübre Fab.	26% N CAN	485	N	126	1-70	-	-	-	100.8	100.8	100.8
	18-46 DAP	198	N	136		-	-	-	28.8	28.8	28.8
			P_2O_5	91		-	-	-	72.8	72.8	72.8
Azot S Ergani	20% NSP	220	P_2O_5	44	1-71	-	-	-	-	35.2	35.2
Marmara Proj.	46% N Urea	350	N	161	6-72	-	-	-	-	-	64.4
(estimate)	46% TSP	200	P_2O_5	92		-	-	-	-	-	36.8
TOTAL			N	420		32.4	50.1	102.9	232.5	232.5	296.9
			P_2O_5	562		42.7	68.7	68.7	232.4	288.3	325.1
				982		75.1	118.8	171.6	464.9	520.8	622.0

a/ Plantsat 80% of designed capacity.

TABLE 8

USE OF FERTILIZER BY CROP: 1967 AND 1972
(thousand metric tons of nutrient)

Crop	Estimated 1967			Projected 1972		
	Nitrogen	Phosphate	Total	Nitrogen	Phosphate	Total
Wheat	13.8	75.9	89.7	175	190	365
Corn	19.5	9.0	28.5	82	34	116
Barley	2.6	11.3	13.9	6	39	45
Pulses	1.2	9.0	10.2	10	20	30
Cotton	28.0	26.5	54.5	70	41	111
Sugar beets	12.6	9.0	21.6	20	11	31
Potatoes	3.4	3.8	7.2	12	8	20
Sunflowers	7.3	8.1	15.4	22	19	41
Citrus	3.3	2.2	5.5-	6	4	10
Other fruits	15.2	10.3	25.5	42	30	72
Other	13.1	9.9	23.0	15	14	29
TOTAL	120.0	175.0	295.0	460	410	870

Source: SPO, "Kalkınma Planı İkinci Beş Yıl 1968-1972" (Second Five Year Plan 1968-1972), Table 159, p. 320; 1972 figures revised by USAID/Ankara.

TABLE 9

FERTILIZER CONSUMPTION FORECAST
DOLLAR WHOLESALE VALUE AND FOREIGN EXCHANGE REQUIREMENTS[a/]
(million dollars and thousand metric tons)

Calendar Year	Nitrogen (N) Thous. MT	Nitrogen (N) Mill. $	Phosphate (P_2O_5) Thous. MT	Phosphate (P_2O_5) Mill. $	Potash (K_2O) Thous. MT	Potash (K_2O) Mill. $	Total Foreign Exchange Value (mill. $)	Foreign Exchange Saved by Local mfg. (mill. $)	Net Foreign Exchange Need to Cover Imports (mill. $)
1967	142	24.1	143	18.6	7.5	.7	43.4	6.6	36.8
1968	187	31.7	230	29.9	12.0	1.2	62.8	10.3	52.5
1969	235	39.9	259	33.7	13.0	1.3	74.9	13.4	61.5
1970	283	48.1	299	38.9	14.0	1.4	88.4	48.8	39.6
1971	367	62.4	335	43.6	16.0	1.6	107.6	52.1	55.5
1972	460	78.2	410	53.3	18.0	1.8	133.3	63.1	70.2

a/ Unit Values:
N = $ 170/MT
P_2O_5 = $ 130/MT
K_2O = $ 100/MT

Sources:
Quantities: Table 2
Foreign exchange value saved by local manufacture: Table 10

TABLE 10

FOREIGN EXCHANGE COST OF FERTILIZER PRODUCTION IN TURKEY[a/]
($ millions and MT thousands)

Calendar Year	Nitrogen (N)			Phosphate (P_2O_5)			Total Production Value $	Total Foreign Exchange Cost $	Foreign Exchange Value Saved by Mfg.
	Quantity (MT)	Production Value $	Foreign Exchange Cost $	Quantity (MT)	Production Value	Foreign Exchange Cost $			
1967	32.4	5.5	1.3	42.7	5.6	3.2	11.1	4.5	6.6
1968	50.1	8.5	2.0	68.7	9.0	5.2	17.5	7.2	10.3
1969	102.9	17.5	4.1	68.7	9.0	5.2	22.7	9.3	13.4
1970[b/]	232.5	39.5	9.3	232.4	30.2	11.6	69.7	20.9	48.8
1971[b/]	232.5	39.5	10.5	288.3	37.5	14.4	77.0	24.9	52.1
1972[b/]	296.9	50.5	13.4	325.1	42.3	16.3	92.8	29.7	63.1

a/ Assumption: based on cost estimates and production at 80% of designed plant capacity.
N: Production Value $ 170/MT = to AS C&F $ 35.70/MT.
P_2O_5: Production Value $ 130/MT = to TSP C&F $ 59.80 /MT.
Foreign Exchange Cost = depreciation, interest, parts, and catalyst.
N: Foreign Exchange Cost Kütahya $ 40/MT.
P_2O_5: Foreign Exchange Cost Gübre FAB. Sulphuric Acid, Phosphoric Acid and Phosphate Rock $75/MT.

b/ Mersin, Marmara, Samsun, Ergani, Kütahya N average Foreign Exchange Cost $45/MT.
Mersin,Marmara, Samsun, Ergani, P_2O_5 average Foreign Exchange Cost $50/MT.

TABLE 11

ESTIMATED AVERAGE RETURN ON COST OF FERTILIZER USED FOR MEXICAN WHEAT

	kg/ha.	$/kg.	$/ha.
Fertilizer use:			
Nitrogen	120	0.17	20.40
Phosphate	60	0.13	13.13
			33.53
Additional wheat yield: a/			
Conservative estimate	1,450	0.06	87.00
Optimistic estimate	2,150	0.06	129.00
Return: b/			
Conservative estimate			53.47
Optimistic estimate			95.47

a/ Wheat yield:

	kg/ha.
Traditional varieties	1,350
Mexican wheat:	
Conservative	2,800
1967-68 average	3,500

b/ Gross of cost of other additional inputs.

TABLE 12

VALUE - COST RATIOS FROM FAO FERTILIZER DEMONSTRATIONS IN TURKEY
1963, 1964, and 1965
(Crops in descending order of ratios)

CROP	YEAR	No. FARMS	N	P	NP	NPK	PK
Table Olives	1963	9				9.7	
	1964	13				6.8	
	Both years	22				8.2	
Peanuts	1963	14		6.5			8.4
	1964	26		3.5			3.7
	1965	35		4.0	5.2		
	All years	75		4.7	5.2		6.0
Rice	1963	86	7.0		6.1		
	1964	156	5.4		5.7		
	1965	135	5.3		5.8	4.4	
	All years	377	5.6		5.9	4.4	
Potatoes	1963	60			4.4	5.1	
	1964	164			5.4	6.2	
	1965	205			3.9	5.0	
	All years	429			4.6	5.4	
Alfalfa	1963	125		3.4			4.1
	1964	147		5.5			6.2
	Both years	272		4.4			5.2
Lucerne	1964						
Dry land		27		3.4			4.1
Irrigated		37		3.4			4.5
	All farms	64		3.4			4.3
Corn	1963	320	3.1		2.9	2.1	
	1964	164	2.5		2.3	1.7	
	1965	333	2.8		2.4	1.5	
	3 years	817	2.8		2.5	1.8	
Cotton	1963	346			2.4	2.3	
	1964	381			2.4	2.7	
	1965	344			2.4	2.6	
	3 years	1071			2.4	2.5	
Sunflower	1963	35			1.8	2.1	
	1964	82			1.9	2.4	
	1965	82			1.2	1.8	
	3 years	199			1.6	2.1	
Barley	1965	29			2.1	2.4	
Wheat							
Mexican[a]	1966	106			4.0		
Native							
Dry land	1963	979		1.8	1.7	1.7	
	1964	1924		2.2	1.7	1.2	
	1965	2365		2.0	2.4	1.8	
	3 years	5268		2.0	1.9	1.6	
Irrigated	1965	42			1.8	2.0	
Oil Olives	1963	26				1.6	
	1964	27				3.0	
	1965	48				1.2	
	3 years	101				1.9	
ALL CROPS		8872	4.2	3.3	3.1	3.3	5.2

a/ Estimates for Mexican wheat prepared by John M. Hill.

Note: Value-cost ratio = increase in annual value of crop divided by cost of fertilizer.

TURKEY'S FERTILIZER SUPPLY AND DEMAND POSITION FOR 1969 - 1982 BY PRODUCT TYPES, IMPORT PROJECTIONS, AND DOLLAR VALUE

By
Dr. *Mehmet Kıroğlu*
Plant Nutrition Section
Ministry of Agriculture

FERTILIZER USE IN RECENT HISTORY

After the foundation of the Republic in Turkey, soil fertility and fertilizer work were started to solve the related problems in this field. Among others, extensive studies on plants, soil, fertilizer, and water were carried out, however, up to the 1960's as a consequence of the development of institutions, yearly fertilizer consumption was rather low (this is shown in Table 1).

Comparing the amount of fertilizers which were used in the 1950's with the total cultivated land of Turkey, the consumption was really low. In the same period the yield of the same land was also low. In fact total cultivated land of Turkey, as indicated in Table 2, is 26,294,000 hectares and approximately 1,200,000 hectares of it is able to produce more than one crop a year, being in Mediterranean coastal areas, and needing fertilizer twice each year.

GOVERNMENT POLICY

To meet the food requirements of a fast growing population (increasing rate is approximately three percent annually) and other industrial and fodder crops from agriculture, the government recognized the important role of fertilizer and took essential measures during the First Five Year Plan Period (1963-67).

These measures can be summarized as follows:

1. The government improved research and extension with the aim of better use of fertilizers by the farmers. For this purpose the Plant Nutrition section was formed in the Ministry of Agriculture. A special working group was formed on fertilizer for the technical personnel and farmers' training. All subject matter specialists and country agents were trained in short courses.

An intensive farmers' training on soil fertility and fertilizer use was carried out. Approximately 15,000 fertilizer demonstrations were given in the country, covering major crops.

2. A special fertilizer fund was established in the Bank of Agriculture. This fund at first was TL 120 million. It is now (1968) TL 938 million and next year (1969) it will be TL 1.4 billion. This fund has been used to supply fertilizer credit to the farmer and finance the supplying agencies.

3. The retail prices of the most important types of fertilizers were set for all the country. Up to now these prices have been lowered three times (presently each kilogram of ammonium sulfate (21%N) is 56 kuruş, A. nitrated (20%N) 56 kuruş, A.N. 26%N 65 kuruş, TSP, 85 kuruş, and NSP, 37 kuruş).

4. Government agencies have improved fertilizer distribution. The Agricultural Supply Organization (Zirai Donatım Kurumu) was the only one to make government distribution for straight phosphorous and nitrogenous fertilizer until 1967. New Agricultural Credit Coops which are coordinated and controlled by the Bank of Agriculture of the Republic of Turkey and other larger coops have been authorized in the same way. Private companies handle the potassium and compound fertilizers.

CONSUMPTION IN FIRST FIVE YEAR PLAN

After these steps were taken the yearly consumption of fertilizer increased nearly four-fold within the period 1963 to 1967 as seen in Table 3.

The target for 1967 was 1,266,000 tons but actual consumption was 1,537,000 tons. The main reasons for this achievement were the emphasis given by government to this program and enthusiasm of the people who took part in the program.

At the end of the First Five Year Plan period, plant nutrient consumption increased from 0.8 to 13 kilos per hectare of arable land. This consumption certainly is still low and needs more emphasis with different and effective measures.

DEMAND THROUGH 1969-1980

It is obvious that fertilizer demand depends on many factors which affect fertilizer use. No doubt these factors change greatly from one country to another. In the estimation of the author the main factors of fertilizer use may be summarized in the following way for Turkey:

Social factors — The age, education or training, personal attitude, and tradition of the farmers are suitable for introducing new techniques or new inputs. In these respects, Turkish farmers generally have a positive reaction, if they are convinced of the value of new products.

Agricultural factors — Soil and climatological conditions with agricultural practice are certainly important and Turkey has a good climate.

Economic factors — Purchasing power of the farmers, availability of credit, price of fertilizer, supplying the fertilizers in time at the farm, are also important factors in developing countries. As explained before, the government took the necessary steps to improve these factors in the First Five Year Plan. The same steps will also be taken for the period of the Second Five Year Plan.

In order to attain the desired targets of fertilizer use in a comparatively shorter time, the final year's target of the Second Five Year Plan was fixed at 4.5 million tons of single nutrient conventional fertilizer (nitrogenous 20%N, phosphorous 18%P_2O_5) or roughly 900,000 tons of nutrient. After the preparation of this target in 1966, the following two important steps were taken in agricultural technique in 1966 which greatly effected fertilizer use.

New practices were started in agriculture with new equipment which helps improve soil moisture content in the dry and transitional areas. This practice permitted the use of nitrogen which was not possible or logical before.

New high yielding semi-dwarf and other varieties were brought from abroad which need more fertilizer than the local ones. By the end of the Second Five Year Plan (1972) three million hectares of the wheat growing area will get these varieties as a package application of seed and fertilizer under government control.

Taking these factors into consideration the Second Five Year Plan targets were increased again. These targets with the estimated demand until 1982 are indicated in Table 4 as the future demand of fertilizer use.

As seen in Table 4 Turkey will be using 1,975,000 tons of nutrient by 1982. Of these nutrients nitrogen will be 1,000,000 tons and phosphate will be 925,000 tons. Most Turkish soils are still rich in potash and consequently demand will be low (50,000 tons). Actually the consumption of potassium fertilizers was also less than the planned targets for the First Five Year Plan period.

The determination of the fertilizer demand for the 1968-82 period was made with the projection that all cultivated land, nurseries, and 10 percent of the grassland will be fertilized by 1982.

DOMESTIC SUPPLY

In order to meet the ever-growing fertilizer demand in Turkey, the government has also given great emphasis to fertilizer production. Present domestic fertilizer production is being carried out by the following agencies. Their present and proposed activities are shown below briefly:

1. Karabük is the oldest plant in the fertilizer industry. It is not essentially a fertilizer producer and uses only the by-products of the steel industry of the Turkish Iron and Steel Mill Corporation (Türkiye Demir ve Çelik Fabrikaları), therefore, its production continues on a small scale. Production is 7,000 tons of ammonium sulfate and 10,000 tons of superphosphate per year.

2. The Fertilizer Industry Co. (Gübre Fabrikaları T.A.Ş.) is second to the oldest in Turkey. It produces superphosphate. There are two plants, one located in İzmit and the other in İskenderun; both have 120,000 metric tons optimal capacity. The İskenderun plant is being converted to triple superphosphate (TSP) in 1968. İzmit will also be converted to TSP in 1971. Each will have a 120,000 ton annual capacity. This company was formed mainly by the Agricultural Credit Coops, Agricultural Supply Organization, and the Nitrogen Co.

3. The Nitrogen Co. (Azot Sanayii T.A.Ş.) is a fully government owned organization and presently produces 80,000 tons of ammonium sulfate (21%N) and 60,000 tons ammonium nitrate in the Kütahya plant. The plant is being expanded and will be completed by September 1968. It will have a capacity of 338,000 tons of ammonium nitrate 26%N content. In this plant nitrogen synthesis has been made.

The Nitrogen Co. has started to construct the following plants: 1) a superphosphate plant in Ergani having 300,000 MT capacity per year; 2) a fertilizer complex in Samsun which will produce 220,000 tons TSP or 155,000 tons of 18-47 DAP; 3) a fertilizer complex in Mersin with the joint cooperation of KUWAIT Petroleum Company. This plant will have the annual capacity of 600,000 tons AN and 140,000 tons 18-47-0 DAP.

4. The fourth fertilizer industry plant is still under negotiation and investigation. Its actual location, capacity and production is not yet determined. But according to the estimation, this plant will be on the Marmara or Aegean coast, having hopefully 400,000 tons TSP and 550,000 tons nitrogenous fertilizer based on 20%N content production capacity per year.

Ammonia synthesis has been carried out only in the Kütahya plant of Azot Sanayii. But other plants will get nitrogen from foreign countries in the form of ammonia, according to the present planning. Due to the low content of local rock phosphate this material will be imported either in the form of rock phosphate or phosphoric acid. Then it will be made in the country.

Potassium fertilizer production has not started in Turkey and will not for at least the next five years. As was pointed out before, the Turkish soils are generally rich enough in potassium for major crops in the main agricultural areas. For this reason the demand is still low and the whole amount will be imported. Table 5 shows the design and estimated production of fertilizer industries for 1968-72 period, with their production data.

IMPORT PROJECTION AND ITS VALUE

As understood from Table 5, during the period of 1968-72, the domestic production of Turkey will not meet the country's demand and considerable amounts of fertilizer will be imported. There is no fertilizer production plan or projection from 1972 to 1982. Therefore production targets of 1973 will be used to indicate the deficiency between demand and supply in 1982.

In the case of the deficiency of raw material in fertilizer production, such as rock phosphate, sulphuric acid and ammonia these items have to be imported, and paid for with foreign currency.

The import projection and its value in US dollars are shown in Table 6.

As stated before, all raw materials, other than Kütahya NH_3 will be imported for new plants. Their imported cost may be summarized as below, taking the CF metric ton price of rock phosphate as $40, phosporic acid $150.

According to the production data:

1 ton of NSP needs	630 kg. R Phosphate	(30% P_2O_5) x $ 13	= $ 8.19
	380 kg. H_2SO_4	(100%) Local Prod.	= - 0
		TOTAL:	$ 8.19
1 ton TSP needs	325 kg. P. Acid	(100%) x $150	= $48.75
	450 kg. R. Phosphate	(30%P_2O_5) x $ 13	= $ 5.85
		TOTAL:	$54.60
or	940 kg. H_2SO_4	(100%) Local Prod.	= - 0
	1600 kg. R. Phosphate	(30%P_2O_5) x $ 13	= $20.80
		TOTAL:	$20.80
1 ton AN (26%) needs	332 kg. NH3	x $ 40	= $12.92
	258 kg. Filler Local Prod. (Dolmite)		= - 0
		TOTAL:	$12.92
Each ton DAP needs	203 kg. NH_3 x CF $40/MT		= $ 8.12
	500 kg. P. Acid (100%) x CF $150 NT		= $75.00
		TOTAL:	$83.12
or	203 kg. NH_3 x $40/MT		= $ 8.12
	(1800 kg. R. Phosphate) x CF $13 MT		= 23.40
		TOTAL:	$31.52

As shown in the calculation above, each ton of fertilizer produced locally by importing NH_3 and rock phospnate from a foreign country, will require a foreign exchange cost as follows: DAP $31.52, TSP $20.80, A.N. (26%N) $12.92, NSP $8.19. Taking these data into consideration the necessary amount of foreign exchange is indicated in Table 7. In the same table the total need for foreign currency both for imported fertilizer and for required materials are shown.

CAPITAL AND RAW MATERIALLS

Construction cost generally varies for any plant according to local sources, social and personal needs, aside from the actual manufacturing units which are also major components affecting the initial cost per unit of finished fertilizer. One of the facts is that imported equipment for a new plant, in a developing country which does not manufacture equipment, costs nearly 20 to 25 percent more due to the foreign trade formalities and transportation costs.

On the other hand, in developing countries labor is cheap but social facilities are necessary as a complementary part of the plants. This was also true three decades ago in developed countries.

To estimate the needed capital for the fertilizer industry, invested and proposed cost for each ton of production capacity of the fertilizer plant in Kütahya, Turkey will be used as an example:

Plant 1
Per ton of N (540,000,000 TL 22,000 TN) = 24,545.4 TL/MT of N

Plant 2
Per ton of N (466,000,000 TL 70,000 TN) = 6,657.14 TL/MT of N

İzmit and İskenderun
(without H_2SO_4 plant)per ton of P_2O_5
(30,000 TL 38,000 T. P_2O_5) = 789.4 TL/MT of P_2O_5

Ergani
(with H_2SO_4 plant) per ton of P_2O_5
(60,000,000 TL 48,000 T. est P_2O_5) = 1,250 TL/M of P_2O_5

Samsun
(with H_2SO_4 plant) (180,000,000 TL
56,000 T. est P_2O_5) = 3,214.28 TL/MT of P_2O_5

(80,000,000 TL 22,000 T. est N) = 3,636.36 TL/MT of N

It seems from the above data that each ton of nitrogen capacity requires an average plant cost of TL 6,000 and TL 1,250 each ton of P_2O_5.

Using these data it can be concluded that necessary investment to meet the deficiency of fertilizer which will be needed in 1972 and 1982 will be as shown below:

In 1972,	for 291,000 tons N	=	1,746,000,000 TL
	for 277,000 tons P_2O_5	=	346,250,000 TL
	Total		2,092,250,000 TL
In 1982,	for 600,000 tons N	=	3,600,000,000 TL
	for 529,000 tons P_2O_5	=	661,250,000 TL
	Total		4,261,250,000 TL *

* 1 TL = 100 kuruş = 11 US cents.

This amount has to be invested for new plants to produce the needed amounts of fertilizer for Turkey. At least 50 percent of this investment will be the cost of equipment which usually needs foreign currency.

As mentioned before, the present rock phosphate in Turkey is not suitable economically for phosphorous fertilizer production, therefore this material will continue to be imported.

It is obvious that for ammonia synthesis, a cheap source of hydrogen is natural gas which is not yet plentiful enough for this purpose. Byproducts of petroleum refineries will be used for other purposes. Coal which is expensive for ammonia synthesis is plentiful.

For the production of sulphuric acid large amounts of pyrite are to be used.

The present fertilizer plants have small capacities, therefore, the value of these future requirements may be 20 to 30 percent less than these estimates.

TABLE 1

FERTILIZER USE IN 1950's
(Product in metric tons)

Years	Nitrogenous 21% N	Phosphate 16-18% P_2O_5	Potassium 48-50% K_2O	Total
1950	28.900	13.133	70	42.103
1954	21.069	40.432	20.561	82.062
1958	46.225	24.129	-	70.354
1960	40.085	50.889	1.358	107.332

TABLE 2

LAND USE IN TURKEY 1966
(unit 1000 hectares)

Area sown	15,454
Fallow	8,500
Meadow and pastures	28,082
Vineyards	830
Fruits and vegetable	865
Olives	645
Forests	10,584
Waste lands and marsh	13,096
Total Area	78,056

TABLE 3

FERTILIZER CONSUMPTION IN TURKEY DURING THE FIRST FIVE YEAR PLAN PERIOD (1963-67)
(Product in metric tons)

Years	Nitrogenous 21% N	Phosphate 16-18% P_2O_5	Potassium 48-50% K_2O	Total
1963	186,760	218,661	21,000	426,421
1964	258,000	265,000	9,000	532,000
1965	349,000	443,000	10,750	802,750
1966	468,000	546,000	12,000	1,026,000
1967	675,000	847,000	15,000	1,537,000

1 Turkish Lira (TL.) = 100 kuruş = 11 U.S. cents

TABLE 4
FERTILIZER DEMAND FROM 1969-1982
(Product in 000 of metric tons)

Year	Nitrogenous 20% N	N	Phosphorous 18% P_2O_5	P_2O_5	Potassium 50% K_2O	K_2O	Total Fertilizer	Total Nutrient
			Second Five Year Plan					
1968	900	180	1600	210	40	20	2540	410
1969	1600	320	1800	300	40	20	3440	640
1970	2100	420	2200	366	45	22	4345	808
1971	2600	520	2500	433	45	22	5145	975
1972	3000	600	3000	500	50	25	6050	1125
			Third Five Year Plan					
1973	3200	640	3250	504	55	27	6505	1171
1974	3300	662	3500	583	60	30	6860	1275
1975	3500	700	3750	626	60	30	7310	1356
1976	3700	740	4000	666	70	35	7770	1441
1977	4000	800	4250	708	75	37	8325	1545
			Fourth Five Year Plan					
1978	4200	840	4500	750	75	37	8775	1627
1979	4350	870	4800	800	80	40	9240	1710
1980	4500	900	5000	830	80	40	9580	1770
1981	4750	950	5250	875	90	45	10090	1870
1982	5000	1000	5550	925	100	50	10650	1975

TABLE 5

DESIGN AND ESTIMATED PRODUCTION OF FERTILIZERS IN TURKEY FOR 1968-1972

	Design Product	Capacity (1000 mt.) MT	Nutrient N	Nutrient P_2O_5	On Stream	Estimated (80% of designed) Nutrient Productions (1000 mt.) 1968 N	1968 P_2O_5	1969 N	1969 P_2O_5	1970 N	1970 P_2O_5	1971 N	1971 P_2O_5	1972 N	1972 P_2O_5
T. Demir Celik															
Karabuk	21% AS	7	1.5	-	Yes	1.2	-	1.2	-	1.2	-	1.2	-	1.2	-
	20% SP	10	-	2	Yes	-	1.6	-	1.6	-	1.6	-	1.6	-	1.6
Gubre Fab.															
Iskenderun	20% SP	120	-	24	Yes	-	8	-	-	-	-	-	-	-	-
Iskenderun Conversion	46% TSP	120	-	55	6-68	-	25	-	44.0	-	44.0	-	44.0	-	44.0
Izmit	40% SP	120	-	24	Yes	-	19.2	-	19.2	-	19.2	-			
Izmit Conversion	46% TSP	130	-	55	1-71	-	-	-	-	-	-	-	44.0	-	44.0
Azot Sanayii															
Kutahya	21% AS	80	16	-	Yes	12.8	-	12.8	-	12.8	-	12.8	-	12.8	-
	20% AN	60	12	-	Yes	9.6	-	9.6	-	9.6	-	9.6	-	9.6	-
Kutahya Expansion	26% AN	338	88	-	1-68	25.2	-	70.4	-	70.4	-	70.4	-	70.4	-
Samsun	46% TSP	220	-(101)	x	1-70	-	-	-	-	-	-	-	-	-	-
	18-46%DAP	155	28	70	-	-	-	-	-	22.4	56.0	22.4	56.0	22.4	56.0
Ergani	20% SP	900	-	60	1-71	-	-	-	-	-	-	-	48.0	-	48.0
Mediterranean	Fertilizer														
Mersin	26% N AN	600	156	-	1-70	-	-	-	-	124.8	-	124.8	-	124.8	-
	18-47% DAP	140	25	66		-	-	-	-	22.4	56.0	22.4	56.0	22.4	56.0
Marmara	46% TSP	400	-	184	6.72	-	-	-	-	-	-	-	-	-	73.0
(Estimated)	20% N	550	-	111	-	-	-	-	-	-	-	-	-	45	-
				Total:		48.8	53.8	94.0	64.8	263.6	176.8	263.6	249.6	308.6	322.6
				Total Nutrient....		102.6		158.8		440.4		513.2		631.2	

x. DAP Alternate if Logical will be chosen.

TABLE 6

ESTIMATED FERTILIZER DEMAND,
DOMESTIC SUPPLY, IMPORT AND IMPORT VALUE
(Amount in 000 MT, value in 1000 dollars)

Years	Nutrients	Demand	Domestic	Import	Import Value[a/]
1968	N	180	49	131	17,030
	P_2O_5	210	54	156	21,060
	K_2O	20	-	20	2,400
Total		410	103	307	40,490
1969	N	320	94	326	42,380
	P_2O_5	300	65	235	31,725
	K_2O	20	-	20	2,400
Total		640	159	581	76,505
1970	N	420	264	156	20,280
	P_2O_5	366	177	189	25,515
	K_2O	22	-	22	2,640
Total		808	441	367	48,435
1971	N	520	264	256	33,280
	P_2O_5	433	250	183	24,705
	K_2O	22	-	22	2,640
Total		975	514	461	60,625
1972	N	600	309	291	37,830
	P_2O_5	500	323	277	37,395
	K_2O	22	-	22	2,640
Total		1122	632	590	77,865
1973	N	640	400	240	31,200
	P_2O_5	504	396	108	14,580
	K_2O	24	-	24	2,880
Total		1168	796	372	48,660
1982	N	1000	400	600	78,000
	P_2O_5	925	396	529	71,415
	K_2O	50	-	50	6,000
Total		1975	796	1179	155,415

a/ The calculation of import values based on CF import prices for Turkey in 1968.

1 ton N = 170 dollar in AN 26% N)
1 ton P_2O_5 = 135 dollar in TSP
1 ton K_2O = 120 dollar in K_2SO_4

Due to lack of data on domestic production between 1973 and 1982, supply of 1973 was taken for 1982 to show the difference which will be imported.

TABLE 7

NECESSARY FOREIGN CURRENCY (US $) FOR MATERIALS WHICH WILL BE NEEDED FOR ESTIMATED FERTILIZER PRODUCTION

(amount 100 tons fertilizer, value 1000 US $)

	1968		1969		1970		1971		1972		1973	
	Fertilizer	Value of Mat.	Fertilizer	Value of Mat.	Fertilizer	Value of Mat.	Fertilizer	Value of Mat.	Fertlizer	Value of Mat.	Fertlizer	Value of Mat.
Karabuk	8 NSP	64	8 NSP	64	8 NSP	64	8 NSP	64	8 NSP	64	8 NSP	64
Eskenderun	50 NSP 70 TSP	400 1470	96 TSP	2016	96 TSP	2016	96 TSP	2016	96 TSP	2016	96 TSP	2016
Izmit SD	96 NSP	864	96 NSP	864	96 NSP	2016	96 TSP	2016	96 TSP	2016	96 TSP	2016
Samsun DAP					124 DAP	3906	124 DAP	3906	124 DAP	3906	124 DAP	3906
Ergani							300 NSP	2400	300 NSP	2400	300 SP	2400
Mersin					480 AN-26 112 DAP	6240 3528	480 AN-26 112 DAP	6240 3528	480 AN-26 112 DAP	6240 3528	480 AN-26 112 DAP	6240 3528
Marmara (Estimated type persum)									160 TSP 220 AN-26	3360 2860	320 TSP 440 AN-26	6720 5720
Total:		2798		2944		17770		20170		26390		32610
Imported fertlizer Value (see Table 6)		40490		76505		48435		60625		77865		48660
GRAND TOTAL:		43288		79449		66205		80795		104255		81270

TSP $ 21 for 1982 $ 32,610 material value of 1973
DAP $ 31.5 155,415 import value
$ 188,025

AN-26 $ 13
NSP $ 18

PAKISTAN'S FERTILIZER SUPPLY AND DEMAND POSITION FOR 1969-1980 BY PRODUCT TYPES AND DOLLAR VALUE

By
Mr. Sarshar Ahmad Khan,
C.S.P.

WEST PAKISTAN

In West Pakistan, the consumption of fertilizers has been steadily increasing since 1959-60 as is evident from the following figures:

Year	Nutrient Tons
1959-60	19,400
1960-61	31,400
1961-62	37,500
1962-63	40,200
1963-64	68,700
1964-65	87,200
1965-66	82,000
1966-67	110,000
1967-68	189,000

For the years 1968-69 and 1969-70, the following targets of consumption have been fixed under the Self-Sufficency Programme:

	Nutrient tons (Percentage of different fertilizers)		
		N (Percent)	P_2O_5 (Percent)
1968-69	320,000	85	15
1969-70	420,000	80	20

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Of the above requirements, about 87,000 nutrient tons of fertilizers will be available from local production during 1968-69 and about 121,000 nutrient tons during 1969-70. The balance will have to be imported. The cost of the imported fertilizers at an average rate of $210 per nutrient ton works out to $48.93 million in 1968-69 and $62.79 million in 1969-70.

Table 1 shows 1970-71 to 1979-80, the consumption projections, domestic production, proposed imports and foreign exchange requirements for 1970-71 and 1978-80. These are tentative projections and have to be firmed up after detailed exercise in the light of agricultural strategy for the Fourth and Fifth Plans. From the Table it will be observed that the annual rate of growth will be slowing down from 30 to 10 percent. The use of nitrogenous fertilizers will gradually decrease from 85 percent in 1968-69 to 70 percent in 1979-80 while the use of phosphatic fertilizers will increase from 15 to 30 percent which would bring about the ratio of 2:1 between nitrogen and phosphorous. At present the use of phosphatic fertilizers is much less than the actual requirements. More emphasis will be on the use of N and P in the ratio of 2:1. A special drive is being undertaken to persuade the farmer to apply more phosphatic fertilizers. To overcome the difficulty of applying N and P in the required proportion, compound fertilizers are being imported. In the soils of West Pakistan, some deficiency of potash and calcium is also noted in places. This deficiency is not very pronounced at the moment. However, studies are being undertaken by the soil scientists to ascertain the extent of this deficiency to work out the requirements of these nutrients for the soil.

EAST PAKISTAN

In East Pakistan the consumption of fertilizers has also been steadily increasing since 1959-60 as is evident from the following figures:

Year	Nutrient Tons
1959-60	12,200
1960-61	22,500
1961-62	22,500
1962-63	27,000
1963-64	49,000
1964-65	45,000
1965-66	54,000
1966-67	75,000
1967-68	100,000

For the years 1968-69 and 1969-70, the following targets of consumption have been fixed under Self-Sufficiency Programme:

Year	Nutrient Tons
1968-69	190,000
1969-70	300,000

Of the above requirements, about 40,000 nutrient tons will be available from local production during 1968-69 and about 55,000 nutrient tons in 1969-70. The balance will have to be imported. The cost of the imported fertilizers at the rate of $210 per nutrient ton works out to $39.90 million in 1968-69 and $63.00 million in 1969-70. The actual consumption may not be up to the level mentioned above during these years. In calculating the projections during 1970-80, we have taken the base as 235,000 nutrient tons (125,000 tons N, 19,000 tons P_2O_5 and 20,000 K_2O) during 1969-70 as projected in the Third Five Year Plan.

On the above basis and on the assumption that the use of fertilizers will increase at the annual compound rate of 16.8 percent for nitrogen, 24 percent for phosphatic fertilizers and 28 percent for ptassic fertilizers, the requirements up to 1979-80 will be as follows:

Year	N	P_2O_5	K_2O	Total
		(quantity in N tons)		
1970-71	190	115	25	330
1971-72	235	140	30	405
1972-73	310	165	35	510
1973-74	380	190	40	610
1974-75	450	220	50	720
1975-76	530	250	70	850
1976-77	600	300	90	990
1977-78	660	350	110	1120
1978-79	710	410	130	1250
1979-80	750	470	150	1370

The total capacity of fertilizers (both existing and sanctioned) is as follows:

	In Weight Tons	In Nutrient Tons
Urea	440,000	198,000
Ammonium Sulphate	12,000	2,400
Triple Superphosphate	272,000	125,100
TOTAL	724,000	325,500

This capacity will take some years before it starts full production. Assuming that this capacity will be in full swing by 1977 the yearly projections of availability from local production may be as follows:

Year	Nutrient Tons
1970-71	75,000
1971-72	100,000
1972-73	150,000
1973-74	200,000
1974-75	250,000
1975-76	300,000
1976-77	325,500
1977-78	325,500
1978-79	325,500
1979-80	325,500

Accordingly, the imports at an average price $210 per nutrient ton will be as follows:

Year	Nutrient Tons	Value Million $
1970-71	255,000	53.55
1971-72	305,000	64.05
1972-73	360,000	75.60
1973-74	410,000	86.10
1974-75	470,000	98.70
1975-76	550,000	115.50
1976-77	664,500	139.55
1977-78	794,500	166.85
1978-79	924,500	194.15
1979-80	1,044,500	219.35

These are purely tentative projections and are likely to undergo changes after the strategy for the Fourth and Fifth Plans is defined and detailed exercises are undertaken. These exercises will take into consideration the following points:

- Cropped area and cropping pattern
- Introduction of improved varieties requiring intensive fertilizers
- Other ancilliary facilities like irrigation, water and flood control measures, proper supply agencies and arrangement
- Farmers' acceptance and ability to purchase fertilizers
- Status of subsidy.

Like West Pakistan, nitrogenous fertilizers have been in greater use in East Pakistan. In the coming years the emphasis will be on the use of balanced fertilizers.

TABLE 1

WEST PAKISTAN

PROJECTIONS OF FERTILIZER CONSUMPTION PRODUCTION AND IMPORTS (OR CAPITAL INVESTMENT) IN 1968 - 69 TO 1979 - 80

(figures in 100,000 nutrient tons)

YEAR	CONSUMPTION PROJECTION			DOMESTIC PRODUCTION			BALANCE IMPORTS			FOREIGN EXCHANGE (Million dollars)			CAPITAL INVESTMENT (Million dollars)		
	N	P	TOTAL	N	P	TOTAL	N	P	TOTAL	N	P	TOTAL	N	P	TOTAL
1968-69	2.50	.44	2.94	.80	.09	.89	1.70	.35	2.05	35.7	7.3	43.0	-	-	-
1969-70	3.06	.76	3.82	1.14	.09	1.23	1.92	.67	2.59	40.3	14.0	54.0	-	-	-
1970-71	3.66	.92	4.58	1.53	.09	1.62	2.13	.83	2.96	44.7	17.4	62.1	-	-	-
1971-72	4.40	1.10	5.50	1.53	.09	1.62	2.87	1.01	3.88	60.2	21.2	81.4	-	-	-
1972-73	5.30	1.30	6.60	4.45	.52	4.97	0.85	.78	1.63	17.8	16.3	34.1	-	-	-
1973-74	5.92	1.98	7.90	6.42	.81	7.23(-)	0.5	1.17	1.17	-	24.5	24.5	-	-	-
1974-75	7.11	2.37	9.48	6.42	.81	7.23	0.69	1.56	2.25	14.4	32.7	47.1	34.5	23.4	57.9
1975-76	8.18	2.72	10.90	6.42	.81	7.23	1.76	1.91	3.67	36.9	40.1	77.0	88.0	28.6	116.6
1976-77	9.40	3.13	12.53	6.42	.81	7.23	2.98	2.23	5.21	62.5	48.7	111.2	149.0	34.8	183.8
1977-78	9.65	4.13	13.78	6.42	.81	7.23	3.23	3.32	6.55	67.8	69.7	137.5	161.5	49.8	211.3
1978-79	10.61	4.54	15.15	6.42	.81	7.23	4.11	3.73	7.84	87.9	78.3	166.2	209.5	55.9	265.4
1979-80	11.66	5.00	16.66	6.42	.81	7.23	5.24	4.19	9.43	110.0	87.9	197.9	262.0	62.8	328.8

NOTE:

1. Foreign exchange requirements for imports calculated on the basis of $ 210 per nutrient ton.
2. The proposed WPIDC ammonium sulphate nitrate plant (156,000 nutrient ton capacity) has not been included as it is still under consideration. If approved soon it will come on stream in 1972-73.
3. Taking the costs of sanctioned units as basis, the capital requirements for 1975-80 have been calculated at the rate of $ 50 million per 100,000 tons of N and $ 15 million per 100,000 tons of P. The capital requirements shown against each year will have to be fulfilled about 3 years in advance to meet consumption requirement, if no imports are to be made.
4. Consumption projections for Potash have not been given in the table as its present use is relatively low. Its consumption may be between 20,000 and 30,000 tons by 1980.

APPENDIX I

AGENDA

I Opening Remarks

II Election of Chairman

III Adoption of Agenda

IV (a) "Fertilizer Progress in the Asian CENTO Countries"
by Frank M. Kennedy,
United States Tennessee Valley Authority

(b) "Estimated World Fertilizer Production Capacity as Related to Future Needs"
by Frank M. Kennedy

V "The Green Revolution: High-Yield Varieties of Wheat, Rice, Corn, etc., and the Impact of Fertilizer and Food Balances"
by Dr. Leon F. Hesser, Assistant Director, Agricultural Policy, USAID/Pakistan

VI "Fertilizer Supply and Demand in CENTO Countries - A General Picture"
by John M. Hill, United States Fertilizer Adviser, USAID/Ankara

VII "Turkey's Fertilizer Supply and Demand Position for 1969-1982— By Product Types, Import Projections and Dollar Value"
by Dr. Mehmet Kiroğlu, Turkish Ministry of Agriculture

VIII "West Pakistan's Fertilizer Supply and Demand Position for 1969-1980 — By Product Types and Dollar Value"
Presented by Mr. Sarshar Ahmad Khan, C.S.P.

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IX "East Pakistan's Fertilizer Supply and Demand Position for 1969-1980 — By Product Types and Dollar Value"
Presented by Mr. Sarshar Ahmad Khan, C.S.P.

X "Fertilizer Product Types in Iran"
by John M. Hill

XI "Prospects for Trade Among the CENTO Regional Countries for Fertilizer Products and Raw Materials"
Comments by each delegation and discussion

XII "Capital and Raw Material Needs for Fertilizer Products Through 1980"
Comments by each delegation and discussion

XIII "Fertilizer Distribution and Market Development"
by John M. Hill

XIV "Standards, Specifications and Regulations for Fertilizer Products and Labelling"
Comments by each delegation and discussion

XV Consideration of Draft Report to the Sub-Committee on Agriculture

XVI Closing Remarks

APPENDIX II

LIST OF DELEGATES

IRAN

Dr. A. A. Byabany
Third Secretary for
Economic and Commercial Affairs
Embassy of Iran
Rawalpindi, West Pakistan

PAKISTAN

Mr. M. Yamin Qureshi, S.K.
Joint Secretary
(Leader of Delegation)
Ministry of Agriculture
and Works (Agriculture Wing)

Mr. Jawaid A. Mirza
Deputy Secretary
Ministry of Industries and
Natural Resources
(Industries Division)

Mr. Muhammad Sami
Section Officer
Ministry of Agriculture
and Works, (Agriculture Wing)

Mr. Mohammad Noorul Haq Miah
Deputy Marketing and
Statistical Adviser
(Agriculture Wing)

Mr. S. Naghat Husain
Assistant Chief
Agriculture and Food Section
Planning Commission

Mr. A. R. Khan
Director
Investment Promotion
and Supplies

Mr. Sarshar Ahmad, C.S.P.
Chief
Agriculture, Planning and
Development Department

Colonel M. A. K. Niazi
General Manager (Supply)
Agricultural Develop-
ment Corporation

Mr. Musahibuddin Khan
Director
Rapid Soil Fertility Project
Lahore, West Pakistan

Mr. Taj Mohammad
Agriculture Chemist
Tandojam, West Pakistan

Dr. A. R. Khalidi
General Manager
Chemical Industries
WPIDC
Karachi, West Pakistan

Dr. M. A. Malek
Manager Purchase, EPADC

Mr. Wahidul Islam
Soil Scientist
Project Directorate
Soil Fertility Survey

Mr. Riaz M. Agha
Representative of Pakistan
National Oils

Colonel B. A. Qureshi
Adviser
Pakistan National Oils

Mr. Ahmed Jaleel
Sales Manager
Pakistan National Oils

Mr. J. A. Ward
Representative of ESSO

TURKEY

Dr. Mehmet Kiroğlu
(Leader of Delegation)
Ministry of Agriculture
Ankara

UNITED KINGDOM

Mr. J. B. Wilmshurst
(Leader of Delegation)
Adviser on Economics and Statistics
Middle East Development Division
British Embassy
Beirut, Lebanon

Mr. R. R. Hand
Second Secretary, Economic
British High Commission
Rawalpindi, West Pakistan

UNITED STATES

Dr. Leon F. Hesser
(Leader of Delegation)
Assistant Director for
Agricultural Policy
USAID/Pakistan

Mr. C. C. Brookshier
Food and Agricultural Officer
USAID/Pakistan
Lahore, West Pakistan

Mr. John M. Hill
Fertilizer Adviser
USAID/Ankara

Mr. James Unti
Agricultural Economist
USAID/Pakistan

Mr. Frank M. Kennedy
Economist
Tennessee Valley Authority

CENTO SECRETARIAT

Mr. Philip Lindsay
Economic Secretary
CENTO Secretariat

CENTO PUBLICATIONS

*Seminar on Cattle and Sheep Breeding, 1959
*Seminar on Land Classification and Soil Survey, 1959
Seminar on Forestry, 1959
*Conference on Minerals, 1959
*Conference on Development Programming, June 1960
*Symposium on Chrome Ore, September 1960
*Conference on Teaching of Preventive Medicine, May 1961
*Conference on Industrial Development Banking, June 1961
*Symposium on Coal, December 1961
Progress Report, "Coordinating U.S. Action for CENTO" 1959–1960
*Progress Report, "Coordinating U.S. Action for CENTO" 1961–1962
*Conference on Agricultural Development Banking, April 1962
Traveling Seminar for Increased Agricultural Production, May 1962
*Conference on National Income Accounting, May 1962
*Conference on Establishment of National Scientific Organizations, June 1962
*Conference on Industrial Development Banking (2), June 1962
*Conference on Development Planning, June 1962
*Symposium on Industrial Rocks and Minerals, 1962
*Conference on Teaching Health Centers, 1962
Seminar on Cost and Return Ratios for Major Agricultural Products, 1963
Conference on Teaching of Science, 1963
*Symposium on Rural Development, 1963
*Symposium on Iron Ore, 1963
*Symposium on Consumer Expenditures, 1963
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*Conference on Manpower Needs and Training of Environmental Sanitation Personnel, 1964
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Traveling Seminar on Veterinary Education and Animal Health, 1965
*Symposium on Field Techniques for Mineral Investigation, 1965
*Second CENTO Veterinary Pathology Seminar, 1965
*Progress Report "Coordinating U.S. Economic Action for CENTO" 1962–1965
Symposium on Hydrology and Water Resources Development, 1966
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Symposium on Mine Health and Safety, 1967
Summer Training Program in Geological Mapping, 1966
Conference on Agricultural Extension, 1967
Traveling Seminar on Processing and Marketing of Fruit and Vegetable Products, 1967
Conference on Engineering Education, 1967
Summer Training Program in Geological Mapping, 1967
Conference on National and Regional Agricultural Development Policy, 1967
Symposium on Agricultural Statistics, 1967
Traveling Seminar on Marketing Livestock and Livestock Products, 1968
Traveling Seminar on Farm Tools and Implements, 1966
Conference on Combating Malnutrition in Preschool Children, 1968
Symposium on Development and Utilization of Mineral Resources, 1968
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