Report No. 928-IN

Appraisal of a Project to Improve Fertilizer Production Fertilizer Industry Credit; India

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Industrial Projects Department

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CURRENCY EQUIVALENTS

Except where otherwise indicated, all figures are quoted in Indian Rupees (Rs)

Rs 1.0	=	US$0.1282
Rs 7.80	=	US$1.00
Rs 1,000,000	=	US$128,205

WEIGHTS AND MEASURES

All weights and measures are in metric units.

1 Metric Ton (t)	=	1,000 Kilograms (kg)
1 Metric Ton (t)	=	2,204 Pounds
1 Kilometer (km)	=	0.62 Miles
1 Hectare (ha)	=	2.47 Acres

PRINCIPAL ABBREVIATIONS AND ACRONYMS USED

ANP	Ammonium Nitrate Phosphate
CAN	Calcium Ammonium Nitrate (25% N)
DAP	Diammonium Phosphate (18-46-0)
DCM	Delhi Cloth Mills
FCI	Fertilizer Corporation of India
FAI	Fertiliser Association of India
GOI, Government	Government of India
GSFC	Gujarat State Fertilizer Co.
HPCL	Hindustan Petroleum Co. Ltd.
IDBI	Industrial Development Bank of India
IEL	Indian Explosives Ltd.
K_2O (K, Potash)	Potassium Oxide Content in Fertilizers
MMTC	Metals and Minerals Trading Co.
MPC	Ministry of Petroleum and Chemicals
N	Nitrogen Content in Fertilizers
NFL	National Fertilisers Ltd.
POIP	Plant Operations Improvement Program
P_2O_5 (P, Phosphate)	Phosphate Content in Fertilizers
SPIC	Southern Petrochemical Industries Corp.
SSP	Single Superphosphate
TPY	Tons Per Year
TSP	Triple Superphosphate

Indian Fiscal Year

April 1 - March 31

INDIA

FERTILIZER INDUSTRY CREDIT

APPRAISAL OF A PROJECT TO IMPROVE FERTILIZER PRODUCTION

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This report was prepared by Don Brown, Denis Carpio, Yermal T. Shetty and Eustachio Tortorelli of the Industrial Projects Department.

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SUMMARY AND CONCLUSIONS

i. The Government of India has undertaken a major program to expand fertilizer production to meet the increasing needs of the agricultural sector. An important part of that program is to improve capacity utilization in existing plants, and the Government has requested an IDA credit of US$105 million to assist in achieving this improvement. Total cost of this program is estimated at US$239 million, including US$92 million in foreign currency.

ii. The Bank Group continues to play a major role in assisting India in the fertilizer sector; this credit would be the ninth operation since 1967 in fertilizer production facilities, including two by IFC, and seven by Bank/IDA. At present, there are 16 major operating fertilizer companies in India, with 20 plants having a total capacity of about 2.8 million tons of nitrogen (N) and 0.8 million tons of phosphate (P). But India, chronically short of a number of resources, has been able to achieve only 60% overall capacity utilization in the fertilizer industry and imports are required to meet about half of the consumption in the country, thus further aggravating India's severe balance of payments situation.

iii. The proposed credit would assist eight public, joint and private sector fertilizer companies in removing production bottlenecks, improving environmental control, diversifying production of industrial chemicals and assist one petroleum refinery in increasing its fertilizer feedstock supplies. In terms of incremental production the credit would assist in increasing capacity utilization by 253,000 metric tons of nutrients per year. With this project, and other programs under way, India is expected to achieve by the end of the decade an overall 85-90% capacity utilization and reach virtual self-sufficiency in nitrogen fertilizer production. The project has an aggregate economic return of 32%, which is understandably high since the benefits consist of incremental production from existing facilities.

iv. The IDA funds would be used for imported equipment and for services and would be channeled through the Government to various beneficiaries in several ways. About US$36 million would be onlent to FCI, the major beneficiary, at 10.25% interest and for 15 years including 4 years of grace. About US$28 million would be onlent to the Industrial Development Bank of India at 8.5%, which in turn would relend the credit proceeds under terms identical to those to FCI. Furthermore two public sector firms would receive about US$25.5 million as equity funds directly from the Government as part of its budgetary contribution to maintain their financial viability, and one private and one public sector firm would purchase about US$4 million of foreign exchange through rupee cash payments. Normal IDA procurement and supervision procedures will be followed. About US$1.0 million would be utilized for technical assistance and US$10.5 million would be initially unallocated.

v. It is increasingly clear that larger supplies of fertilizers alone are not the sole answer for increasing agricultural production in India. Other inputs, plus an efficient mechanism for fertilizer distribution and use and policy changes, are becoming more critical to improved agricultural productivity. This report reviews the broad aspects of fertilizer use. Based on this review, the Government has agreed to undertake the following: First, a 10-year comprehensive forecast of fertilizer supply and demand will be undertaken by the Government and updated annually. Second, a committee on fertilizers staffed by senior Government representatives will be established to coordinate all aspects of the fertilizer sector.

vi. There are a number of critical policy and institutional issues to be tackled including (i) industry organization; (ii) feedstock supply and prices; (iii) adequate infrastructure availability; (iv) raw material and fertilizer imports; (v) pricing and credit systems; (vi) improved distribution systems; and (vii) educational and support programs necessary to extend fertilizer use to small farmers and present non-users. These issues are discussed in the report and some steps are proposed but most will require substantial time to effect adequate remedies. Developing and implementing policy positions on these issues would be a major task of the committee on fertilizers.

vii. The most critical role in improved productivity in the agricultural/fertilizer sector will fall on the Government, in implementing necessary policy changes and providing finance. Over the next four years, the Government must provide about US$2 billion equivalent in investment funds for fertilizer projects and an additional US$3.6 billion to cover imports of raw materials and fertilizer products. Such demand for finance will likely put a heavy strain on the Government's budgetary resources and it is therefore essential that the Government does all in its power to improve - directly and indirectly - the industry's efficiency and the distribution and use of fertilizer.

viii. Based on the agreements reached with the Government, FCI and IDBI as contained in Chapter IX, the project is suitable for an IDA credit of US$105 million.

I. INTRODUCTION

1.01 India's installed fertilizer capacity has expanded greatly over the past 10 years but actual production has fallen short of expectations and most facilities continue to operate well below design rates. The proposed US$105 million IDA credit would assist 8 fertilizer companies in raising average capacity utilization by 13% by 1979, 1/ reduce polluting effluents at four of these, and modernize one refinery for increased fertilizer feedstock production. The location of major fertilizer plants and refineries in India is shown in Map IBRD 10453R2.

1.02 The Bank Group has been actively involved in the fertilizer sector over the past eight years, with two IFC projects, five IDA projects and one Bank project (Annex 1). The IFC projects are private sector investments at new locations and are now operating satisfactorily; the Bank project is a joint sector investment also at a new location. Each of the IDA credits involves major expansion of existing public sector facilities coupled with elements of modernization of these units. As yet, none of the Bank/IDA projects is commercially operating and their impact will only be felt during 1976-78 and thereafter. Further, fertilizer raw material imports have been included in the Industrial Imports Credit program for India.

1.03 There remains great scope for improvement in the Indian fertilizer industry. Operating levels remain low for a wide variety of factors including (1) old facilities, (2) shortages of electrical power and other infrastructure, (3) lack of raw materials, (4) management/labor problems, (5) financing gaps and (6) technical limitations.

1.04 The Plant Operations Improvement Program (Credit 481-IN, Annex 1), recognized this need and provided US$17 million to be used in two principal public sector companies - Fertilizer Corporation of India (FCI) and Fertilisers and Chemicals, Travancore Ltd. (FACT). The respective sub-projects are now being implemented and are expected to improve operating levels by 1978.

1.05 The proposed credit would modernize or otherwise improve operations at most major fertilizer companies in India. The report describes the elements of the program to improve fertilizer production and a detailed analysis of each sub-project is contained in the Annexes. However, recognizing that efficient use of fertilizer is of primary importance to the success of India's agricultural development, much of the report describes problems within the fertilizer sector, other than production limitations, and proposes certain steps to improve fertilizer availability and agricultural productivity.

1.06 This appraisal is based on missions to India in April/May 1975 by Messrs. Don Brown (Chief), Denis Carpio, Yermal T. Shetty and Eustachio

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1/ All years are Indian fiscal years, ending March 31 unless otherwise noted.

Tortorelli of the Industrial Projects Department, and Mr. Graham Donaldson of the Agriculture and Rural Development Department.

II. FERTILIZER USE IN AGRICULTURE

A. Agriculture in India

2.01 With a cropped area of 168 million hectares India is the third largest country in terms of cultivated land (after the U.S.S.R. and U.S.) and second in irrigated land (after China). About 80% of India's 600 million population is directly dependent on agriculture and about 45% of the country's gross domestic product (GDP) is from the agricultural sector. As against a population growth of about 2.5% during the decade ending in 1972 the growth rate for foodgrain output during the same period averaged 2.7% annually, of which 2.1% was due to higher productivity. While progress has been made in expanding irrigation, high yielding seed varieties, and fertilizer use, the agricultural sector is still characterized by heavy reliance on uncertain rainfall, low crop productivity and the fact that most farmers have yet to adopt modern agriculture practices (Annex 2-1). Much improved output is essential if India is to keep pace with its rising population and to improve nutritional levels. The agricultural sector and fertilizer production have been focal points of Bank/IDA lending in recent years and progress is slowly but steadily being made.

2.02 The original draft Five-Year Plan target for foodgrain production in 1979 was 140 million tons but has been reduced to 123 million tons. To meet the 123 million tons forecast, agricultural output would have to grow 4.3% annually over the next four years after three years of virtually no growth; such an achievement is, therefore, likely only with favorable weather. If foodgrain consumption targets are maintained, imports would be 12 million TPY during the 1976-80 period, at an annual cost of US$3 billion. However, in the more likely event that GOI will still be importing 3-4 million tons of foodgrains in 1979, consumption per capita would improve marginally over current levels.

2.03 Agriculture depends on many inputs, including water, seeds, fertilizer, pesticides, research, extension services, credit, and appropriate pricing and distribution systems, and not all of these are receiving adequate emphasis. Heretofore, the principal focus of the Bank's fertilizer projects in India has been to increase production. This focus will remain, but more attention will be given to improving use of fertilizer and integrating this "input" into an overall agricultural approach.

B. Supply and Demand for Fertilizer

2.04 Fertilizer consumption and production in India are analyzed in Annexes 2-2 to 2-4. Consumption of the three major plant nutrients (N, P, and K) increased at an average rate of 21% and 22% annually during 1951-1962 and 1961-1972 respectively. During the following three years consumption has virtually stagnated because of fertilizer scarcity, high prices, inadequate credit, and a restrictive permit system for purchasing (para 2.13).

2.05 In the past, fertilizer consumption has always fallen short of predictions. The Draft Fifth Five-Year Plan estimates a consumption of 5.2 million tons of N, 1.8 million tons of P_2O_5 and 1.0 million tons of K_2O in 1979, but since the Bank has considered the Fifth Plan targets unrealistic, most previous Bank/IDA appraisal reports have used figures some 20% lower. However, based on the current situation of high prices, frequent drought in some areas and the inability of the administrative system to respond quickly to changing conditions, even these lower forecasts are likely to be optimistic and a revised projection (by Bank staff) is shown below:

India - Fertilizer Consumption, Past and Future
(in million nutrient tons)

Fiscal Year	N	P_2O_5	K_2O	Total	N:P:K Ratio
Actual					
1966	0.55	0.13	0.08	0.76	7.1:1.7:1
1971	1.49	0.46	0.23	2.18	6.5:2.0:1
1972	1.76	0.56	0.30	2.62	5.8:1.9:1
1973	1.78	0.59	0.33	2.70	5.4:1.8:1
1974	1.84	0.63	0.31	2.78	5.8:2.0:1
1975	1.84	0.54	0.36	2.74	5.2:1.5:1
Forecast					
1979 Low	3.0	1.0	0.60	4.6	5.0:1.7:1
1979 Probable	3.5	1.2	0.70	5.4	5.0:1.7:1
1984 Low	4.5	1.5	1.00	7.0	4.5:1.5:1
1984 Probable	5.2	2.1	1.40	8.7	3.7:1.5:1

2.06 The 1979 "probable" figure of 5.4 million nutrient tons is a hopeful target based on needs rather than a scientifically derived projection of consumption. Unless policy changes are quickly decided and implemented, the low figure of 4.6 million tons could easily materialize with a possible negative effect on foodgrain production and a need for increased food imports. However, it is difficult to make reliable predictions in the absence of a sufficient data base and analysis. The 1984 figure is even more of a target figure, more useful for planning fertilizer production than predicting agricultural output. Quite obviously, reliable demand forecasts should be developed as quickly as possible. Through a study to be financed from the credit, GOI will implement a 10-year forecast, to be updated annually, the first to be completed by March 31, 1977 (Annex 2-5).

2.07 Starting from a low base, fertilizer production (Annex 2-4) also increased rapidly over the last two decades, as shown below:

Comparison of Fertilizer Production and Consumption in India
('000 tons)

Fiscal Year	Nitrogen			Phosphate		
	Production	Consumption	Deficit	Production	Consumption	Deficit
Actual						
1954	53	89	- 36	14	8	+ 6
1964	219	407	-188	108	117	- 9
1974	1,070	1,835	-765	390	634	-244
Forecast						
1979	3,400	3,500	-100	1,000	1,200	-200
1984	5,100	5,200	-100	1,700	2,100	-400

2.08 The forecast assumes that gradually India will become virtually self-sufficient in nitrogen fertilizer production, but keep importing some amount of phosphate and all of its potash requirements. To meet its increasing demands for fertilizer, the Government is making efforts to increase the output from existing plants and is undertaking an ambitious program to add new capacity.

C. Current Situation

2.09 The recent fertilizer scarcity in the world resulted in the Government being unable to obtain adequate imports in 1972 through 1974 (Annex 2-6), and paying sharply increased prices for imported fertilizer. Since India depends on imports for about half of its fertilizer needs, this difficulty quickly led to shortages and to high prices payable by farmers. GOI's response included: (i) measures to expand production; (ii) regulation of distribution and use of scarce supplies; (iii) concentrated efforts to obtain supplies on the world market, and (iv) regulation of nitrogen fertilizer prices. To encourage domestic manufacturers to fill the import gap, they received priority allocations of feedstock and electricity. While there was some increase in domestic output, overall capacity utilization remained low (60% for N, 58% for P). Existing stocks, which have been maintained traditionally at a relatively high level, were quickly used up.

2.10 Fertilizer control orders were instituted in 1972 and 1973 to facilitate equal access by farmers to limited supplies. The orders included (i) a ban on interstate trade in fertilizer, (ii) a system of allocations to the states from a central pool, together with the zoning of distribution by domestic manufacturers, (iii) licensing of fertilizer dealers and abolition of cash sales by cooperatives, (iv) fixing of retail margins and (v) introduction of a permit system (ration card) for eligible farmers.

2.11 The effect, however, was to a large degree the opposite of that intended. By restricting the free movement of fertilizer, some manufacturers who had developed markets in particular regions were cut off from these markets. While the pool allocation procedure attempts to ensure that all states have a proportional share of supplies, each state in practice tends to over-estimate requirements. This practice has led to excessive imports and high stock carry-overs, both at considerable cost to the Government.

2.12 The retail margin was not changed from the 1968 level of Rs 80/ton of fertilizer, even when transport and storage costs had more than doubled. Although the margin has recently been raised to Rs 115/ton, studies by the Fertiliser Association of India (FAI) indicate that it should now be Rs 220-240 per ton for fertilizer retailing to be profitable. As a consequence, dealers and cooperatives have been reluctant to hold stocks. To overcome this problem the central pool has set up stocks in several states.

2.13 The fertilizer permit system was introduced to ration supplies evenly among farmers. As might have been expected, administration was difficult, and many small farmers were unable to buy fertilizer for lack of appropriate papers. There is evidence that this "permit system" was more damaging than high prices in suppressing fertilizer consumption. Because of widespread dissatisfaction, almost all states have relaxed the permit requirement.

2.14 The official response to the fertilizer shortage on the supply side was to go to extraordinary lengths to obtain imports. Guided by the high demand estimates of the Fifth Plan, and concerned about the cost to foodgrain production of a short-fall in fertilizer supplies, GOI contracted for large quantities of fertilizers. The consequence has been a rapid accumulation of stocks at high prices (up to US$400 per ton for urea).

2.15 A number of institutions have been involved in fertilizer importation. Requirements are estimated by the Ministry of Agriculture in conjunction with the states and domestic producers and Ministry of Petroleum and Chemicals (MPC). The Ministry of Supply arranged for imports from hard currency countries and the Minerals and Metals Trading Corporation (MMTC) was responsible for imports from Eastern European countries, tied aid sources and for phosphate rock and sulfur supplies. The government-owned Potash Corporation imported all potash fertilizers. Imports have not been adequately coordinated and deliveries have been bunched with ships waiting 7 to 9 weeks to unload. However, in August 1975, the Government entrusted MMTC with responsibility for all fertilizer and fertilizer raw material imports; so the situation should improve.

2.16 There remains, however, little coordination and planning with respect to fertilizer demand, supply, production, and import policies. The creation of a committee on fertilizers to coordinate these functions (Annex 2-7) has been agreed. It will consist of a small number of top-level people representing government and industry. Such a group is expected to provide a basis for improving performance of the fertilizer sector in India.

D. Price and Market Prospects

2.17 Fertilizer retail prices had been more or less stationary up to June 1974 when a sharp increase took place as a result of the jump in import prices (Annex 2-8). This affected the growth of fertilizer consumption. Therefore, the Government reduced prices in July 1975 for the main fertilizers used in the country. Still, the current average farm-gate price for fertilizer in India is apparently one of the highest in the world. The recent changes in fertilizer prices have been due to high import price and government intervention, particularly in controlling nitrogen fertilizer prices. Nevertheless, since the price of imports continued to rise after the domestic price had been set each year, the pool has incurred a substantial deficit in the past two years. Last year this deficit represented a de facto subsidy of approximately 37% on nitrogen fertilizer as shown below:

India - Nitrogen Fertilizer Prices and Effective Subsidy

Fiscal Year	Retail Price Nutrient		Pool Deficit	Consumption Million	Effective Subsidy
	Rs/Ton	US$/Ton	Rs Million	Nutrient Tons	Rs/Ton
1973	2,080	267	-	1.78	-
1974	2,280	292	600	1.84	330
1975	4,350	558	3,000	1.84	1,630
1976	4,020	515	n.a.	2.10	n.a.

2.18 The price of phosphatic fertilizer is not controlled but is allowed to change in relation to the price of imported phosphate rock. Since this price has increased sharply over the past two years, the price of phosphate fertilizer has, in fact, risen more than the price of nitrogen. Because the price elasticity for phosphate fertilizer is usually greater than that for nitrogen (reflecting the residual effect of phosphates in the soil), this much higher, unsubsidized, price for phosphatic fertilizer has serious implications for fertilizer demand and, consequently, crop yields.

2.19 Taking current average farm-gate NPK prices for fertilizer of Rs 4,500/nutrient ton and the estimated average realized price 1/ for cereal grains of Rs 1,400/ton the benefit/cost ratio for fertilizer use on cereals is as follows:

Grain Yield/Fertilizer Ratio	Benefit/Cost Ratio to Farmer
5:1	1.6:1
7.3:1	2.3:1
10:1	3.1:1

1/ A small portion of grain production is procured by the Government at Rs 1,050/ton.

The average ratio of 7.3:1 used in the Fifth Plan is the amount of grain produced by the use of one nutrient ton and is an average figure for a good year. A 10:1 ratio is the expected value for high-yielding varieties (HYV's) under irrigation. Generally, a benefit/cost ratio of 2.5-3.0:1 is required to ensure farmer adoption of new technology and at a ratio below 2:1 farmers will cease to use a given technology where there are cash costs involved. The uncertainty of weather and harvest fluctuations, as experienced over the past three years, could limit increases in fertilizer consumption unless the Government acts quickly to establish higher grain prices or lowers fertilizer prices further. Other areas of concern that could affect fertilizer consumption including marketing, distribution and credit are discussed in Annexes 2-9 and 2-10.

III. THE FERTILIZER INDUSTRY IN INDIA

A. Historical Development

3.01 Fertilizer production in India, as a modern industry, began some 25 years ago with commissioning of ammonia/ammonium sulfate facilities at FACT and Sindri, respectively. Prior to that time, there were only several very small manufacturers of single superphosphate (SSP) based on relatively simple industrial facilities. Although the original facilities of FACT and Sindri are obsolete and inefficient by today's standards including size and feedstock, they represented large-scale facilities at the time of establishment and operated satisfactorily over their first 15 years of production.

3.02 Initially, production was ammonium sulfate (21% N) and SSP (16% P_2O_5), both of which are single nutrient, low analysis materials (Annex 3-1). The industry has expanded, to higher analysis products such as calcium ammonium nitrate (CAN, 26% N) and urea (46% N) and complex fertilizers such as diammonium phosphate (DAP), 28-28-0 and 15-15-15 grades. In 1975 urea accounted for 67% of total N production. The typical size of a nitrogen facility has increased tenfold from 50-100 TPD ammonia to 600-1,000 TPD ammonia. Ammonia feedstock sources have also changed considerably (para 3.18). Phosphate facilities have increased in size about fivefold to about 350 TPD P_2O_5.

3.03 India's policy toward the fertilizer industry has, since Independence in 1947, permitted public and private sector development, as well as combinations of the two designated as joint sector. All companies operate under the Companies Act of 1956. However, related policy issues, such as pricing, allocation of foreign exchange, restrictions on profits, and foreign participation, have often led to the private sector being deterred from investment.

3.04 Fertilizer production was recognized as an important goal, but up until 1965, actual expansion was slow and production that year was only 365,000 nutrient tons. The slow rate of expansion was attributed to lack of foreign exchange, reluctance of Indian investors to participate, the Government's restrictions on foreign collaborators and repatriation of profits, and its insistence on use of indigenous equipment. It was during this period that the first urea project and the first major modern phosphate fertilizer facilities were built in India.

3.05 During the mid-1960s, the Government made a comprehensive shift in its policy toward the industry, including (i) expansion of public sector fertilizer investment, (ii) abolition of required GOI equity in the private sector, and relaxation of conditions requiring Indian ownership and management; (iii) increased credit; (iv) freer role for companies in marketing; and (v) speeding procedures for project approval and imports of equipment. Also in 1966, the rupee was devalued from Rs 4.7 to Rs 7.5 to the US dollar.

3.06 The above policy changes resulted in two major industrial developments. The first was a significant expansion in the private sector (four plants) and the joint sector (two plants) as a result of the relaxed investment environment. Four of the six had a foreign company with fertilizer experience as major equity shareholder and in two (Indian Explosives and Zuari Agro) the International Finance Corporation participated. All of these projects were implemented successfully.

3.07 The second development was a major expansion of the public sector industry, principally FCI (Annexes 3-2 and 3-3). Two small FCI projects were implemented satisfactorily, largely with technical assistance from foreign contractors, and both have been operating in recent years at relatively acceptable rates. However, in 1966-67, while these two projects were underway, the Government decided to expand production with maximum indigenous input including engineering. At the same time, in the US and Europe, large-scale ammonia plants were developed using substantially different technology. Four large ammonia/urea projects were undertaken by the public sector. Each involved a 600 TPD ammonia plant based on the newer technology that was now available. Engineering was largely by FCI with imports, including technology, based on available supplier credit financing rather than an objective technical assessment of worldwide process technology equipment and project management. Each project took about six years to construct, and none has experienced satisfactory commercial operation. Under normal conditions the four units together should have been producing about one million TPY urea by 1972, thus filling most of the recent import requirements. The program was later expanded to include two large coal-based projects by FCI and these projects are also experiencing protracted construction delays.

3.08 The mistakes made were not so much due to Indian-made equipment, most of which, in fact, have operated well. It was primarily a combination of factors including inexperienced project management and engineering, weak coordination between project sponsors and contractors, poor use of suppliers' credits, and wrong choice of equipment at a time when technology was changing rapidly. The goal seemed to be maximizing use of Indian engineering and equipment rather than maximizing fertilizer production. Correcting the problems associated with all six projects, with a total urea capacity of about 2 million TPY is going to take a long time. IDA's Trombay Project (Annex 1) includes assistance for four of these units.

3.09 Exploratory Bank Group missions in 1967 and in 1969 identified many of the problems facing the industry, but within India the desire to maximize local participation and ignore problems appeared to continue unabated and clouded judgment. Compounding the poor performance record of the public sector, implicit policy shifts by the Government reversed the previous trend (para 3.05) and made private sector and foreign investment again very difficult. Prices were controlled at low profit levels and investors were discouraged. No foreign company has made a significant investment in the Indian fertilizer industry since 1971 and no Indian private sector company has been able to raise the required capital and also obtain required GOI approvals. Also, efforts by IFC to develop further investments proved unsuccessful during this period. However, three joint sector companies have successfully implemented projects, and are now commercially operating.

3.10 IDA became involved in the Indian fertilizer industry in 1970 and since it was impossible to identify a private sector project, the Association concentrated on those projects of the public sector which were limited to modernization/expansion of existing plant with external engineering. During the Fourth Plan (1969-74), seven public sector projects were started, including four assisted by IDA, which are scheduled for commercial production during 1977-78. Each IDA project is aimed at removing production limitations of the units involved as well as expanding capacity, although two are behind schedule. The other three public sector projects are substantially behind schedule, and include the two FCI coal-based projects.

B. <u>Present Fertilizer Industry Situation</u>

3.11 During 1975, the first year of the Fifth Plan, the public sector emphasis continued with five additional projects being started, including three by FCI and two by a newly formed company, National Fertilisers Limited (NFL). During the rest of the Fifth Plan, it is possible that three to four additional public sector projects by FCI and NFL will be initiated. At present only one joint sector project is underway (the Bank-assisted IFFCO plant) and another is planned (GSFC Expansion). Possibly, two private sector projects could be implemented but private (particularly foreign) investment restrictions remain and capital costs have increased so sharply that it is unlikely that a private company can raise sufficient funds for a major project without significant financial support by GOI (thereby indirectly becoming a joint sector project).

3.12 As shown in the following table, there are at present 16 major fertilizer companies with 20 operating plants, plus 16 plants under construction and five under planning:

Major Fertilizer Companies in India

	Companies	Operating Plants	Plants Under Construction	Plants Under Advanced Stage of Planning
		(Nos.)		
I.	Public Sector			
	1. FCI	6	11 /a	2
	2. Rourkela	1	-	-
	3. FACT	2	1	-
	4. Neyveli	1	-	-
	5. Khetri	-	1	-
	6. NFL	-	2	1
II.	Joint Sector			
	1. GSFC	1	-	1
	2. Madras	1	-	-
	3. SPIC	1	-	-
	4. Mangalore	1	-	-
	5. IFFCO	2	1	-
III.	Private Sector			
	1. IEL	1	-	-
	2. Zuari Agro	1	-	-
	3. Coromandel	1	-	-
	4. DCM	1	-	-
	5. Nagarjuna	-	-	1
	16	20	16	5

/a Including five new projects and six expansions of existing units.

The industry should have a total nutrient capacity of about 6.4 million TPY by 1979 of which 55% will be in the public sector, 27% in the joint sector, and 18% in the private sector (Annex 2-4). The total capacity will include 5.1 million TPY of N and 1.3 million TPY of P.

3.13 In addition, there are a large number of smaller companies. They manufacture SSP or NPK and are involved in mixing, granulation and distribution of fertilizer. While these firms are an important element of the fertilizer sector in India, particularly on the distribution side, they contribute less than 10% of the nutrient manufacturing capacity. They generally have adequate physical facilities. They operate reasonably well when supplied with adequate primary fertilizer nutrients and if Government policy does not unduly restrict them in pricing, credit and distribution.

3.14 An increasingly important factor, from about 1965, has been joint sector ownership with Government equity, usually being held by State Governments, plus cooperative and private shareholders. These companies have been relatively efficient and through their public ownership have access to the required capital for expansion. There are now five joint sector companies in operation. Nevertheless, Government policy has continued to emphasize public sector expansion, at times at the cost of lower efficiency. As mentioned previously, the heavy emphasis on public sector, excessive use of unproved domestic engineering capability and overburdened management has caused great difficulties in meeting production targets in the industry. These faults have largely been recognized by now, and acceptable solutions have been incorporated into recent projects.

3.15 The problems plaguing the industry cannot, however, entirely be explained in a public versus private framework since age and size of plant and feedstock are key factors (Annex 3-4). Furthermore the industry suffers from a wide variety of shortages that reflect the inability of the economy to provide all needed inputs and infrastructures; principally shortages in electrical power, raw materials, transportation systems and equipment replacement. Generally, when any operating unit, public or private, is provided with the required inputs, it operates at a high production level. Nevertheless, private and joint sector companies have usually implemented projects with a competent, experienced foreign engineering company as project manager. The engineering company could make decisions on equipment choices or design criteria in the best interest of the project. Public sector projects, on the other hand, usually implemented by public sector Indian engineering companies have been characterized by split and ill-defined responsibility and the lack of rapid decision making and execution, thus stretching out implementation and ending up with a late and expensive project with major initial operating difficulties.

3.16 Although the difficulties may appear to be insurmountable, the Indian fertilizer industry is now in a relatively good position compared to that of other developing countries. Some domestic engineering capability has been established (particularly when associated with experienced foreign engineering firms and consultants), and Indian capacity in equipment, construction and civil works has expanded greatly in the last few years. Foreign exchange engineering costs are about half those of projects in countries such as Indonesia, Philippines and Arabian Gulf countries, and total foreign exchange requirements are only about 30-40% of a project's cost compared to about 60-80% elsewhere. The equipment manufacturing industry however, appears to be operating at full capacity and needs to expand so that delivery times can be reduced.

3.17 The Government is considering reorganization of the public sector fertilizer enterprises. Initially, this would probably include FCI and NFL being reorganized into three or four regional companies. Rourkela, Neyveli and FACT may be included but apparently at a later date. Reorganization into smaller, more manageable groups would be highly desirable, particularly if the new companies could operate more freely from Government day-to-day interference. Also the units weak in management such as FACT and Rourkela could well benefit. As regional and more autonomous companies, with stronger emphasis on professional management and profitability, the public companies could duplicate the success of the joint sector companies.

C. Feedstock and Transportation

3.18 India utilizes a wide range of raw materials in ammonia production including natural gas, naphtha, fuel oil, coal, lignite, coke-oven gas and electrolytic hydrogen (Annex 3-5). To the extent domestic gas is available it is being used but, at present, there are only limited reserves in Assam and Gujarat. The older plants are in the process of being converted to either fuel oil or naphtha. So generally in India the choice for new capacity is limited to naphtha, fuel oil or coal. By 1979, of the estimated 5.1 million TPY of total N installed capacity, 37% would be based on naphtha, 31% on fuel oil, 13% on coal, 12% on gas and 7% on other sources.

3.19 As production expands, transportation will continue to be a problem including ports, petroleum and raw material movement and product shipping. The Government has agreed to complete by June 30, 1976, a study of the fertilizer transportation system. The proposed committee on fertilizers (para 2.16) would also include this aspect in its scope of activity.

IV. SECTOR FINANCING REQUIREMENTS

A. Investment Program

4.01 The expansion of the Indian fertilizer industry is continuing and from a present level of 3.6 million TPY, is expected to reach about 6.4 million TPY nutrient capacity by 1979 (Annex 2-4).

4.02 The ongoing projects and those proposed involve substantial capital investments as shown in Annexes 4-1 to 4-3 and summarized below:

Fertilizer Industry Investment Program in India (1975-1980)
(US$ Million)

	Foreign Exchange	Local Currency	Total	%
1. Modernization Programs	105	155	260	6
2. Ongoing Projects	875	1,575	2,450	60
3. Proposed New Projects	495	890	1,385	34
Total	1,475	2,620	4,095	100

4.03 About 18% of the above total investment cost has been disbursed as of the end of 1975 and some 75% (US$3.1 billion) will be required during 1976-79. The financing sources are shown in Annex 4-4 and summarized below:

Financing Sources for the Fertilizer Investment Program
(US$ Million)

Fiscal Year (March 31)	Disbursement Period Through 1975	1976-79	1980	Total	%
1. IBRD/IDA (including this credit)	45	395	-	440	11
2. Other External Credits	180	320	-	500	12
3. Local Financial Institutions	-	200	-	200	5
4. Internal Enterprise Funds	40	130	-	170	4
5. GOI	485	2,010	290	2,785	68
Total	750	3,055	290	4,095	100

4.04 The GOI contribution will account for more than two-thirds of the total cost. Most of the GOI funds will be needed during 1976-79, at an annual average of about US$0.5 billion, and could account for about 15 to 20% of GOI's annual developmental capital budget.

4.05 The investment program faces some risk. The management and technical capabilities of the industry are rapidly being stretched with the addition of more projects. The capital goods industry, still experiencing difficulties in supplying fertilizer equipment on time, will be hard-pressed to keep up with orders. And, most importantly, Government funding constraints could further delay completion of several projects. Consequently, the possibility of scaling down this industry investment program must be considered. The Government has agreed to prepare a funding schedule for the projects under implementation and for any new projects before proceeding with them and will periodically consult with IDA regarding the financing and overall progress of the expansion program of the fertilizer industry.

B. Cost of Imports of Fertilizers and Raw Materials

4.06 India is projected to approach self-sufficiency in N by 1980 while phosphate imports are expected to be maintained at about 200-400,000 TPY and potash imports increased to about 800,000 TPY (all in nutrients). Import costs including raw materials will average about US$900 million annually from 1977 through 1981, on the assumption that ongoing projects are completed as scheduled (Annex 4-5). Import costs will remain large primarily because of increasing potash consumption and the high import content of phosphate materials. Should the NPK ratio shift towards more P and K relative to N as would be desirable agronomically, the cost of fertilizer imports would still be higher.

4.07 The phosphatic fertilizer import cost estimates assume that by 1979 one-third of domestic production will be based on local phosphate rock. However, currently developed mines can supply only a small fraction of requirements. The Rajasthan area has additional phosphate deposits that can be developed but, unfortunately, political problems between the state and the central governments have delayed this high priority project for several years.

V. PROJECT SCOPE

A. Project Components

5.01 While some of the problems limiting production in the Indian fertilizer industry involve institutional and policy issues, many are physical constraints such as raw material/utility limitations, and lack of sufficient funds to replace worn equipment. Also funds are often not available for upgrading production facilities to rectify pollution problems and diversify production into industrial chemicals. Diversification is desirable since industrial chemicals usually generate more profits than price-controlled fertilizer.

5.02 The objective of the proposed credit is to assist in removing these limitations and thereby raising production in the existing facilities from a current industry-wide average level of 60% to about 85-90% capacity utilization, 1/ provide pollution control facilities, particularly fluorine and ammonia effluent control, and sufficient technical assistance to prepare and implement these programs properly. The project will increase output by 253,000 TPY nutrient, or an average of 13% of nutrient capacity of the plants involved in the project.

5.03 Management and engineering limitations are to be reduced by collaboration between Indian and foreign firms. Also the projects are small and the several beneficiaries have demonstrated that they can successfully execute similar projects. Time-consuming procedures for approval of licenses, imports and fund allocations are eased for Bank Group projects and some improvements have been seen in other, notably NFL and joint sector, projects. The project supports training programs including the training of personnel outside India.

5.04 More fundamental policy issues, such as pricing policy, limitations on corporate ownership and dividends, which result in part from the continuing resource gap facing the country, cannot be solved in a short period of time. A systematic approach to and treatment of these issues will be included in the scope of responsibility of the proposed committee on fertilizers (para 2.16 and Annex 2-7).

B. Project Description

5.05 Project components were selected after surveying the needs of the Indian fertilizer industry and reviewing with the Ministry of Petroleum and Chemicals (MPC) to determine those sub-projeccts that have high priority, would contribute substantially to improved capacity utilization, and were ready for rapid implementation. The project components are discussed and analyzed in detail in Annexes 5-1 to 5-9 and summarized below.

1/ Including other modernization projects already underway.

1. FCI (Public Sector)

5.06 Gorakhpur and Durgapur Inplant Power Generators (US$44.2 million): 1/ The Gorakhpur unit will install two turbo-generators of 12.5 MW each, and Durgapur one 15 MW turbo-generator with related facilities for in-plant power generation. This will reduce sharply the plants' dependence on outside power supply which continues to be unreliable and for which no solution is in sight considering the rapidly increasing need for electricity in India.

5.07 Trombay Steam Generating Unit (US$12.9 million): Trombay requires considerable amounts of steam and so does the ongoing Trombay IV (nitrophosphate) expansion project and Trombay V (ammonia/urea) expansion which is at an advanced stage of planning. Since the existing boilers are old and unreliable and need major repairs and considering Trombay's additional steam needs, a 170-ton/hr boiler will be installed.

5.08 Ammonia Storage and Tank Wagons (US$20.5 million): All FCI units except Trombay (with 15,000 tons) have limited ammonia storage capacity. Since operation of an ammonia plant and downstream units located elsewhere cannot always be synchronized, FCI is planning to establish storage facilities for ammonia at selected locations, and use tank wagons to transport the product to different units experiencing ammonia shortages. Under the proposed credit, four storage centers will be established with a total capacity of 25,000 tons and 35 tank wagons (30-ton capacity each and FCI-owned) to transport ammonia.

5.09 Pollution Control and Testing Equipment (US$1.4 million): FCI proposes to establish a Central Pollution Control Wing with necessary equipment to advise its units on environmental protection aspects. Further, it wants to strengthen its Non-Destructive Testing Laboratory which serves not only FCI but also other fertilizer units. With the increase in FCI units and rising demand for service from outside units, it has become necessary to acquire additional equipment for industrial vibration testing, advanced ultrasonic inspection, noise analysis, etc.

2. Neyveli (Public Sector)

5.10 Conversion from Lignite to Fuel Oil Feedstock (US$19.5 million): The Neyveli sub-project involves a change in ammonia feedstock, from lignite to fuel oil, making it possible to raise capacity utilization from 35% to about 90%. The conversion will enable the existing power plant at that complex to utilize the lignite to generate more electricity. The power plant can substitute five tons of lignite for each ton of fuel oil, and the fertilizer plant will release almost 10 tons of lignite for each ton of fuel oil consumed as feedstock after the conversion. At present the lignite mine provides barely 50% of the lignite requirements of the power plant, necessitating the use of fuel oil for additional power generation. Mining capacity

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1/ Figures in parenthesis are estimated total costs of sub-projects.

is being expanded but even afterward the entire lignite production can still be utilized by the power plant and the briquetting plant. The fuel oil gasification unit will be similar to that of FCI's Gorakhpur plant, and the conversion will be implemented by FCI under a turn-key engineering contract.

3. Rourkela (Public Sector)

5.11 Conversion from Coke Oven Gas to Naphtha Feedstock (US$26.1 million): Rourkela produces calcium ammonium nitrate (CAN). At present 39% of the ammonia synthesis gas requirement is supplied by a naphtha reforming unit installed in 1971 and the remainder from coke oven gas produced in an adjacent steel plant. However, the coke oven gas has been inadequate and CAN production has been limited to 40-55% of capacity. A debottlenecking program involving the coke oven gas unit is underway but the coke oven gas supply will provide at most only 25% of the plant's requirement. The proposed project involves the addition of a second 180 TPD naphtha reforming unit to produce sufficient raw hydrogen to permit the factory to run at capacity. The raw hydrogen would be processed in the existing purification section of the ammonia plant to produce the pure hydrogen required for ammonia synthesis.

4. Madras (Joint Sector)

5.12 Modernization of Ammonia and Urea Plants (US$1.7 million): Madras is an efficient company that has already undertaken a number of improvement projects, including expansion of its NPK facilities. This credit is to include two further modernization projects. The first involves modernization of the ammonia plant to include computerized process control and operation mainly to reduce downtime and lower feedstock and steam consumption. One of the Company's partners, Amoco, has successfully utilized computer control in one of its ammonia plants in the U.S. The second project is modernization of the urea plant to replace several obsolete pieces of equipment with more modern, larger capacity units and thus increase urea output by an estimated 13%.

5. GSFC (Joint Sector)

5.13 Modernization of Various Plants (US$20.6 million): The phosphoric acid plant at GSFC operates at a low rate due to design limitations. The unit is being evaluated by a consultant to determine the remedies to upgrade production to the original design specifications. The major difficulties are in poor reaction of phosphate rock, lack of process control, and insufficient filtration capacity. The consultant, to be financed retroactively under the technical assistance portion of the proposed credit, has already started studies on these problems and will complete his work by December 1975.

5.14 Fluorine recovery from the phosphoric acid plant, including conversion to cryolite will be included in the project. Phosphate rock contains 2-4% fluorine, a substantial portion of which is a gaseous effluent in the process. The fluorine will be recovered as fluosilicic acid and then converted to cryolite, which is used in aluminum manufacture. The design of this unit is not completed but it is estimated that 1,400 TPY of cryolite will be recovered.

5.15 The existing ammonia plant at GSFC will also be modernized by recovering argon and increase ammonia production by 63 TPD.

6. SPIC (Joint Sector)

5.16 Soda Ash/Ammonium Chloride Unit and Fluorine Recovery System (US$46.2 million): The SPIC factory which includes the largest ammonia plant in India (1,100 TPD), was commissioned recently, and has excess ammonia for conversion to 65,000 TPY each of soda ash and ammonium chloride. Soda ash is an industrial chemical in great demand in India. Ammonium chloride would be utilized as a fertilizer in NPK mixes. SPIC will sponsor a new company to own and operate the soda ash plant. The new company will be evaluated by IDBI as part of its detailed appraisal of this sub-project.

5.17 SPIC also plans to install a 1,500 TPY cryolite facility based on fluorine recovery from its phosphoric acid plant. In addition, SPIC will evaluate other modernization and pollution abatement requirements during the first six months of commercial operation. The foreign exchange costs of these studies will be funded out of the technical assistance portion of the credit.

7. Hindustan Petroleum (Joint Sector)

5.18 Refinery Debottlenecking (US$25.9 million): HPCL, a refinery in Bombay owned by GOI, has a capacity of 3.5 million TPY, and was originally built with the idea of expanding to 6.0 million TPY. Thus the 2.5 million TPY project expansion is relatively inexpensive. The expanded refinery (plus the adjacent Burmah Shell refinery) would be sufficient to process the forecast production from offshore reserves near Bombay, and have sufficient conversion capacity to assure feedstock to Trombay, Zuari Agro, and the new fuel oil based ammonia plants in North India (although transport to the North would require additional tank cars). The project itself includes the reactivation of idle equipment, addition of some new equipment, and the expansion of utilities.

8. Coromandel (Private Sector)

5.19 Power Generation and Fluorine Recovery (US$8.5 million): As with other fertilizer plants in India, unreliability of power supply has been the major problem for Coromandel in the last years. Furthermore, in March 1975, the Electricity Board imposed a power-cut of 20% on the factory. The installation of a captive power generation unit is the best way to overcome this problem and to assure a continuing high production rate in the future. This sub-project includes a 45 TPH boiler and a 5 MW turbogenerator. It is anticipated that a gain of 29,500 TPY NPK would result.

5.20 Coromandel is also planning to install a 3,800 TPY aluminum fluoride plant, which will recover fluorine from its phosphoric acid plant and therefore, help eliminate a major pollution hazard for the environment. Aluminum fluoride is also used in aluminum manufacture.

9. Zuari Agro (Private Sector)

5.21 Ammonia Plant Modernization and Pollution Control (US$10.2 million): This factory, with a capacity 280,000 TPY of urea began production in 1974. A complex fertilizer (28:28:0) plant, based on imported phosphoric acid, has operated intermittently since February 1975 due to lack of acid as well as limited availability of ammonia. The factory discharges two effluent streams that have allegedly caused problems in the environment. One effluent, containing arsenic, has already been removed, by converting the process within the ammonia plant so that arsenic is no longer used. The second effluent containing some diluted quantities of ammonia and urea from the urea plant, will be recycled in a recovery unit that will be financed from the proposed credit. The effluent will be minimized by installing a cooling tower and recycling water. The overflow from the cooling tower will be processed to remove the contained nitrogen chemicals down to less than 50 ppm. The nitrogen will be recovered as ammonia, but the amount is too small to affect the plant's profitability.

5.22 A second component at Zuari is a modernization scheme of the ammonia unit. The factory is about 10% short of its ammonia requirements if both urea and DAP plants run at full capacity. The ammonia plant capacity can be increased by 10% by making only a few changes in some of the equipment. Zuari Agro plans to undertake a detailed feasibility study with the designer of the ammonia plant, Toyo Engineering (Japan), to determine the exact scope of the modernization project. The study, which would be financed from the proposed credit, is expected to be completed by January 1976.

10. Technical Assistance

5.23 Consultants, Training and Studies (US$1.0 million): The technical and engineering studies related to the sub-projects mentioned and described above are expected to require about US$0.5 million in foreign exchange. In addition some US$0.5 million is proposed to finance the fertilizer demand forecast and related marketing studies referred to in para 2.06.

C. Project Implementation and Administration

5.24 Each individual company, whether in the public, joint or private sector, will execute their respective sub-projects. There will be two Project Agreements, one with FCI and another with the Industrial Development Bank of India (IDBI) to which the Bank Group has previously lent. Besides the obligations to carry out its own sub-projects, FCI, under its Project Agreement, is authorized to implement the two other sub-projects in the public sector, Neyveli and Rourkela, for which FCI will be the engineering contractor. The Project Agreement with IDBI is patterned after and includes the standard covenants applicable to DFC sub-loans and specifies GSFC's, HPCL's, Zuari's and SPIC's obligations for implementing their respective sub-projects in an efficient and timely manner. These covenants will in turn be incorporated into the subsidiary loan agreements between IDBI and respective firms. IDBI will appraise and have the prime responsibility for supervising its sub-projects. Project implementation schedules of all sub-projects will be proposed and updated as necessary by MPC as part of their overall role of coordination of the project.

5.25 With regard to two companies (Madras in the joint sector and Coromandel in the private sector) which will purchase the foreign exchange with rupee funds, the Credit Agreement with the Government specifies the obligation of those companies to implement their sub-projects efficiently including procurement arrangements. IDA will directly supervise these sub-projects.

5.26 The Ministry of Petroleum and Chemicals (MPC) will coordinate project implementation on the Indian side. This would include obtaining necessary Government approvals for sub-projects; working with the Department of Economic Affairs (DEA) and with IDBI on IDA procurement and disbursement matters; and assisting IDA in project supervision. MPC will receive requests for technical assistance funds covering plant modernization schemes and forward the requests for IDA approval. MPC will advertise the project in the Indian Press, and inform all embassies in New Delhi of the Bank member countries and Switzerland. In addition, vendor lists from all recent Indian fertilizer projects, will be made available to all project sponsors so that each will have a list from which to prequalify a reasonable number of international bidders. IDA will review the prequalified bidders' list in all instances.

5.27 The Bank Group's project supervision activity in the Indian fertilizer industry is already large, and will become even larger with the proposed credit. While three of the six previous Bank/IDA fertilizer projects are expected to be completed within the next year, the number of sub-projects in the proposed credit will offset this factor and will require more supervision effort, particularly over the next two years. However, the involvement of the Ministry of Petroleum and Chemicals and IDBI should make the task less burdensome than would otherwise be the case.

VI. PROJECT COST AND FINANCING PLAN

A. Capital Costs

6.01 The total financing required is estimated at Rs 1,862 million (US$239 million), including Rs 721 million (US$92 million) in foreign exchange. The base cost estimates are based on prices prevailing in early calendar 1975. The estimates are summarized below. Cost estimates by type of sub-project and by company are shown in Annexes 6-1 and 6-2. The estimates include 10% physical contingency and 20% price escalation (Annex 6-3).

Summary of Capital Costs

	in Rs Million			in US$ Million			
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total	%
1. Equipment, Materials & Spares (Delivered)	468	381	849	60.0	48.9	108.9	66
2. Duties	-	151	151	-	19.3	19.3	12
3. Licenses, Engineering & Supervision	41	70	111	5.3	8.9	14.2	9
4. Civil Work, Erection & Commissioning	21	151	172	2.7	19.4	22.1	13
5. Base Cost Estimate	530	753	1,283	68.0	96.5	164.5	100
6. Physical Contingency	52	76	128	6.7	9.8	16.5	10
7. Price Escalation	105	150	255	13.4	19.2	32.6	20
8. Installed Cost	687	979	1,666	88.1	125.5	213.6	130
9. Additional Working Capital	30	51	81	3.8	6.6	10.4	
10. Technical Assistance	4	4	8	0.5	0.5	1.0	
11. Interest During Construction	-	107	107	-	13.7	13.7	
Total Financing Required	721/a	1,141	1,862	92.4/a	146.3	238.7	

/a Includes Rs 148 million (US$19 million) of indirect foreign exchange.

6.02 About 82% of the project cost will be used to increase production by expanding capacity, improving process efficiency and supplying power. Another 11% of the cost will be for raising the refinery capacity of HPCL and the remaining 7% will be utilized for reducing pollution and for providing technical assistance.

6.03 The sub-projects will take advantage of existing infrastructure and complementary equipment, thereby requiring substantially lower capital costs relative to greenfield installations. The total capital cost (excluding the cost of industrial chemicals and the refinery expansion) per annual ton of additional nutrient output is about US$650 compared to US$1,050 in a new fuel oil based ammonia/urea fertilizer plant in India.

B. Financing Plan and Onlending Arrangements

6.04 An IDA Credit of US$105 million is proposed to cover the foreign exchange cost (excluding working capital) and a portion of local costs. The credit will be allocated by company as follows:

Credit Allocation

		Initial Allocation for Credit Documents		Expected Final Allocation	
		US$ Million	%	US$ Million	%
1.	FCI	36.0	34	38.5	37
2.	Neyveli Lignite Corp.	11.0	10	12.0	11
3.	Hindustan Steel Corp. (Rourkela)	14.5	14	15.5	15
4.	IDBI (As Lending Channel)				
	a. GSFC	8.0	8	9.0	9
	b. SPIC	13.0	12	14.0	13
	c. HPCL	3.0	3	4.0	4
	d. Zuari	4.0	4	6.0	5
5.	Coromandel	3.0	3	4.0	4
6.	Madras	1.0	1	1.0	1
7.	Technical Assistance	1.0	1	1.0	1
8.	Unallocated	10.5	10	-	-
	Total IDA Credit	105.0	100	105.0	100

6.05 The IDA funds allocated for FCI will be onlent by GOI to FCI at 10.25% annual interest and for 15 years including four years of grace. The credit proceeds for the Neyveli and Rourkela sub-projects will be invested by GOI as equity in these two firms. The funds allocated to IDBI (Annex 6-4) will be lent to IDBI by the Government at 8.5% annual interest and for 15 years including four years grace. IDBI will onlend at its standard interest rate but not less than 10.25% for a maximum of 15 years including up to four years of grace. The size of the sub-projects to be carried out through IDBI is in line with IDBI's de facto exposure limit; to date, IDBI's largest loan has been Rs 220 million (US$27.5 million), or 27% of its own net worth. The remaining portion of the credit will be purchased by Coromandel and Madras against cash payment of rupees or used by the Government as technical assistance funds.

6.06 The expected financing plan for the total funds requirement of the project is shown below, with US$104.5 million of the IDA Credit to be utilized as project funds and US$0.5 million as grant funds:

Financing Plan

	-------Rs Million-------			-------------US$ Million-------------				
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total		%
1. Equity:								
a. GOI	129	535	664	16.5	68.6	85.1	(27.5)/a	36
b. Enterprises (private/ joint)	57	315	372	7.3	40.4	47.7	(5.0)	20
2. Long-Term Loans:								
a. Local Financial Institutions	223	141	364	28.6	18.1	46.7	(33.0)	20
b. GOI	312	146	458	40.0	18.7	58.7	(39.0)	24
3. Grant - GOI (IDA)	-	4	4	-	0.5	0.5	(0.5)	-
Total	721	1,141	1,862	92.4	146.3	238.7	(105.0)	100

/a Numbers within parentheses represent IDA funds.

6.07 The private and joint sector firms' equity contributions are based on Coromandel and Madras funding the entire cost of their sub-projects with their own funds; GSFC financing 55% of the cost of its sub-projects with internal resources; and SPIC and Zuari providing 40% of the cost of their respective sub-projects with equity investments. All equity for the public sector firms will be provided by GOI since the enterprises are not expected to have sufficient internally generated funds. As Neyveli and Hindustan Steel (Rourkela) are weak financially, GOI will provide all funds to them as equity. GOI will finance about 50% of the costs of FCI sub-projects as equity and provide loan funds to HPCL to cover the local currency costs of its sub-project.

6.08 Coromandel, Madras, Zuari Agro and GSFC are in good financial position to provide the necessary internal resources to carry out their sub-projects. SPIC started commercial production early in July 1975 and is not yet in a comparable financial position to the other four firms, but should be able to generate the required equity from its own resources and from the Tamil Nadu State Government, which owns 26% of SPIC. The Government has agreed to provide, in addition to the funds indicated in the above financing plan, any additional funds that might be needed to complete the project.

6.09 The foreign exchange risks for the IDA funds will be borne by GOI.

C. Procurement and Disbursement

6.10 All equipment and materials to be financed by the IDA credit will be procured from prequalified suppliers in accordance with Bank Group guidelines. International competitive bidding (ICB) will be used except for US$20 million to be procured by international shopping. The latter category includes critical or proprietary items, duplicate items, or items costing US$100,000 or less. Local suppliers, for purposes of bid evaluation, will receive a preference of 15% or the amount of the customs duty, whichever is lower. The procurement and disbursement of the portion being channelled through IDBI will also follow Bank Group ICB procedures.

6.11 For expenditures eligible for IDA financing, disbursements would cover 100% of the CIF cost of services, equipment, materials and spares (but excluding duties); 100% of the ex-factory cost of equipment supplied by local firms winning in international competition (excluding local taxes); and 100% of the cost of technical assistance. Some sub-projects are already underway for which retroactive financing, up to a maximum of US$6 million, is proposed to assist in rapid completion of these projects. Disbursement (Annex 6-5) is expected to be completed in about three years.

VII. FINANCIAL ANALYSIS

A. Operating Costs and Benefits

7.01 All sub-projects are expected to be completed by 1979. Projected 1979 prices and operating costs, expressed in constant calendar 1975 rupees (dollars), are used for the financial and economic analyses of each of the sub-projects. Annex 7-1 contains the principal assumptions. For petroleum feedstock, the projected domestic price has been calculated on the basis of a Government formula of making fuel oil-based and naphtha-based ammonia plants equally viable in financial terms. On this basis, naphtha at Rs 835 (US$107) per ton would cost 1.5 times more than fuel oil. Based on these feedstock prices and estimated urea prices (below), a new ammonia/urea factory will earn about 15% return on investment.

7.02 The ex-factory urea price is projected to increase slightly in real terms over the next four years varying from Rs 1,100/ ton in 1975 to Rs 1,150 per ton (in constant calendar 1975 rupees) by 1979. The increase in ex-factory prices, however, is not projected to lead to higher retail prices. As domestic production increases and imports of urea decrease, the import equalization levy is assumed to be phased out, and the equivalent amount passed on to the manufacturer and the distributors, leaving the retail prices in 1979 at about the same level as in 1976 in current terms (Rs 1,850/ton of urea). The assumed change in urea ex-factory price is modest and even though the international price of urea is projected to decline from last year's level, the ex-factory price in 1979 would still be about 20% lower than the expected c.i.f. price. Phosphatic fertilizer ex-factory prices are projected to decline in real terms, from Rs 4,800/ton of P_2O_5 in 1976 to about Rs 3,800/ton by 1979, as a result of the projected decreases in international prices for phosphate rock. Ex-factory phosphatic fertilizer prices in India are assumed to decline at a slower rate than international prices. As a result, the 1979 local price will be higher, by about 25%, than the c.i.f. price of phosphatic products. Ex-factory prices of complex (NPK) fertilizers in India, as a consequence of the downward movement of phosphatic fertilizer prices and upward movement of nitrogenous and potassic fertilizer prices, are projected to stay at about 1976 levels, in real terms.

7.03 Only incremental costs and benefits are considered in both the financial and the economic analyses of the project. The beneficial environmental impact of the four anti-pollution projects are not taken into consideration. The Zuari anti-pollution project is mandatory and is justified as the least cost solution. For the three fluorine recovery sub-projects, the value of the recovered industrial chemicals is used to calculate the respective rates of return and justify each of the investments. The benefits from the ammonia tankwagons and storage facilities for FCI are based on the assumption that on average, some 150 TPD of imported ammonia as well as surplus production from certain factories would be moved for use in ammonia-deficit plants. Similarly, the incremental benefits from the internal power generation sub-projects and the Trombay boiler unit are determined on the basis of the output that would be lost if these sub-projects were not implemented. In all, 17 out of 20 sub-projects have quantifiable benefits, in terms of additional output or reduction in raw material usage or both.

7.04 The project will add 253,000 TPY of nutrients (Annex 7-2) (N and P_2O_5), save 31,210 TPY of raw materials and provide 73,600 TPY of industrial chemicals. The net incremental financial benefit is Rs 550 million (US$71 million) annually before income taxes (Annex 7-3). This amount represents 30% of the total project cost leading to an average payback period of about 3-1/2 years. The public sector firms, which are in poor financial position at present, will see a significant improvement in their earning power since about Rs 230 million (US$29 million) equivalent will be added to their annual cash flow as a result of the project.

B. Financial Rate of Return

7.05 The financial rate of return for the 17 sub-projects (for which such returns can be quantified) range from 14% to over 60% as shown in Annex 7-4. Taking the costs and benefits streams of these projects together yields a composite financial return for the whole project of 26%. This return is high, primarily because of the incremental nature of the sub-projects that takes advantage of existing organization, infrastructure and complementary equipment.

C. Major Risks

7.06 Overall, the proposed project does not face major risks. With the exception of Neyveli and Rourkela, most of the sub-project sponsors have recent experience in successfully implementing projects and operating factories. Several firms will also be assisted by foreign technical consultants in determining the exact scope and implementing the modernization schemes. The technology involved in the sub-projects is all commercially proven. The financial position of the private and the joint sector firms are also good, ensuring the availability of the necessary equity funds for the project. However, the fertilizer industry itself faces some potential major commercial problems such as feedstock supply, input and output price levels and marketing which have already been discussed (paras 2.17 to 2.19, and 3.18). Furthermore, FCI has several ongoing projects that are behind schedule and over budget. There is a likelihood of still further delays and cost overruns in the ongoing projects; this poses a major risk to FCI and a burden on the Government and the economy. In such an event, the financial gains expected from the proposed project could be offset.

7.07 To ensure that financing constraints do not become a source of risk to the project and the industry as a whole, agreements were obtained from GOI and the beneficiary firms on the following: (i) GOI, IDBI and the beneficiary enterprises will provide for each of the sub-projects the equity and loan funds in addition to the IDA credit as presented in the proposed financing plans in paras 6.06 to 6.08; (ii) GOI will make available the necessary financing for these sub-projects (para 6.08); (iii) GOI will provide to FCI and other fertilizer firms the necessary funds to complete without delay their other ongoing projects and any other new project that may be started (para 4.05); (iv) GOI will maintain FCI in a sound financial position, and (v) GOI will cause Neyveli and Hindustan Steel to (a) keep separate financial accounts for their respective fertilizer units and (b) maintain a current ratio of at least 1.1 to 1 at all times for their respective fertilizer units.

VIII. ECONOMIC ANALYSIS

A. Economic Rate of Return

8.01 Assumptions for the economic return calculations are given in Annex 7-1. The individual economic rates of return range from 18% to over 60% (Annex 7-4). The composite economic rate of return for the project as a whole is 32%. The economic value of the additional fertilizer output alone is about US$117 million annually. The net economic benefits from the project are estimated at US$84 million annually (Annex 8). About 20% of the project cost is for in-plant power generation. While there are economies of scale in public power generation, power shortages and voltage fluctuations are expected to continue for some time. These shortages and fluctuations are harmful to fertilizer equipment and reduce capacity utilization (Annex 5-8). Although in-plant power units are not the optimal long-term solution, the fact that the steam requirements for power generation are integrated with the overall steam production of a fertilizer plant reduces the actual cost of in-plant power generation. Since capacity utilization is also increased, this makes in-plant power generation economically viable.

B. World Fertilizer Supply and Prices

8.02 The speed with which the world energy and the fertilizer supply situations deteriorated into crisis proportions during 1974 and 1975 prompted many governments to focus their attention on reduced import reliance for essential commodities. The fertilizer scarcity and resulting high prices have attracted worldwide attention and in both developing and developed countries, there has been a sharp increase in the number of fertilizer factories being constructed. Fertilizer supply should be in better balance with demand by the end of this decade with a consequent substantial decline forecast for most nitrogen and phosphate fertilizer prices. The price of urea has declined from about US$350-400/ton (f.o.b.) last year to a current price of about US$110-140/ton, due to a temporary oversupply. Long range prices are projected at US$160/ton in 1979 (in constant 1975 dollars).

8.03 Notwithstanding the anticipated easing of the supply and a consequential decrease in international fertilizer prices, there are several factors that justify capital investments for increasing domestic fertilizer production in India, either by modernizing or expanding existing plants or by building new factories. Firstly, even with the expected lowering of international fertilizer prices, the economic return on capacity additions in India is still expected to be satisfactory. Secondly any shortage in the international market even temporary, has a major adverse effect on the balance of payments of countries who rely on imports to fill a large portion of their requirements. During 1972 to 1975, India depended on imports for 45 to 50% of fertilizer nutrient consumption. When prices almost tripled between 1974 and 1976, the fertilizer import bill jumped from US$355 million in 1974 to an estimated US$1,090 million in 1976 (Annex 4-5). Such large and unexpected drains on the scarce foreign exchange resources of a country creates strains on the economy and disrupts economic development programs. Considering the cyclical nature of the fertilizer industry, such disruption may happen again unless steps are taken now to reduce major dependence on imports.

IX. AGREEMENTS

9.01 Assurances and agreements were obtained from the Government, FCI and IDBI as follows:

From the Government that:

(i) A study will be undertaken, in consultation with IDA, of the effective demand for fertilizer, including a 10-year forecast to be completed by March 31, 1977; and a mechanism will be set up to update this forecast annually (para. 2.06);

(ii) A committee on fertilizers will be established to coordinate all aspects of the sector including production, imports, distribution and consumption (para. 2.16);

(iii) A study will be undertaken of the raw material/products transportation situation, to be completed by June 30, 1976, and its findings, in consultation with IDA, will be implemented on a priority basis (para. 3.19);

(iv) Adequate financing will be provided on a schedule to be agreed for all ongoing and new projects (para 4.05);

(v) Subsidiary agreements satisfactory to IDA will be obtained from all beneficiaries that their respective sub-projects will be implemented and completed in an efficient and timely manner, equipment will be procured in accordance with IDA Guidelines, and that IDA will be permitted to supervise the implementation of each of the sub-projects (paras 5.24 to 5.27 and 6.08);

(vi) The proceeds of the IDA Credit will be passed on to the several beneficiaries on terms and conditions satisfactory to IDA including (a) to FCI at 10.25% interest per annum for 15 years including 4 years of grace; (b) to IDBI at 8.5% interest per annum for 15 years including 4 years of grace (para. 6.05);

(vii) Any overrun funds will be provided, if and when needed and in a form satisfactory to the Association, to assure the timely completion of each of the sub-projects (para 6.08);

(viii) FCI will be maintained in a sound financial position (para 7.07); and

(ix) Neyveli and Hindustan Steel will (a) keep separate financial accounts for their respective fertilizer units and (b) maintain a current ratio of at least 1.1:1 at all times for their respective fertilizer units (para 7.07).

<u>From FCI that</u>:

(i) It will obtain sub-contracts, subject to IDA approval, for the projects to be executed for Neyveli and Rourkela (paras. 5.10, 5.11 and 5.24);

(ii) Its sub-projects will be adequately financed and implemented and completed in an efficient manner and that procurement will proceed in accordance with IDA guidelines (paras. 5.24, 6.10 and 7.07);

From IDBI that:

(i) Its sub-projects will be adequately financed and implemented and completed in an efficient and timely manner and that procurement will proceed in accordance with IDA guidelines (paras 5.24 and 7.07);

(ii) Funds will be on-lent for at least 10.25% per annum for periods up to 15 years including at most 4 years grace (6.05).

9.02 Based on the above agreements, the project represents a suitable basis for an IDA Credit of US$105 million.

Industrial Projects Department
November, 1975

INDIA FERTILIZER INDUSTRY CREDIT

WORLD BANK GROUP FERTILIZER PROJECTS IN INDIA

	Company	Project	Bank Group Financing	Report No.	Date	Commissioning Date	Cost, $ Million: Total Cost 1/	Cost, $ Million: Bank Group Financing	Project Capacity 000 TPY Nutrient: N	Project Capacity 000 TPY Nutrient: P_2O_5
1.	Indian Explosives Ltd. (IEL)	Kanpur	IFC		April 13, 1967	1970	82	11.5	207	-
2.	Zuari Agro Chemicals	Goa	IFC	IFC/P-56	March 17, 1969	1973	75	18.9	170	30
3.	FACT	Cochin II	IDA	PI-8	May 14, 1971	1976	70	20.0	47	115
4.	FCI	Gorakhpur	IDA	PI-12a	November 22, 1971	1976	23	10.0	51	-
5.	FCI	Nangal	IDA	46-IN	January 2, 1973	1976	115	58.0	152	-
6.	FCI	Trombay IV	IDA	448-IN	May 20, 1974	1977	81	50.0 2/	75	75
7.	FCI	Sindri	IDA	569-IN	November 11, 1974	1978	188	91.0	145	-
8.	IFFCO	Phulpur	IBRD	591-IN	December 9, 1974	1978	221	109.0	228	-
							855	368.4	1,075	220

1/ Total cost from appraisal reports.
2/ Includes $17 million for plant operations improvement program.

Industrial Projects Department
July 1975

INDIA: FERTILIZER INDUSTRY CREDIT

AGRICULTURAL DEVELOPMENT

1. The role of fertilizers as an important input needed to boost agricultural production has been established. Combined with water from irrigation and rainfall, high-yielding seed varieties, and modern farm practices, fertilizers help achieve increased yield per unit of land area.

2. About 65% of fertilizers in India is consumed by foodgrains. The current high proportion of fertilizer use on foodgrains reflects the high priority given by the Government to increased foodgrain production and the allocation policy to achieve that objective. However, fertilizer use on cash crops may increase depending on the increased fertilizer availability and the relative prices of foodgrains and cash crops.

3. Nitrogen (N), phosphorus (P_2O_5 or P) and potash (K_2O or K) are the three principal nutrients used for balanced fertilization. During the Fourth Five-Year Plan (1968/69 - 1973/74), fertilizer consumption in India increased at an annual rate of about 10% for N as well as P and 15% for K compared to the Plan targets of 23%, 29% and 42% respectively for N, P and K. The consumption in 1973/74, the final year of the Fourth Plan, was 1,835,000 tons of N; 634,000 tons of P; and 314,000 tons of K. The consumption in 1974/75, first year of the Fifth Plan, was static for N, and declined considerably for P. But, in the case of K, the consumption increased following a drop the previous year. The reasons for the poor achievement in fertilizer consumption, especially during the last three years (1972/73 - 1974/75) is traceable to limited availability, rising prices, and the heavy dependence of Indian agricultural fortunes on the weather.

4. The Fourth Plan started off reasonably well thanks to good monsoons and record harvests in 1969/70 and 1970/71. In those years, economic growth was not far off the average annual 5.7% growth targets of the Fourth Plan. But weather is a precarious basis for sustained development and in years of disappointing weather, there have been no alternative source of comparable economic drive to keep up the momentum of development. Within the vast expanse and wide fluctuations of Indian agriculture, the stabilizing forces of technological advancement and irrigation are still relatively small. The turn of the weather for the worse in 1971/72, the widespread drought conditions of 1972/73 and poor rains and unusual cold during the winter of 1973/74 deflated much of the economic drive toward Fourth Plan objectives. As a result,

achievement on the food front was only 103.6 million tons compared to the Fourth Plan target of 114 million tons. The following table shows the trend of foodgrain achievements during the last decade when increased attention was given to the production of high-yielding varieties (HYV) which are responsive to high doses of fertilizers combined with irrigation and other inputs:

Foodgrain Production
(Million tons)

Fiscal Year	Wheat	Rice	Other	Total Foodgrains
1964/65	12.3	39.3	37.8	89.4
1965/66	10.4	30.6	31.4	72.4
1966/67	11.4	30.4	32.4	74.2
1967/68	16.5	37.6	41.0	95.1
1968/69	18.7	39.8	35.5	94.0
1969/70	20.1	40.4	39.0	99.5
1970/71	23.8	42.2	42.4	108.4
1971/72	26.4	43.1	35.7	105.2
1972/73	24.7	39.2	33.1	97.0
1973/74	22.1	43.7	37.8	103.6
1974/75 (est.)	27.0	41.0	36.0	104.0

5. The above table shows that since the beginning of the HYV program in 1966/67, foodgrain production has increased significantly, reaching the peak of 108.4 million tons in 1970/71. But the trend of production has been erratic mainly because of vagaries of nature. However, the production of wheat and rice both maintained a continuous increase during 1966/67 - 1971/72. This is partly because of the impact of inputs like fertilizers and irrigation which are concentrated on these two crops. However, their production either declined or increased marginally during the next two years when acute fertilizer shortages were experienced in the country.

6. During the last decade, the yield per ha of wheat and rice increased as follows:

Yield per Hectare
(kg/ha)

	Wheat	Rice
1964/65	913	1,078
1965/66	827	862
1966/67	887	863
1967/68	1,103	1,032
1968/69	1,169	1,076
1969/70	1,209	1,073
1970/71	1,307	1,123
1971/72	1,380	1,141
1972/73	1,271	1,070
1973/74	1,158	1,151
1978/79 (target)	1,727	1,350

7. Though yields have increased especially since 1966/67, they are still low by international standards as shown below:

Comparison of Per Hectare Yields (1971/72)
(kg/ha)

	Wheat	Paddy (unhusked rice)
India	1,380	1,605
US	2,196	5,250
USSR	1,467	3,891
UK	4,224	*
Egypt	3,102	5,334
Japan	*	5,847

* Not a significant producer.

8. The above table shows that the per hectare yield for wheat in India is only 33% of that in the U. K., and of rice is only 27% of that in Japan.

9. Foodgrain Production Prospects: The Fifth Plan target for foodgrain production is 140 million by 1978/79. This was based on the anticipated achievement of 114 million tons at the end of the Fourth Plan in 1973/74. But the actual production in 1973/74 (a drought year) was only 103.6 million tons and the 1978/79 forecast has been decreased to 123 million tons.

10. Food Imports: Gross food imports during 1950-60 averaged nearly 3 million tons a year. In the following decade, they averaged nearly 5.8 million tons a year. The following table shows food imports during the Fourth Plan period:

	Gross Food Imports (Million Tons)
1969/70	3.55
1970/71	2.01
1971/72	0.46
1972/73	3.61
1973/74	4.78

11. In 1971/72, India was close to self-sufficiency in food. However, during the next two years, mainly because of droughts, imports increased considerably. However, the import need even in those two bad years was hardly 5% of the total production. As a matter of fact, in only one year since 1950 has India's imports exceeded 5% of its annual production.

12. Increase in Cropped Area: The scope for increasing the net area sown is limited. During 1966/67 - 1970/71, it increased by about 1 million ha a year, reaching a total of 141.2 million ha by 1970/71 . However, the total cropped area has been expanding at a faster pace mainly because of the expansion of the area sown more than once. During 1966/67-1970/71, the multiple cropped area increased from 19.5 million ha to 26.3 million ha and the total cropped area expanded from 156.6 million ha to 167.4 million ha.

13. In 1973/74, the total cropped area was 169.1 million ha of which nearly 126.3 million ha (75%) were under foodgrains. Rice and wheat, two major foodgrains grown, accounted for 23% and 11.5% respectively of the total cropped area. During the Fifth Plan period, the area under rice is projected by the Bank to increase from 38 million ha to 40 million ha and the area under wheat, from 19.1 million ha to 22 million ha. The area under all foodgrains is expected to expand during the same period by about 7 million ha to 133 million, accounting for about 75% of the total cropped area projected for 1978/79.

14. Irrigated Area: In 1971/72, the latest year for which detailed irrigation data is available, the gross irrigated area was 38.8 million ha of which 30.7 million ha (nearly 80% of the total) was under foodgrains. Among foodgrains, rice accounted for 14.7 million ha (38%) and wheat for 10.3 million ha (26%); together, those crops accounted for nearly two-

thirds of the gross irrigated area. The gross irrigated area is projected to increase from 41.6 million ha to 54.3 million ha during the Fifth Plan. Of this 12.7 million ha increase in irrigated area, 8.9 million ha is expected to come under foodgrains.

15. According to the 1971/72 data, among Indian States Uttar Pradesh has the largest area under irrigation (22% of the total) followed by Punjab, Andhra Pradesh and Tamil Nadu. These four states account for slightly more than half of the total irrigated areas as shown below:

Statewise Irrigated Area (1971/72)

	Area Irrigated (m. ha)	% of Total
Uttar Pradesh	8.36	21.5
Punjab	4.38	11.3
Andhra Pradesh	3.79	9.8
Tamil Nadu	3.53	9.1
Bihar	2.79	7.2
Rajasthan	2.44	6.3
Haryana	2.28	5.9
Madhya Pradesh	1.71	4.4
Origsa	1.62	4.2
Karnataka	1.60	4.1
Maharashtra	1.57	4.0
West Bengal	1.54	3.9
Gujarat	1.31	3.4
Others	1.92	4.9
	38.84	100.0

SOURCE: Estimates of Area and Production of Principal Crops in India 1973/74, Directorate of Economics & Statistics, Ministry of Agriculture and Irrigation, 1975.

16. High-Yielding Varieties Program: The corner stone of the new agricultural strategy started in 1966/67 is the spread of the new high-yielding varieties of rice, wheat, maize (corn), jowar (sorghum) and bajra (millet). At the beginning of the Fourth Plan in 1968/69, HYV program had spread to 9.2 million ha. During the Fourth Plan, the HYV program target was to cover an additional 15.8 million ha and this target is reported to have been reached. The total area covered by the program by the end of the Plan was 25 million ha, accounting for roughly one-fifth of the area under foodgrains. The HYV area is expected to increase further to about 36 million ha by 1978/79.

17. The mere achievement of the area target for HYV cereals is, however, no matter for satisfaction unless it is accompanied by equivalent production increases. This has not happened. Almost all surveys of HYV cereals show that fertilizer applications were below the recommended level; and other changes in agronomic practices that should have been made were often ignored. This is particularly important in the case of the new rice varieties. Unlike the new wheat varieties that can yield near their full potential without major changes in farming practices, the new rice varieties are highly responsive to good management particularly to careful water control, and they do require changes in farming practices.

18. During the period 1967/68 to 1971/72, large annual increase in wheat production were almost the sole source of additional foodgrain production. The major cause of the production lag in the last two years of the Fourth Plan was the abrupt ending of the growth in "rabi" (winter), especially wheat, production. Some of this may be the result of weather; however, the greater part of it is due to the spread of new races of rust to which the then existing wheat varieties are not resistant, and to shortages of fertilizers and power. Since then, rust resistant wheat varieties have been developed and their use is promoted widely.

19. Up to 1971/72, foodgrain production growth in the Fourth Plan can to a large degree be attributed to fertilizer use on irrigated HYV area; as far as one can estimate about 65% of all fertilizers were being used on HYV foodgrains by 1971/72. So when fertilizer supplies stopped increasing, as they did after 1971/72, production growth rapidly fell off despite a continued increase in the area under HYVs. As a result, despite a reported further increase of nearly 7 million ha in the HYV area during 1972/73 and 1973/74, foodgrain production, especially "rabi" production which had grown at the annual rate of 7% during the 10 years up to 1971/72, actually declined. This was partly also due to severe power shortages in both 1972/73 and 1973/74 which undoubtedly had a major effect on pump irrigation and crop yields.

20. The following table compares the targets and estimated achievements during the Fourth Plan with respect to HYV area and production:

	HYV Area (Million ha)		HYV Production (Million tons)	
	Target	Achievement	Target	Achievement
Rice	7.5	6.9	1.48	0.85
Wheat	2.9	6.0	1.65	1.25
Maize	0.8	0.2	1.24	0.85
Jowar	2.5	0.4	1.24	0.65
Bajra	2.1	2.3	0.62	0.55
	15.8	15.8	6.23	4.15

INDIA: FERTILIZER INDUSTRY CREDIT

FERTILIZER CONSUMPTION

1. From a low base, fertilizer consumption grew at a rapid pace with the average annual increase for the decade 1954/55 - 1964/65 being 16.4% for N, 26% for P and 20% for K (Table 1). In the following decade (1964/65 - 1974/75), the average annual rate of increase was slower with consumption of N growing at 15.5%, P at 13.8% and K at 17.6%. However, the average increase for the 1964/65 - 1974/75 is misleading because there was only marginal increase in fertilizer consumption during the last three years. If those three years are excluded, the average annual rate of increase in fertilizer consumption during the decade ending 1971/72 (when there was no excessive shortage or surplus of fertilizer), was 19.7% for N, 24% for P and 27% for K. In other words, the rate of increase in consumption with respect to all the three nutrients had not slackened up to 1971/72. This is not surprising considering the fact that fertilizer consumption per ha is still one of the world's lowest -- about 16 kg of nutrients for India compared to 85 kg for the U.S., 49 kg in the U.S.S.R. and 61 kg in Romania (Table 2); countries that use extensive (rather than intensive) agricultural practices similar to India.

2. In terms of volume, fertilizer consumption in 1952/53 was only 58,000 tons of N, 4,600 tons of P and 3,300 tons of K (Table 1). By 1971/72, over a period of nearly two decades, the consumption had increased to 1.76 million tons of N, 564,000 tons of P and 304,000 tons of K. In the following three years, N consumption of K actually declined by about 5%. The following table summarizes fertilizer consumption trends since 1952/53:

Fertilizer Consumption
('000 nutrient tons)

	N	P	K	TOTAL
1952/53	57.8	4.6	3.3	65.7
1962/63	360.0	81.4	36.4	477.8
1966/67	838.7	248.6	115.7	1,203.0
1970/71	1,487.1	462.0	228.2	2,177.3
1971/72	1,755.4	564.0	304.0	2,623.4
1972/73	1,778.9	587.4	332.5	2,698.8
1973/74	1,835.0	634.0	314.0	2,783.0
1974/75	1,837.0	537.0	356.0	2,730.0

3. Fertilizer consumption received a fillip in 1966/67 with the introduction of the "green revolution" based on high-yielding seed varieties. During the next five years up to 1971/72, consumption of each of the three nutrients more than doubled. Data prior to 1966/67 also shows that nutrient consumption was doubling more or less every five years, but from a lower base (Table 1). But the trend in consumption during the past three years has been virtually stagnant. In 1972/73 as well as in 1973/74, there were widespread shortages of fertilizers in India because of low production, foreign exchange difficulties and also due to the tight fertilizer supply situation in the world making it difficult to import even the quantity planned

for. This led to widespread shortages, affecting timely availability of fertilizers. The consumption was also hampered with the doubling of fertlizer prices with effect from June 1, 1974 as a result of world fertilizer shortages and also steep increases in fertilizer raw material costs, mainly due to the steep increases in oil and rock phosphate prices. The doubling of fertilizer prices in India was not followed by a corresponding increase in foodgrain prices, though the increases allowed prior to June 1, 1974, are reportedly remunerative even under the changed circumstances. However, farmers were taken aback by the sudden upsurge in fertilizer prices and cut back their plans for increased fertilizer consumption. This cutback was also necessitated by the reluctance of the Government to increase the credit limit to farmers to cope with the sharp increases in fertilizer prices. Instead, the Government introduced a credit squeeze in a bid to control acute inflation in the country. This further dampened the growth of consumption. Moreover, the weather situation was unfavourable throughout the three-year period up to 1974/75. In 1974/75, Gujarat, Tamil Nadu and Haryana -- three major consumers of fertilizers -- were severely affected by drought. Partly as a result of this, consumption of fertilizer nutrients dropped in those states as follows:

	Total Fertilizer Consumption ('000 nutrient tons)		
	1973/74	1974/75	Decline
Gujarat	212	137	75
Tamil Nadu	341	269	72
Haryana	115	80	35

4. Another state in which fertilizer consumption fell sharply in 1974/75 was Punjab, which had been spearheading the wheat revolution. However, the state was not affected by drought. The reason for the decline in consumption was mainly due to high prices, inadequate credit, and switch over from wheat to barley in certain parts of the state as barley production without high dose of fertilizers had become more profitable. As a result of the above factors, nutrient consumption dropped in Punjab from 333,000 tons in 1973/74 to 305,000 tons in 1974/75.

Pattern of Fertilizer Consumption

5. The pattern of consumption has undergone marked changes over the 1952-1975 period, with N fertilizers being supplemented with P and K fertilizers. However, the achievement of balanced fertilization is a long way off but the progress towards that goal is considerable. The N, P, K ratio was about 17.5:1.4:1 in 1952/53, indicating that the concentration was mainly on nitrogen use. However, with the increase in the use of P and K, the ratio has gradually improved to 5.2:1.5:1 in 1974/75 (Table 1). Experiments and field trials have indicated that the ideal N, P, K ratio under Indian soil condition is probably 4:2:1. This awareness is growing in promoting fertilizer use in the country.

State-wise Consumption

6. The per ha consumption of fertilizer nutrients reached 16 kg in 1971/72, the latest year for which full details are available (Table 2). However, there has been significant variation in consumption per ha among various states (Table 3). For example, the per ha consumption in Punjab, the leading state in the "green revolution", was nearly 53 kg -- more than three times the national average. Tamil Nadu and Haryana and Andhra Pradesh are three other states where the per ha consumption is significantly higher than the all-India average. But in about six states -- Assam, Rajasthan, Orissa, Madhya Pradesh, Himachal Pradesh and Jammu and Kashmir, the per ha consumption is less than half of the national average. Additional promotional efforts are necessary in these areas to step up fertilizer consumption.

7. With respect to the N, P, K consumption ratio also, there are marked variations among states compared to the all-India ratio of nearly 6:2:1 in 1971/72 (Table 4). The ratio varies from 3:1.5:1 in Maharashtra to 29.5:2.7:1 in Haryana. Even among the states where per ha consumption is comparatively high, the N, P, K ratio shows wide divergence from the ideal national ratio of 4:2:1 as shown below:-

	N, P, K Ratio (1971/72)
Punjab	18.6:4.4:1
Tamil Nadu	3.5:1.2:1
Haryana	19.6:3.9:1
Andhra Pradesh	7.2:2.7:1

8. The above table shows that even among the leading states with respect to per ha fertilizer consumption, there may be lack of balanced use. This perhaps is one of the reasons why further increase in fertilizer use in those states has been slackening in recent years. Farmers in those areas should be made to realize through soil testing and extension work that their N, P, K ratio needs to be improved to get significant farm yield increases from additional per ha use of nutrients.

Consumption by Type of Fertilizers

9. Over the years, there has been considerable change in the share of different fertilizer materials in total consumption. Ammonium sulphate, and calcium ammonium nitrate (CAN) were the most important fertilizers used in the past. However, in recent years high-analysis fertilizers such as urea and complex fertilizers have gained in importance as shown below:-

Apparent Consumption by Types of Fertilizers
('000 Product Tons)

	1962/63			1974/75		
	Production	Imports	Consumption	Production	Imports	Consumption
Ammonium Sulfate	422	597	1,019	589	235	824
Ammonium Chloride	11	-	11	27	30	57
Calcium Ammonium Nitrate (CAN)	326	13	339	406	360	766
Ammonium Sulfate Nitrate	62	-	62	27	14	41
Urea	19	219	238	1,721	1,244	2,965
Ammonium Phosphate Sulfate	9	-	9	139	-	139
Nitrophosphate	-	48	48	210	183	393
Diammonium Phosphate	-	-	-	58	436	494
Urea Ammonium Phosphate	-	-	-	165	-	165
NPK Complex Fertilizers	-	-	-	664	286	950
Superphosphates	487	-	487	837	-	837
Triple Superphosphate	-	-	-	3	5	8
Total Products	1.336	887	2,213	4,846	2,793	7,639

Crop-wise Consumption

10. In 1970/71, the latest year for which details of crop-wise fertilizer consumption are available, foodgrains accounted for nearly 66% of all fertilizer nutrient consumption and non-food crops for the remaining 34% (Table 5). Among the food crops, rice and wheat accounted for slightly more than 50% of all nutrients. Among the non-food crops, sugarcane and cotton accounted for slightly more than one-fourth of the total nutrient consumption. The following table shows the respective percentage shares of nutrient consumption by selected crops:-

Fertilizer Consumption by Selected Crops (1970/71)
(percentages)

	N	P	K	Total Nutrients
Foodgrains	68.0	62.6	40.8	65.7
of which:				
Rice	31.7	34.5	18.3	31.4
Wheat	21.7	8.9	10.1	19.2
Non-Food Crops	32.0	37.4	59.2	34.3
of which:				
Sugarcane	18.0	14.4	31.3	18.2
Cotton	7.8	7.4	9.2	7.9
All Crops	100.0	100.0	100.0	100.0
All Crops ('000 tons)	1,487	462	228	2,177

With respect to individual nutrients, N and P are predominantly used on food crops while K is mostly used on non-food crops.

Season-wise Consumption

11. The following table shows the trend of fertilizer consumption in "kharif" (monsoon) and "rabi" (winter) crop seasons for the last four years:-

		Kharif	Rabi	Total
1971/72				
	N	733	1,022	1,755
	P	238	326	564
	K	121	183	304
1972/73				
	N	682	1,097	1,779
	P	231	356	587
	K	146	187	333
1973/74				
	N	786	1,049	1,835
	P	275	359	634
	K	141	173	314
1974/75				
	N	755	1,082	1,837
	P	235	302	537
	K	168	188	356
1975/76 (est.) 1/				
	N	900	1,275	2,175
	P	280	379	659
	K	185	215	400

1/ Estimate by the Fertilizer Association of India.

12. The major part of fertilizers -- about 60% of N as well as P, and 55% of K -- are consumed during the "rabi" season. Food production during "rabi" is also higher than during "kharif". In the "rabi" season, the growing season is longer, there is less incidence of diseases because of low humidity, and irrigation water is assured. Assured irrigation is critical at the sowing, tillering, primordial (earing) and dough (grain-filling) stages.

ANNEX 2-2
Table 1

INDIA: FERTILIZER INDUSTRY CREDIT
N, P, K Consumption and Ratios

Year 1/	N	P	K	Total N+P+K	N:P:K: Ratio
	------------'000 tons			------------	
1952/53	57.8	4.6	3.3	65.7	17.52 : 1.39 : 1
1953/54	89.3	8.3	7.5	105.1	11.91 : 1.11 : 1
1954/55	94.8	15.0	11.1	120.9	8.54 : 1.35 : 1
1955/56	107.5	13.0	10.3	130.8	10.44 : 1.26 : 1
1956/57	123.1	15.9	14.8	153.8	8.31 : 1.07 : 1
1957/58	149.0	21.9	12.8	183.7	11.64 : 1.71 : 1
1958/59	172.0	29.5	22.4	223.9	7.68 : 1.32 : 1
1959/60	229.3	53.9	21.3	304.5	10.77 : 2.53 : 1
1960/61	211.7	53.1	29.0	293.8	7.30 : 1.83 : 1
1961/62	291.5	63.9	28.0	383.4	10.41 : 2.28 : 1
1962/63	360.0	81.4	36.4	477.8	9.89 : 2.24 : 1
1963/64	407.0	116.7	50.6	574.3	8.04 : 2.31 : 1
1964/65	434.5	147.7	70.4	652.6	6.17 : 2.10 : 1
1965/66	547.4	132.2	77.7	757.3	7.05 : 1.70 : 1
1966/67	838.7	248.6	115.7	1,203.0	7.25 : 2.15 : 1
1967/68	799.5	236.5	129.8	1,165.8	6.16 : 1.82 : 1
1968/69	1,131.3	389.2	154.2	1,674.7	7.34 : 2.52 : 1
1969/70	1,360.3	419.8	209.4	1,989.5	6.50 : 2.00 : 1
1970/71	1,487.1	462.0	228.2	2,177.3	6.52 : 2.02 : 1
1971/72	1,755.4	564.0	304.0	2,623.4	5.77 : 1.86 : 1
1972/73	1,778.9	587.4	332.5	2,698.8	5.35 : 1.77 : 1
1973/74	1,835.0	634.0	314.0	2,783.0	5.84 : 2.02 : 1
1974/75	1,837.0	537.0	356.0	2,730.0	5.16 : 1.51 : 1

Average Annual Growth Rate (%)

	N	P	K	Total
1954/55-1964/65	16.4	26.0	20.0	18.4
1964/65-1974/75	15.5	13.8	17.6	15.4
1954/55-1974/75	16.0	19.6	19.0	16.9

1969/70-1974/75

1/ April 1 - March 31

2/ For 1952/53 to 1957/57, distribution figure is treated as consumption.

SOURCES: FAI, Fertilizer Statistics, 1973/74, table 7.01, for all years except 1974/75 for which data were provided by the Ministry of Petroleum and Chemicals.

Industrial Projects Department
June 1975

ANNEX 2-2
Table 2

INDIA: FERTILIZER INDUSTRY CREDIT

FERTILIZER CONSUMPTION IN RELATION TO ARABLE LAND (1972/73)
(Kgs)

	Consumption per Ha of Arable Land				Per Capita Consumption of N+P+K
	N	P	K	Total N+P+K	
India	10.7	3.5	2.0	16.2	4.8
Bangladesh	1.3	0.7	-	2.0	0.9
Brazil	11.6	20.8	13.4	45.8	15.8
Burma	2.4	0.5	0.1	3.0	2.0
Chile	11.4	16.5	3.5	31.4	14.2
Egypt	122.7	30.8	1.4	154.9	12.3
France	87.0	107.8	85.6	280.4	103.5
Germany (FRG)	146.9	111.5	141.8	400.2	52.8
Greece	57.8	34.4	5.5	97.7	39.4
Israel	80.5	38.1	32.0	150.6	20.6
Italy	56.2	47.4	21.6	125.2	28.3
Japan	138.4	135.4	113.2	387.0	19.1
Korea, Republic of	161.2	74.0	45.1	280.3	19.2
Mexico	18.9	5.9	1.3	26.1	13.2
Netherlands	446.4	120.1	150.4	716.9	45.2
Pakistan	20.1	2.5	0.1	22.7	6.6
Philippines	10.3	3.6	3.5	17.4	4.7
Poland	64.6	51.6	84.9	201.1	91.4
Romania	40.1	16.5	4.3	60.9	30.8
Sri Lanka	28.7	4.9	17.7	51.3	7.7
Spain	31.5	22.1	12.2	65.8	41.0
Thailand	4.4	4.0	3.0	11.4	4.1
Turkey	13.6	8.9	1.0	23.5	25.2
United Kingdom	131.1	65.0	60.2	256.3	33.0
United States	39.6	24.1	20.9	84.6	77.4
USSR	24.2	11.1	13.9	49.2	46.3
Yugoslavia	41.8	25.0	21.3	88.1	34.5
Averages					
Asia	28.0	9.1	3.2	40.3	6.3
Developing Market Economies	9.9	4.6	2.6	17.1	6.3
Developed Market Economies	42.3	33.8	26.2	102.3	54.9
Centrally Planned Economies	30.8	14.9	16.1	61.8	21.3
World	24.4	15.3	12.7	52.4	20.6

SOURCE: FAO Annual Fertilizer Review, 1973.

Industrial Projects Department
June 1975

INDIA: FERTILIZER INDUSTRY CREDIT

REGIONWISE FERTILIZER CONSUMPTION PER UNIT OF CROPPED AREA
(kg/ha)

	1970/71				1971/72			
	N	P	K	Total	N	P	K	Total
Central	6.80	1.96	0.89	9.65	9.82	2.18	1.16	13.16
Madhya Pradesh	2.57	1.26	0.21	4.04	3.86	1.64	0.29	5.79
Rajasthan	2.85	0.79	0.13	3.77	3.50	1.12	0.35	4.97
Uttar Pradesh	13.03	3.33	1.99	18.35	15.13	3.32	2.54	20.90
Delhi	25.20	3.31	1.44	29.95	NA	NA	NA	NA
East	5.14	1.32	0.86	7.32	6.27	1.42	1.13	8.82
Assam	1.69	0.71	0.52	2.92	1.77	0.74	0.43	2.94
Bihar	6.84	1.62	0.65	9.11	7.92	1.28	0.59	9.79
Orissa	2.73	0.74	0.28	3.75	4.46	1.00	0.48	5.94
West Bengal	9.70	1.86	2.07	13.63	8.39	2.63	3.30	14.32
Manipur	2.43	0.23	0.06	2.72	3.60	0.46	0.18	4.24
Tripura	0.95	0.22	0.19	1.36	0.46	0.11	0.07	0.64
Nagaland	0.41	0.22	0.22	0.85	NA	NA	NA	NA
North	21.94	3.73	0.85	26.52	25.06	5.05	1.28	31.39
Haryana	15.04	1.69	0.55	17.28	14.77	1.35	0.50	16.62
Himachal Pradesh	3.48	1.98	0.88	6.34	4.53	1.77	0.89	7.19
Jammu & Kashmir	4.47	1.60	0.42	6.49	4.86	0.95	0.31	6.12
Punjab	33.06	5.93	1.32	40.31	40.92	9.57	2.20	52.69
South	15.05	5.07	3.06	23.18	15.91	6.00	3.96	25.87
Andhra Pradesh	16.62	4.74	1.38	22.74	14.88	5.64	2.07	22.59
Kerala	9.23	4.97	5.66	19.86	10.73	5.38	6.17	22.28
Karnataka	8.76	3.52	2.47	14.75	9.08	3.84	2.53	15.45
Tamil Nadu	23.86	7.81	5.79	37.46	29.88	9.91	8.52	48.31
Pondicherry	60.78	39.22	23.92	123.92	62.94	36.67	25.10	124.71
West	7.27	3.52	1.40	12.19	8.24	4.35	1.72	14.31
Gujarat	10.14	5.09	0.56	15.79	11.21	6.00	0.69	17.90
Maharashtra	5.74	2.68	1.86	10.28	6.70	3.47	2.25	12.42
Goa	3.73	1.78	0.61	6.12	8.74	5.54	2.17	16.45
ALL INDIA	9.34	2.90	1.42	13.67	10.74	3.44	1.85	16.03

SOURCE: FAI, Fertiliser Statistics, 1971/72, Table 6.18.

ANNEX 2-2
Table 4

INDIA: FERTILIZER INDUSTRY CREDIT

STATEWISE CONSUMPTION RATIOS OF N, P, K (1970-72)

	1970/71	1971/72
Central	7.6 : 2.2 : 1	8.5 : 1.9 : 1
Madhya Pradesh	12.2 : 6.0 : 1	13.3 : 5.7 : 1
Rajasthan	21.9 : 6.1 : 1	10.0 : 3.2 : 1
Uttar Pradesh	6.5 : 1.7 : 1	6.0 : 1.3 : 1
Delhi	17.5 : 2.3 : 1	NA
East	6.0 : 1.5 : 1	5.5 : 1.3 : 1
Assam	3.3 : 1.4 : 1	4.1 : 1.7 : 1
Bihar	10.5 : 2.5 : 1	13.4 : 2.2 : 1
Orissa	9.8 : 2.6 : 1	9.3 : 2.1 : 1
West Bengal	4.7 : 0.9 : 1	2.5 : 0.8 : 1
Manipur	40.5 : 3.8 : 1	20.0 : 2.6 : 1
Tripura	5.0 : 1.2 : 1	6.6 : 1.6 : 1
Nagaland	1.9 : 1.0 : 1	NA
North	25.8 : 4.4 : 1	19.6 : 3.9 : 1
Haryana	27.3 : 3.1 : 1	29.5 : 2.7 : 1
Himachal Pradesh	4.0 : 2.3 : 1	5.1 : 2.0 : 1
Jammu & Kashmir	10.6 : 3.8 : 1	15.7 : 3.1 : 1
Punjab	25.0 : 4.5 : 1	18.6 : 4.4 : 1
South	4.9 : 1.7 : 1	4.0 : 1.5 : 1
Andhra Pradesh	12.0 : 3.4 : 1	7.2 : 2.7 : 1
Kerala	1.6 : 0.9 : 1	1.7 : 0.9 : 1
Karnataka	3.5 : 1.4 : 1	3.6 : 1.5 : 1
Tamil Nadu	4.1 : 1.3 : 1	3.5 : 1.2 : 1
Pondicherry	2.5 : 1.6 : 1	2.5 : 1.5 : 1
West	5.2 : 2.5 : 1	4.8 : 2.5 : 1
Gujarat	18.1 : 9.1 : 1	16.2 : 8.7 : 1
Maharashtra	3.1 : 1.4 : 1	3.0 : 1.5 : 1
Goa	6.1 : 2.9 : 1	4.0 : 2.6 : 1
ALL INDIA	6.6 : 2.0 : 1	5.8 : 1.9 : 1

INDIA: FERTILIZER INDUSTRY CREDIT

FERTILIZER USE ON DIFFERENT CROPS - 1970/71
(In percentages)

Crops	N	P	K	Total Nutrients
Rice	31.7	34.5	18.3	31.4
Wheat	21.7	8.9	10.1	19.2
Jowar	4.5	8.7	8.7	5.3
Maize (Corn)	4.7	1.2	1.7	4.0
Other Cereals	4.7	8.6	1.7	5.1
Total Cereals	67.3	61.9	40.5	65.0
Pulses	0.7	0.7	0.3	0.7
TOTAL FOODGRAINS	68.0	62.6	40.8	65.7
Cotton	7.8	7.4	9.2	7.9
Sugarcane	18.0	14.4	31.3	18.2
Oilseeds	2.5	10.4	2.6	3.6
Other Crops	3.7	5.2	16.1	4.6
TOTAL ALL CROPS	100.0	100.0	100.0	100.0

SOURCE: Bank Report, "Economic Situation and Proposects of India," (Report No. 691a-IN), May 1, 1975, Table 7.8

INDIA: FERTILIZER INDUSTRY CREDIT

FERTILIZER CONSUMPTION FORECASTS

1. The Fourth Plan (1968/69-1973/74) target for N was 3.2 million tons; for P, 1.4 million tons and for K, 0.9 million tons. However, the overall achievement was only about one half of the target for all nutrients.

2. The official consumption target for the Fifth Plan is 5.2 million tons for N; 1.8 million tons for P; and 1.0 million tons for K (Table 1). This will require an average annual increase of 23% for N as well as P, and 27% for K over the Plan period. But, during the first year (1974/75) of the Plan, there was virtually no increase in N consumption and P consumption actually declined. Only K consumption showed considerable increase from a low base. Consumption of all nutrients in 1975/76 is, however, expected to show a significant increase because of the relaxation of credit and the distribution system, the good 'rabi' harvest of 1975 improving the cash position of farmers to buy fertilizers, and comfortable supply situation in the country. Further, 1975/76 is expected to be a normal year weatherwise. Because of these factors, FAI has projected the consumption in 1975/76 to increase by at least 20% for N, 22% for P, and 16% for K. The following table shows the revised FAI forecast of consumption up to 1978/79:

FAI Consumption Forecast
(million nutrient tons)

Fiscal Year	N	P	K
1973/74 (actual)	1.84	0.63	0.31
1974/75 (actual)	1.84	0.54	0.36
1975/76	2.10	0.66	0.40
1976/77	2.5-2.9	0.85-1.00	0.50-0.60
1977/78	3.0-3.5	1.10-1.30	0.60-0.70
1978/79	3.5-4.0	1.20-1.80	0.70-0.90

3. For the purpose of this report, the lower end of the forecasts by FAI are used. Thus, the 1978/79 consumption is projected at 3.5 million tons for N, 1.2 million tons of P, and 0.7 million tons of K compared to 1.13 million tons of N, 0.39 million tons of P and 0.15 million tons of K in 1968/69. For the decade (1968/69-1978/79) as a whole, the average annual growth rates would be about 12% for both N and P, and 16% for K.

The fertilizer consumption is projected to advance as follows:

Bank Fertilizer Consumption Forecast
(million nutrient tons)

	N	P	K	Total	N:P:K Ratio
1968/69	1.13	0.39	0.15	1.67	7.5:2.6:1
1973/74 (actual)	1.84	0.63	0.31	2.80	5.9:2.1:1
1974/75 (actual)	1.84	0.54	0.36	2.74	5.1:1.5:1
1975/76	2.10	0.71	0.40	3.21	5.3:1.8:1
1976/77	2.50	0.85	0.50	3.85	5.0:1.7:1
1977/78	3.00	1.00	0.60	4.76	5.0:1.8:1
1978/79	3.50	1.20	0.70	5.40	5.0:1.7:1
1979/80	4.00	1.30	0.80	6.10	4.9:1.7:1
1980/81	4.30	1.50	0.90	6.70	4.7:2.0:1
1981/82	4.60	1.70	1.00	7.30	4.6:1.7:1
1982/83	4.90	1.90	1.20	8.00	4.1:1.6:1
1983/84	5.20	2.10	1.40	8.70	3.7:1.5:1
Growth Rates (%)					
1967/77	12.0	12.0	16.5	12.5	
1974/79	13.7	13.0	17.6	14.0	
1974/84	11.0	12.5	16.2	12.0	
1979/84	8.5	12.0	15.0	10.0	

4. Prospects for growth of consumption are highly unpredictable, given the past three years of stagnant consumption, the large unfulfilled agronomic need, and the obvious need for substantial and fundamental policy changes by GOI. There has been no recent forecast based on statistically valid methods and the forecasts originating from official Indian sources have been too optimistic.

5. The above forecasts are largely derived from pragmatic assumptions, given the previous history of the fertilizer sector in India. The forecast assumes a rapid recovery of growth in N consumption, to average 14% annually during the next four years; and, with some modest improvement in N, P, K ratios, the total nutrient consumption is likely to reach 5.4 million tons in 1978/79. This level coincides with the Bank Agricultural Project Department forecasts based on foodgrain production requirements. However, unless policy changes on pricing, distribution, and credit are implemented quickly, even these forecasts are likely to prove optimistic. It is conceivable that 1978/79 consumption could be as low a level as 3.0, 1.0 and 0.6 million TPY for N, P, K respectively corresponding to 10.3% and 10.5% annual growth respectively for N and total nutrients during 1974/1979.

INDIA : FERTILIZER INDUSTRY CREDIT

FERTILIZER PRODUCTION

1. India produces nitrogenous, phosphatic and NPK complex fertilizer. The country depends entirely on imports of potash fertilizer.

2. The total installed capacity of the fertilizer plants in production in the country at the end of 1974/75 was about 2 million tons of N and 560,000 tons of P. Six nitrogenous plants went into production during the last three years. They included : Madras Fertilizer Ltd., Madras; Zuari Agrochemicals, Goa; Cochin I of Fertilisers and Chemicals, Travancore Ltd., Cochin; Southern Petrochemical Industries Corporation, Tuticorin; and the Kalol-Kandla plants of IFFCO. There has also been some revamping of phosphate capacity during that period. Total production during 1974/75 was 1.2 million tons of N and 326,000 tons of P compared to 69,000 tons of N and 14,200 tons of P in 1954/55.

Public Sector Companies

3. There are six major public sector companies -- Fertilizer Corporation of India (FCI), National Fertilizers Limited (NFL), Fertilisers and Chemicals, Travancore Limited (FACT), Neyveli, Khethri and Rourkela. FCI and FACT, which have been the beneficiary of previous IDA credits, are familiar to the Bank. Annex 3-2 includes a description of FCI. FCI, one of the largest fertilizer companies in the world, accounts for 16.5% of the fertilizer capacity in India. Its size and large-scale expansion programs have led to management and financial constraints which are discussed more fully in Annex 3-3. However, FCI management has responded well over the past 2-3 years and considerable progress has been noted in planning and project execution and in performance of some of the individual units, particularly Trombay, Namrup and Gorakhpur.

4. FCI has under construction eleven new plants of which three are coal-based, and the rest based on either gas, naphtha or fuel oil. Work is continuing on all except one -- the Korba project which is stalled for lack of funds. There is insufficient information available now to judge the technical and economic viability of coal-based plants. The capital costsof these projects have escalated greatly and they are seriously delayed. Before any further coal-based plants are undertaken, a thorough study of technology and costs is needed.

5. NFL is a newly-formed (1974) company, created in part in recognition of the constraints in FCI, to take advantage of available Japanese credits, and to develop an additional engineering

company (Engineers India Limited) in India with ammonia experience. At present, two duplicate projects, Bhatinda (Punjab) and Panipat (Haryana) are being built, and the projects are proceeding satisfactorily. The company is being staffed largely from FCI middle management and engineering personnel. The local engineering is being executed by Engineers India Ltd. under the supervision of Toyo Engineering of Japan who are the design engineers. A third project may be undertaken later in the Fifth Plan period. The company is 100% GOI-owned. As yet, the Managing Director has not been appointed, but other senior management and the Board of Directors appear to be functioning well. Previous mistakes in public sector project implementation have been recognized and appear to be corrected in the NFL projects.

6. FACT was the beneficiary of an IDA Credit in 1972. GOI owns 95% of the shares with the balance held by Kerala and Tamil Nadu Governments and private shareholders. The company has major management and financial problems. The political relations with Kerala appear to have kept the Central Government from taking a strong role in FACT management. Outside engineering expertise has not been effectively used and the project is proceeding at a very slow pace.

7. The Neyveli Lignite Corporation was created in the late 1950s to develop lignite reserves. Later, it received a Government licence to produce urea. Today, its facilities have the following capacities: 3.3 million TPY of lignite mining; 600MW power generation and 152,000 TPY urea capacity. Major shortfall is quantity and quality of lignite which have resulted in low-capacity utilization in power and chemical fertilizer production and created financial difficulties for the company.

8. Khethri has a TSP plant (capacity - 90,000 nutrient tons per year) under construction, based on Rajasthan phosphate rock deposits now being mined in limited amounts. The project, being built by FACT's engineering company, has serious financing problems. The project is behind schedule, but should be finished by the end of 1976.

9. Rourkela with a capacity of 460,000 TPY of CAN (i.e. 115,000 TPY N) was built in 1962 to utilize an apparent excess of coke-oven gas from the adjacent Hindustan Steel Limited plant. The plant itself operates reasonably well but low steel productivity plus increased use of gas within the steel mill have created a significant shortage of feedstock. A 180 TPD naphtha reformer which operates satisfactorily was built in the late 1960s to supplement feedstock, but continued shortages of gas kept fertilizer capacity utilization low.

10. The five joint sector companies have proved to be efficient enterprises within the Indian system. Three are partially owned by state governments, one is partially owned by the GOI, and one is a cooperative (IFFCO) venture. All have competent professional management and apparently operate substantially outside the constraints

and governmental interventions faced by the public sector companies. They are able to expand since they generate internal capital and the partial public sector ownership makes it politically acceptable for GOI to contribute financially. The joint sector will likely remain an efficient vehicle for expansion in the future.

Private Sector Companies

11. The private sector units would most likely remain efficient producers but expansion, if at all, would come slowly. Expansion of the larger private companies in India is limited by the Monopolies Restrictive Act. At present all corporate dividends are also limited by law and public borrowing carries with it the GOI option to convert loans to GOI equity. A foreign company has difficulty in repatriating profits, plus for the existing firms any expansion requires dilution of foreign held equity to 26%. A recent regulation also taxes heavily any expatriate personnel working in India more than 6 months. These restrictions have clearly prevented companies such as DCM, Tata, IEL and Coromandel from undertaking major fertilizer expansions.

Engineering Companies

12. There are three public sector engineering companies, FCI, FACT and EIL plus several private companies based on collaboration/ownership arrangements with foreign engineering firms. The companies play an important role since India can competitively supply a large proportion, if designed properly, of a fertilizer project equipment.

13. The private companies, operating outside direct GOI control, generally perform reasonably well since the parent company usually provides a proven design package and handles foreign procurement. Performance of FCI and EIL have improved substantially although they must operate within the public sector framework and decision taking and management need improvement. FACT's engineering group has lost most of its staff to other Indian companies and to Arabian Gulf fertilizer companies and is largely defunct although political forces in Kerala will probably attempt to keep it in existence.

Comparison of Production

14. Latest production figures for different countries are available only for 1972/73. They show that India has emerged as the 10th largest producer of nitrogenous fertilizers as shown below :

Nitrogenous Fertilizer Production by Selected Countries
(million tons)

	1971/72	1972/73
U.S.A.	8.09	8.47
USSR	6.06	6.55
Japan	2.13	2.45
China	1.85	2.25
France	1.42	1.47
Germany, F.R.	1.32	1.47
Poland	1.08	1.15
Netherlands	1.04	1.19
Italy	1.03	1.05
India	0.95	1.05
World	35.00	38.03

Source: FAO, Fertilizer Review, 1973

15. In the production of P fertilizers, there are 17 countries in the world which produce more of such fertilizers than India. In 1972/73, India with 330,000 tons of production accounted for only 1.4% of world production of P (estimated at 23.7 million tons) compared to nearly 3% of the world output of N.

Product Mix

16. A variety of nitrogenous, phosphatic and complex fertilizers are produced in India including urea, ammonium sulfate, calcium ammonium nitrate, ammonium sulfate nitrate, ammonium chloride, single superphosphate (16% P), triple superphosphate (45% P), ammonium phosphate sulfate (16-20-0), diammonium phosphate (18-46-0), urea ammonium phosphate (28-28-0, 14-35-14), nitrophosphate (15-15-15), and NPK fertilizers (17-17-17 and 14-28-14).

17. The following table shows the capacity and volume of production of various fertilizers in 1974/75.

Productwise Capacity Utilization
('000 product tons)

	Capacity	Production	Capacity Utilization(%)
Ammonium Sulfate	910	589	65
Ammonium Sulfate Nitrate	50	27	54
Urea	2,808	1,721	61
Calcium Ammonium Nitrate	800	406	51
Ammonium Chloride	66	27	41
Ammonium Phosphate Sulfate	222	139	63
Nitrophosphate	180	210	117
Diammonium Phosphate	108	58	54
Urea Ammonium-Phosphate	410	165	40
NKP Complex Fertilizers	365	664	182 1/
Superphosphates	1,350	837	62
Triple Superphosphates	27	3	11
Total N	1,961	1,185	60
Total P	560	326	58

1/ In plants producing both Urea and NPK fertilizers, flexibility exists to increase the production of complex fertilizers.

Source: Ministry of Petroleum and Chemicals.

18. Urea is the most leading fertilizer produced in India. Data for an international comparison of the share of urea in total N fertilizer production is available only for 1972/73 as shown below :

	Total N Fertilizers	Urea	Urea as % of Total
	(million nutrient ton)		
India	1.05	0.65	62.0
U.S.A.	8.47	0.52	6.1
Japan	2.45	1.47	60.0
Republic of Korea	0.39	0.30	78.0[1/]
France	1.47	0.70	5.0
Italy	1.05	0.37	36.0

1/ 1970/71 figure.

Source: FAO, Fertilizer Review, 1972/73

19. Urea production as a percentage of total N production in India is high as in the case of Japan and Korea. Urea being a high-analysis fertilizer is in great demand especially in Asian countries. Because of its high-analysis, transportation cost per unit of N is lower for urea than for most N fertilizers.

20. Currently, urea accounts for about 68% of the licensed capacity of N in India. The percentage is expected to go up to 75% by 1978/79 when the licensed capacity is forecast to increase by nearly 40% to 1.8 million nutrient tons from 1.3 million nutrient tons in 1974/75.

21. Capacity Forecasts: The installed capacity for N fertilizer is expected to increase from nearly 2 million tons in 1974/75 to 5.1 million tons by 1978/79, and to further increase to 6.3 million tons by the end of the Sixth Plan in 1983/84. In the case of P fertilizers, the installed capacity is expected to increase from about 560,000 tons to 1.3 million tons in 1978/79 and 1.7 million tons in 1983/84 (Tables 1, 2 and 3).

22. to Production of Complex Fertilizers : India's first NPK plant went into commercial production at Trombay in 1965/1966. It has a capacity of 365,000 product tons of NPK. One more NPK unit is under construction: Cochin II will have a product capacity of 485,000 tons. Further, the Kandla plant of IFFCO, which went into production in early 1975, has a capacity of about 400,000 tons of diammonium phosphate (DAP). The addition of potash to it enables a variety of NPK grades to be made. according to need.

23. Mixing Plants : In terms of nutrient content, both mixed and granulated fertilizers are more expensive than single-element or complex products. There are 636 mixing plants, including 179 in the cooperative sector. Hand-mixed fertilizer is cheaper than granulated fertilizer. However, only powdered materials can be mixed and only low-analysis mixtures can be produced. These powdered products tend to absorb water in storage and handling, and they may be adulterated by unscrupulous mixers or sellers. Short-weighting is also sometimes practiced during the bagging process. Distribution of mixed fertilizers totalled 898,000 tons in 1967/68, but fell to 753,221 tons in 1968/69. Since then, it has declined further to about half a million tons. The mixture consumption is declining mainly because of competition from complex fertilizers.

24. Granulating Plants : There are 36 granulating plants, including 21 in the cooperative sector. Their total capacity at the end of 1974 was about 1.6 million tons. It is expected to be raised to 2.1 million tons by 1978/79. However, the sales of granulated mixtures declined from 176,259 tons in 1971/72 to 135,977 tons in 1972/73 because of growing competition from high-analysis urea and complex fertilizers in their original manufactured form, better marketing, financing and extension services of the large manufacturers, and higher prices for granulated products. However, granulated products are easier to handle, less subject to deterioration in storage or to leaching in the field, and may come in somewhat higher analysis than simply-mixed products. The National Cooperative Development Corporation, a heavy investor in granulating plants, hopes that these units will be able to produce tailor-made granulated mixtures for localized use, whereas nationally distributed complex fertilizers come in only three or four grades. It may even be possible to include in them micro-nutrients, whereas it would be ineffective for mixing plants to try to ensure distribution of micro-nutrients in minuscule doses. If the railroads can be induced to invest in bulk handling cars for solid chemicals, it will be possible to reduce transportation costs for raw materials (which now must be purchased in bags). Eventually granulating plants might be able to develop into small-scale manufacturers of NPK materials by purchasing anhydrous ammonia and phosphoric acid in tank-car lots as raw materials (provided Indian producers of ammonia are willing to encourage potential competitors).

Consumption and Production Forecasts

25 The fertilizer consumption and production forecasts (Tables 3 and 4) in this report are lower than previous Bank/IDA estimates which were in turn much lower than the official GOI projections. Consumption is projected to double from 2.7 million to 5.4 million nutrient tons between 1974/75 and 1978/79. While the forecasts are based on a pragmatic approach as opposed to a formal demand-supply-price model, they represent the best judgement available within IDA and those familiar with the fertilizer sector. The forecasts assume that factors depressing consumption, which has stagnated at 2.7 million nutrient tons over the last three years, will gradually be overcome during the next two years. More importantly, the NPK consumption ratio , which has also stabilized at about 5:1.7:1 during the last three years, is assumed to remain at this level up to 1979/80. While a ratio of 5:1.7:1 is still far from the agronomically recommended ratio of 4:2:1, it reflects the impact of relative nutrient prices, availability and the pattern of production facilities that will evolve over the next five years. For example, the international (FOB) price of nitrogen (N, in the form of urea) during 1975 is about 5.6 times the potassium (K, in the form of muriate of potash) price and 1.2 times the phosphate (P_2O_5, in the form of TSP) price[1/]. These ratios are projected to decrease to 3.2 and 1.1 respectively during 1978/79 through 1980/81. In addition, the domestic urea price is projected to remain lower than the import cost while the domestic phosphate price is expected to stay higher than the import price. Consequently, with the price of N declining relative to the price of both K and P, it is unlikely that the NPK ratio will shift towards proportionately less N and more K or P, unless there is some price subsidy or if the growth in N consumption is drastically reduced. Neither seems desirable.

26. With installed capacity, plants under construction and the three new projects proposed in the private/joint sector, the industry could potentially supply all of the N and close to 85% of the P_2O_5 requirement during 1978/79 through 1980/81 (Table 4). However, the overall nutrient deficit cannot be reduced since all potassium is imported and any gains from the higher N and P_2O_5 production is offset by rising potassium consumption.

27. The production forecast assumes that ongoing projects will be completed as presently scheduled. Furthermore, three new projects in the private/joint sector--namely, GSFC II, Nagarjuna Fertilizer (Shaw-Wallace), and the Maharashtra Cooperative Fertilizer Company (MCFC) are assumed to be implemented and completed by 1979/80. One on-going project -- Korba -- and the three other proposed new projects in the public sector, Trombay V, Paradeep and Mathura, are assumed to be postponed for at least two years and will be completed after 1980/81. The production forecasts are derived in Table 3 which shows the capacity utilization assumed for the plants installed as of the end of 1975 and those scheduled for commissioning during 1976/77 through 1979/80. The production of the existing plants are assumed to gradually improve from about 58% capacity utilization during 1975/76 to 90% by 1980/81. The production from the

1/ The prices are in terms of nutrients on a per ton basis as derived from Table 2 of Annex 4-5.

new plants expected to come on-stream during 1977/78 through 1979/80 are assumed to initially stay at low capacity levels--40% to 70%--since most of these plants are based on coal and fuel oil feedstocks and represent new technologies which may require some time to master thereby restricting capacity utilization during the initial few years of operation.

28. The following table shows the production/consumption comparison for N and P fertilizers up to 1983/84; based on Bank forecasts (Table 4):

Production/Consumption Comparison
('000 nutrient tons)

	N Fertilizer			P Fertilizer		
	Production	Consumption	Deficit 1/	Production	Consumption	Deficit 1/
1974/75 (actual)	1,185	1,837	- 652	326	537	- 211
1975/76	1,600	2,100	- 500	500	710	- 210
1976/77	2,100	2,500	- 400	700	850	- 150
1977/78	2,600	3,000	- 400	850	1,000	- 150
1978/79	3,400	3,500	- 100	1,000	1,200	- 200
1979/80	4,000	4,000	0	1,100	1,300	- 200
1980/81	4,300	4,300	0	1,200	1,500	- 300
1981/82	4,500	4,600	- 100	1,400	1,700	- 300
1982/83	4,800	4,900	- 100	1,500	1,900	- 400
1983/84	5,100	5,200	- 100	1,700	2,100	- 400

1/ Does not correspond to imports since stocks are not considered.

Forecasts show that India would be able to reduce its heavy dependence on N imports and could approach self-sufficiency by the end of this decade. In the case of P fertilizers, India would continue to be an importer, with the need for imports increasing significantly in the early 1980's.

Industrial Projects Department

July, 1975

ANNEX 2-4
Table 1

INDIA: FERTILIZER INDUSTRY CREDIT

CAPACITY OF OPERATING PLANTS AS OF DEC 1975
('000 tons)

		N	P	N + P
I. **Public Sector**				
FCI				
Sindri		75	-	75
Nangal		80	-	80
Trombay		81	36	117
Gorakhpur		80	-	80
Namrup		45	-	45
Durgapur		152	-	127
	Sub-total	513	36	549
FACT				
Udyogamandal		82	27	109
Cochin I		152	-	152
	Sub-total	234	27	261
Rourkela		115	-	115
Neyveli		75	-	75
Other		12	36 1/	48
	Total Public Sector	949	99	1,048
II. **Joint Sector**				
GSFC		257	57	314
SPIC		297	54	351
Madras		203	85	288
Mangalore		160	-	160
IFFCO - Kalol		245	-	245
IFFCO - Kandla		-	127	127
	Sub-total	1,162	323	1,485
Private Sector				
Kanpur		207	-	207
Zuari Agro		171	42	213
Coremandel		96	132	228
DCM		142	-	142
Other		34	193 1/	227
	Sub-Total	650	367	1,017
	GRAND TOTAL	2,761	789	3,550

1/ Single Superphosphate (SSP) and Triple Superphosphate (TSP) units.

SOURCE: Ministry of Petroleum and Chemicals, and Bank

Industrial Projects Department
August 1975

INDIA: FERTILIZER INDUSTRY CREDIT
LIST OF ONGOING AND PROPOSED PROJECTS

	FY of Commis-sioning	Capacity in '000 TPY	
		N	P
A. Ongoing Projects			
1. Namrup Expansion	1976/77	152	-
2. Gorakhpur Expansion	"	51	-
3. Barauni	"	152	-
4. Cochin II	"	47	115
5. Khetri	"	-	90
6. Sindri (Rationalization)	"	-	156
7. Madras Expansion	"	-	25
8. Nangal Expansion	1977/78	152	-
9. Trombay IV	"	75	75
10. Talcher	"	228	-
11. Ramagundam	"	228	-
12. Haldia	1978/79	152	75
13. Sindri (Modernization)	"	130	-
14. Bhatinda	"	235	-
15. Panipat	"	235	-
16. IFFCO (Phulpur)	"	228	-
17. Korba	Sixth Plan	228	-
B. Proposed Projects			
1. GSFC II	1978/79	243	-
2. Nagarjuna	Sixth Plan	228	-
3. Trombay V	Sixth Plan	130	-
4. Paradeep	Sixth Plan	345	300
5. Mathura	Sixth Plan	235	-
6. Other		51	39

SOURCE: Ministry of Petroleum and Chemicals, and Bank.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

FERTILIZER PRODUCTION FORECAST 1/
(1975/76 - 1980/81)

	NITROGEN			P_2O_5		
	Capacity (1000 TPY)	Production (1000 TPY)	% Capacity Utilization	Capacity (1000 TPY)	Production (1000 TPY)	% Capacity Utilization
YEAR CAPACITY INSTALLED						
A. 1975/76 PRODUCTION						
1. Up to December 1974 2/	2,009	1,375	68	557	430	77
2. 1975/76	752	225	30	232	70	30
Total	2,761	1,600	58	789	500	63
B. 1976/77 PRODUCTION						
1. Up to December 1974 2/	2,009	1,455	72	557	430	77
2. 1975/76	752	525	70	232	160	69
3. 1976/77	402	120	30	386	110	28
Total	3,163	2,100	66	1,175	700	60
C. 1977/78 PRODUCTION						
1. Up to December 1974 2/	2,009	1,610	80	557	445	80
2. 1975/76	752	600	80	232	175	75
3. 1976/77	402	280	70	386	220	57
4. 1977/78 3/	683	110	16	75	10	13
Total	3,846	2,600	68	1,250	850	64
D. 1978/79 PRODUCTION						
1. Up to December 1974 2/	2,009	1,810	90	557	500	90
2. 1975/76	752	640	85	232	200	86
3. 1976/77	402	320	80	386	250	65
4. 1977/78 3/	683	410	60	75	40	53
5. 1978/79 3/	1,274	220	17	75	10	13
Total	5,120	3,400	66	1,325	1,000	75
E. 1979/80 PRODUCTION						
1. Up to December 1974 2/	2,009	1,810	90	557	500	90
2. 1975/76	752	675	90	232	210	90
3. 1976/77	402	340	85	386	300	78
4. 1977/78 3/	683	480	70	75	50	67
5. 1978/79 3/	1,274	640	50	75	30	40
6. 1979/80 4/	228	55	24	39	10	25
Total	5,348	4,000	75	1,364	1,100	81
F. 1980/81 PRODUCTION						
1. Up to 1976/77	3,163	2,845	90	1,175	1,060	90
2. 1977/78	683	545	80	75	60	80
3. 1978/79	1,274	775	61	75	55	73
4. 1979/80 4/	228	135	60	39	25	64
5. 1980/81 5/	-	-	-	-	-	-
Total	5,348	4,300	80	1,364	1,190	89

1/ Capacity and production figures are in 1000 TPY of nutrients.
2/ See Annex 7-2 for break-up by plant.
3/ Two coal based plants (Talcher and Ramagundam) are expected to be commissioned during 1977/78 and a third plant (Haldia) is to be commissioned during 1978/79. All the other projects expected to start commercial operation during 1977/78 through 1979/80 are fuel oil-based plants. Since technologies involving coal and fuel oil as feedstock are new, the projected capacity utilization for these projects, during the initial 1 to 3 years operating period, are lower than those used for naphtha-based plants.
4/ Nagarjuna fertilizer (Shaw-Wallace) and other small phosphate projects completed 1979/80.
5/ No additional capacity added during 1980/81 as Korba, Trombay V, Paradeep and Mathura are assumed to be completed after 1980/81.

Industrial Projects Department
May 1975

INDIA - FERTILIZER INDUSTRY CREDIT

FORECAST OF FERTILIZER CAPACITY, CONSUMPTION AND PRODUCTION - FISCAL YEAR 1976 TO 1981 1/
(1,000 tons)

Fiscal Year Ending Mar. 31		Nitrogen (N)				Phosphate (P_2O_5)				Potassium 2/ (K_2O)	NPK	Total NPK		
		Capacity	Consumption	Production	Deficit	Capacity	Consumption	Production	Deficit	Consumption	Ratio	Consumption	Production	Deficit
Actual	1974	2,009	1,835	1,070	765	557	634	390	244	314	5.0-1.8-1	2,783	1,460	1,323
	1975	2,009	1,837	1,185	652	557	537	326	211	356	5.1-1.5-1	2,730	1,511	1,219
Forecast	1976	2,761	2,100	1,600	500	789	710	500	210	400	5.0-1.8-1	3,210	2,100	1,110
	1977	3,163	2,500	2,100	400	1,175	850	700	150	500	5.0-1.7-1	3,850	2,800	1,050
	1978	3,846	3,000	2,600	400	1,250	1,000	850	150	600	5.0-1.7-1	4,600	3,450	1,150
	1979	5,120	3,500	3,400	100	1,325	1,200	1,000	200	700	5.0-1.7-1	5,400	4,400	1,000
	1980 3/	5,348	4,000	4,000	0	1,364	1,300	1,100	200	800	5.0-1.6-1	6,100	5,100	1,000
	1981 4/	5,348	4,300	4,300	0	1,364	1,500	1,200	300	900	4.8-1.7-1	6,700	5,500	1,200

NOTE: Figures beyond 1975 are rounded to two significant digits. N capacity during 1974/75 differs from 1.98 million official GOI figure because the ammonia capacity, based on 330 stream days per year, is used here rather than the urea capacity based on 330 stream days which is commonly used in GOI statistics.

1/ Should projects scheduled for commissioning during 1977/78 and onwards be delayed for one year, the production would be as follows (in 1000 TPY):

	Production		Deficit		Total Nutrient (NPK) Deficit
	N	P_2O_5	N	P_2O_5	
1977/78	2,490	840	510	160	1,270
1978/79	2,880	960	620	240	1,560
1979/80	3,455	1,070	545	230	1,575
1980/81	4,020	1,200	280	300	1,480

2/ Consumption equal imports since all potash is imported. Forecast consumption of P_2O_5 and K_2O are derived from the N forecast assuming an NPK ratio of about 5-1.7-1.

3/ Nagarjuna fertilizer (Shaw-Wallace) and other small phosphate projects completed in 1979/80.

4/ No additional capacity added during 1980/81 as Trombay V, Paradeep, Mathura and Korba are assumed to be completed after 1980/81.

Industrial Projects Department
May 30, 1975

INDIA: FERTILIZER INDUSTRY CREDIT

PROPOSAL FOR 10-YEAR DEMAND FORECAST

1. A substantial improvement in fertilizer demand forecasting has to be sought in two directions. The first is the preparation of a demand forecast that can command a certain measure of general acceptance and the second a continuous updating and monitoring of relevant developments with the aim of annually producing such a ten-year forecast.

2. At present, there is no generally accepted demand forecast available in India. Most recent projections are either derived from agricultural output targets, in particular for cereals, and are therefore fertilizer requirements data, or are extrapolations of past trends of fertilizer use by using statistical methods of varying sophistication.

3. The first type of projection, i.e. requirements figures, is crucially determined by the fertilizer input/crop output ratio adopted in this "top-down" procedure. It is known, however, that fertilizer response of crops is not linear and this should be taken into account in any realistic assessment of future requirements. A second major shortcoming of requirements figures is that, even if the fertilizer input/crop ratios are correct, the output targets themselves may be unrealistically high. Recent experience has shown that requirements data have been consistently above actual achievements in fertilizer consumption by large margins. Planning domestic production and import policy on the basis of requirements figures therefore involves a high risk of error, which, given the large sums of money involved, can be extremely costly.

4. The second type of forecast, i.e. extrapolation of past trends, involves other risks of the same type. Real consumption data are available only since 1966-67, that is, for less than ten years. This is too short for meaningful trend analysis and even these do not fully allow for inventory variations. Even if "distribution" figures for earlier years are adjusted, and a longer time series is used, the period covered must in many ways be considered exceptional. For example, during the latter half of the 1960's the spread of high-yielding wheat varieties provided a powerful stimulus to fertilizer consumption. If these developments are projected forward, it is implicitly assumed that a similar revolutionary change in fertilizer-using technology will occur. Also, several years during the period were affected by local or national shortages and, last year, an abrupt price change occurred, which was not accompanied by a similar change in output prices. Extrapolations cannot take such features into account.

5. A number of additional reasons can be cited why statistical extrapolations are inappropriate under prevailing Indian conditions. Average fertilizer application rates are still very low in India and it is consequently not possible to identify the point on the consumption curve where the nation may be. In addition, average applications differ widely among the states and also within the states. Most importantly, however, the Indian fertilizer

economy does not work in a free market environment but is determined by many public policy interventions, a large number of which are state responsibility. This makes for a large diversity of policy environments and this singularly restricts the usefulness of extrapolations as a method of forecasting effective fertilizer demand.

6. Up to now there is no alternative to the use of requirements data or extrapolations because of shortcomings and gaps in basic data required for other methods. In particular, very little work has been done on the economics of fertilizer use at the farm level. Similarly, no attempt has been made to establish systematically crop response curves by major nutrient or by different nutrient mixtures. Statistics on irrigation require considerable improvement if they are to be fully adapted to fertilizer demand forecasting. Fertilizer stock reporting has to be improved. Many more data gaps and shortcomings can be mentioned but it is clear that very little improvement in demand forecasting can be expected unless a concerted and continuous effort is made to improve the data base for this work.

7. It also has to be recognized that even the best forecasting methods will remain inevitably dependent on a large number of judgements. Two objectives should, therefore, be assigned to demand forecasting work. Firstly, judgements must be made as informed as possible. Secondly, expertise of various kinds and from various sources should be brought to bear on these judgemental factors in order to minimize the risk of gross error.

8. Terms of reference for the organization of a 10-year fertilizer demand forecast, together with the base studies required to set it up have been prepared.

Industrial Projects Department
July 1975

INDIA: FERTILIZER INDUSTRY CREDITS

FERTILIZER IMPORTS

1. Fertilizer imports (Table 1) during the Fourth Plan averaged about 968,000 tons a year in terms of nutrients. The imports during 1974/75 were 1.6 million tons, including 884,000 tons of N, 281,000 tons of P and 437,000 tons of K. In that year, N imports were equivalent to 48% of total N consumption; and P imports were equivalent to 52% of total P consumption. In the case of potash, all the needs were met from imports.

2. According to the original plan, 951,000 tons of N, 365,000 tons of P and 225,000 tons of K were to be imported in 1975/76. However, because of the temporary fertilizer glut in the country because of heavy imports in 1974/75, based on overoptimistic demand projections of the Fifth Plan, the Government of India has curtailed its import program for the current year and actual imports could be considerably less.

3. India's fertilizer import policy is centered on meeting the gap between demand and domestic production. Initially, imports were confined to products like ammonium sulfate. However, imports now cover a wide range of high-analysis products like urea and complex fertilizers. The actual product mix of imports is largely determined by availability and prices in the international market. In the absence of a domestic source for potash, its entire requirement is imported.

4. Greater emphasis is being given to import of fertilizers in bulk to reduce the foreign exchange outflow and generate more employment. The phosphatic fertilizer industry is largely dependent on imported materials. The country imports a substantial part of the rock phosphate (about 80%) and almost the entire quantity of sulfur required for the manufacture of phosphatic fertilizers. There is need for fuller utilization of domestic sources of rock phosphates and sulfur from pyrites and other sources, e.g., ore smelters.

5. A number of institutions are involved in fertilizer importation. The annual requirements are estimated by the Ministry of Agriculture in consultation with the States and domestic producers. These estimates are subsequently reviewed by the Ministry of Petroleum and Chemicals.

Industrial Projects Department
August 1975

Table 1

INDIA: FERTILIZER INDUSTRY CREDIT
FERTILIZER IMPORTS
('000 nutrient tons unless otherwise noted)

Year 1/	N	P	K 2/	Total N+P+K	Value of Imports (Rs Million)	Value of Imports (US$ Million)
1952/53	44.3	-	3.3	47.6	45.6	5.8
1953/54	19.3	-	7.5	26.8	25.2	3.2
1954/55	20.0	-	11.1	31.1	30.7	3.9
1955/56	51.4	-	10.3	61.7	73.3	9.4
1956/57	56.8	-	14.8	71.6	77.7	10.0
1957/58	110.1	-	12.8	122.9	158.8	20.4
1958/59	97.5	-	22.4	119.9	113.1	14.5
1959/60	142.3	3.8	33.0	179.1	162.9	20.9
1960/61	171.9	0.1	24.8	196.8	164.2	21.1
1961/62	142.9	0.6	30.4	173.9	146.1	18.7
1962/63	229.5	8.0	44.3	281.8	261.2	33.5
1963/64	197.7	12.3	64.1	274.1	213.9	27.4
1964/65	256.5	12.3	57.2	326.0	242.5	31.1
1965/66	376.3	21.8	93.6	491.7	465.3	59.7
1966/67	574.6	129.2	143.3	847.1	1,415.1	181.4
1967/68	866.8	346.7	276.5	1,490.0	1,933.0	247.8
1968/69	780.1	132.6	165.2	1,077.9	1,629.6	208.9
1969/70	574.4	88.1	99.2	761.7	1,179.4	151.2
1970/71	481.6	32.5	119.0	633.1	794.4	101.8
1971/72	462.5	240.7	267.1	970.3	899.7	115.3
1972/73	691.4	211.4	316.3	1,219.1	1,460.0	187.2
1973/74	660.6	214.0	381.0	1,255.6	2,767.7 *	354.8
1974/75*	884.0	281.0	437.2	1,602.2	5,991.3	768.1
1975/76(Est.)*	951.0	364.7	225.0	1,540.7	8,500.0	1,089.7

1/ April 1 to March 31

2/ Figures for 1952/53 to 1956/57 related to July 1 - June 30.

* Figures from the Ministry of Petroleum and Chemicals

SOURCE: FAI, Fertiliser Statistics, 1973/74, Table 7.01, for all years except 1973/74, 1974/75 and 1975/76.

Industrial Projects Department
June 1975

INDIA: FERTILIZER INDUSTRY CREDIT

PROPOSAL FOR COMMITTEE ON FERTILIZERS

1. A large number of institutions are involved in fertilizer production, importation, distribution and use development in India. This is not surprising in that the activities that comprise the sector are diverse - including complex industrial manufacturing processes which use inputs from a number of other sectors as well as imported feedstocks, sophisticated international contractual arrangements and large amounts of foreign exchange, substantial domestic finance and credit facilities, and an extensive transport and distribution network, all organized within a complex federal structure where responsibilities are divided (not always clearly) between the central and state governments. Nor is it surprising, despite the size and importance of the fertilizer sector, that the development of institutional arrangements should be incomplete at this time. The sector has emerged into its current importance in foodgrain production, and hence its priority status, only within the past decade. The type of institutional arrangements and the appropriate role of the various bodies involved has only become clear with experience in the functioning of the sector. Nevertheless, the relative importance of the sector to India's overall economic position, through its contribution to food production, together with the difficulties that have been encountered in the past shortage period, suggest the need for better coordination and a more structured institutional set-up.

2. Recent experience has seen extensive activity by various Ministries to offset the shortage and regulate the use of scarce fertilizer supplies. While these actions were appropriate in many respects, there were side effects and interactions which were adverse and unexpected. To a large degree, this was due to a lack of analysis of the policy options and of their implications, and the unexpected nature of some of the interactions, both of which might have been better handled were appropriate decision making machinery in existence. Further, many of the side effects had an extended impact because there was no responsible point of contact or coordinating machinery which could have ameliorated these effects. In the past year, for example, actions taken to prevent the emergence of a "black market" had severe effects on the distribution of fertilizers by domestic manufacturers which not only backed up supplies in the distribution pipeline, thus causing a storage problem, but diverted the attention of senior executives away from the more important concerns of getting capacity utilization, and thus total domestic production, increased.

3. In another case, the restriction of the retail margin to 1968 levels (Rs 80 per ton), caused retailers (both cooperatives and dealers) to be reluctant to hold stocks. Because of barriers in the way to changing this regulation, it was necessary for the pool to make special arrangements for storage within the states. Also, the accumulation of imported stocks has created a competitive situation, in respect of the limited storage capacity available, between the pool and domestic manufacturers. There is a risk

that this will adversely affect domestic production. All of these conflicts could be avoided or resolved if appropriate high level coordinating machinery existed. Further, the rapid stock buildup of high cost imported fertilizer, delivered without careful scheduling, and often of a complex type not common in India (nor well suited to Indian conditions), might have been avoided if a well informed authority existed who could regulate the import procedure with regard to domestic conditions.

4. The fertilizer sector also faces fairly daunting problems in the future. The current problems of the domestic manufacturers, as manifested by their low levels of capacity utilization, warrant continual review at a high level. Many of the constraints on the efficiency of the industry relate to its linkages with other sectors, and to regulations and procedures imposed by government agencies. These will probably increase as the industry expands and competes within the industrial sector for more resources, including skilled manpower. In pursuing a greater degree of self sufficiency in fertilizer supplies, an effective Fertilizer Authority or Fertilizer Commission could be a most constructive influence, provided it was given full responsibility to coordinate the activities and take decisions relating to the functions of the existing responsible agencies.

5. The planning and organization of fertilizer and feedstock imports, and their coordination with changes in demand and the level of domestic production also needs full-time attention. India has typically held high stocks of fertilizer between seasons. This is undoubtedly a sensible safeguard in an uncertain supply situation, but carrying such stocks has a cost. Much lower stocks might be needed if supplies from domestic and overseas sources were better coordinated and more accurately aligned with likely demand in the coming season.

6. The development of domestic feedstock supplies similarly needs planning and coordinating with the derived demand for these inputs. This applies to natural gas and coal production for nitrogenous fertilizer and the phosphate rock deposits in Rajasthan for phosphate fertilizers. In both cases a failure to coordinate supply and demand could be unnecessarily expensive. The development of these supplies requires capital, transport facilities and storage capacity, and may substantially influence the location of future plant development.

7. Changes in farm technology in the future will place new demands on the fertilizer sector. New kinds of fertilizers and more accurate complexes suited to particular regions will be required. There is also the likelihood of alternative sources of nutrients being developed, including some from biological and organic sources. These will largely complement conventional industrial fertilizers, but they will change farmers' needs, use patterns and demand responses.

8. The diversity of the policy issues and problems that have confronted the fertilizer sector in the past, and those that are likely to confront it in the future, suggest the importance of the coordinating role

of a Committee on Fertilizer, and the membership it should have. It also suggests the need for much better informed base upon which to make decisions. Much of the information needed is readily available, though often not compiled or appropriately analyzed. In other cases, the necessary data are unreliable or not available, in which case there is a need for base studies and new measurement and reporting systems. In particular, there is an apparent need for an acceptable accurately based demand projection for fertilizer, since no such reliable forecast is available, and demand effects are fundamental to a large number of the decisions and issues confronting the sector.

9. If a Committee on Fertilizer were established, its membership should be small and include top level administrators and executives able to take decisions relating to the functions of the agencies associated with the fertilizer sector and be able to formulate and implement policy decisions. Since it needs to make decisions about diverse technical and administrative matters, it might appropriately have a second level "Working Committee" with a larger membership and wider representation. This would oversee the data collection and analysis work. The two would constitute a permanently established authority which could effectively guide the development of this important sector, and resolve issues as they might arise. Terms of Reference for such a body have been prepared.

Industrial Projects Department
July 1975.

INDIA: FERTILIZER INDUSTRY CREDIT

FERTILIZER PRICING POLICY

1. The pricing policy of the Government of India for the Central Fertilizer Pool has been on a "no profit, no loss" basis. But, in actual practice, the Pool had, in the past, been making a profit. But in recent years when world fertilizer prices have been rising rapidly, the Pool has operated at a loss. For example, in 1973/74, it lost Rs 601 million (US$77 million) and in 1974/75, Rs 3,000 million (US$385 million).

2. As a part of the Government's revised fertilizer policy in 1965, manufacturers were allowed to fix their own prices for a period of seven years from the commencement of commercial production. This relaxation, in practice, is allowed to manufacturers of all fertilizer materials except three nitrogenous materials, i.e. urea, calcium ammonium nitrate, and ammonium sulfate which account for about 85% of the total domestic production of N. For these three grades, prices are statutorily controlled. For the remaining materials, domestic manufacturers are allowed to fix their own prices.

3. The price of an essential commodity like fertilizers has wide ramifications as it affects such diverse groups as farmers, dealers and producers. The Government has been conscious of the impact on the fertilizer consumer in particular and has been reluctant to permit any increase in prices of these fertilizers even if justified by escalation in the costs of raw materials, equipment, services, etc. Excluding an increase in price in October 1973 to cover increases in naphtha prices in June and August 1973, the statutorily controlled prices more or less remained unchanged up to mid-1974 since 1969 (Table 1).

4. The position, however, worsened late in 1973 with the worldwide energy crisis. The prices of both raw materials like petroleum feedstock and finished fertilizers skyrocketed in international markets. Restricted availability gave a further push to prices of imported fertilizers. As a result, the cost of imported urea, for example, rose to nearly three times the statutorily-controlled price at which it was to be sold to the farmer. The difference, amounting to about two-thirds of the cost, had to be absorbed by the Government through the operation of the Fertilizer Pool. The subsidy which varied with different materials was Rs 1,630 (US$209) per ton in the case of nitrogen in 1974/75. To minimize this burden, the Government of India substantially increased the statutorily-controlled ceiling selling prices of urea, ammonium sulfate and CAN with effect from June 1, 1974. At the same time, the Government also raised Pool selling prices for other fertilizers. Approximately a year later, GOI reduced the prices slightly with effect from July 18, 1975. The following table shows the price increases in recent years for selected fertilizer materials:

Retail Fertilizer Prices per Product Ton

	1973/74		1974/75		% increase over 1973/74	July 18, 1975 onwards		% change over 1974/75
	Rs	US$	Rs	US$		Rs	US$	
Urea	1,050	135	2,000	256	90	1,850	237	-7.5
Ammonium Sulfate	600	77	935	120	56	935	120	0
CAN (25% N)	615	79	1,095	140	78	1,015	130	-7.5
DAP	1,335	171	3,005	385	125	2,805	360	-7.0
Potash	670	86	1,220	156	80	1,170	150	-4.0

5. The new prices are applicable to the sale of both imported and local fertilizers. To minimize loss on imported fertilizers for which very high prices have to be paid but which are marketed at a subsidy, domestic producers are charged a Pool Price Equalization Levy. In the case of urea, it amounts to Rs 335 per ton compared to Rs 610 per ton during 1974/75.

6. Domestic producers of complex fertilizers are complaining that though the prices of such fertilizers are not controlled, the Pool is marketing such imported fertilizers at prices at which domestic producers are not able to realize a reasonable margin. This reported inequity in pricing needs closer scrutiny.

7. The growth in demand for fertilizer can be achieved only through a well-planned and expanded extension effort to convince the farmer of the economic advantage of its use. In this assessment the price of fertilizer relative to the grain price would play a significant role.

Industrial Projects Department
August 1975

INDIA: FERTILIZER INDUSTRY CREDIT

RETAIL PRICES FOR SELECTED FERTILIZER MATERIALS

	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	July 18,1975 Onwards
Urea	840	860	943	943	923	959	1050	2000	1850
Ammonium Sulfate	492	502	539	539	529	549	600	935	935
Calcium Ammonium Nitrate	510	510	545	545	545	565	615	1095	1015
Diammonium Phosphate	1095	1095	1217	1217	1212	1246	1335	3005	2805
Muriate of Potash	440	480	523	523	523	543	670	1220	1170

SOURCES: FAI and Ministry of Petroleum and Chemicals.

Industrial Projects Department
June 1975

ANNEX 2-8
Table 1

INDIA: FERTILIZER INDUSTRY CREDIT

MARKETING AND DISTRIBUTION

1. The Central Fertilizer Pool, an agency under the Ministry of Agriculture, has become an integral part of the fertilizer distribution system in India. The Pool originally handled all nitrogenous fertilizers, both imported and domestically produced, and channelled these through institutional agencies of State governments. The revised fertilizer policy of 1965 relaxed this system by allowing domestic fertilizer units to market their products but the Pool continued to distribute imported fertilizers excepting potash which is marketed by the Indian Potash Corp. The Pool being the major single distributor of fertilizers, its operations have had a decisive influence on the marketing policies of domestic manufacturers.

2. The concept of marketing that emerged from the Government Fertilizer Policy of 1965 had many new facets, one of which was the freedom in the choice of channels of distribution. Domestic producers began making use of all available channels, that is, the private trade, cooperatives, agro-industries corporations and State agencies depending upon their effectiveness in different States.

3. However, with the acute shortage of fertilizer materials in the country since 1972, the Government has been putting pressures on domestic producers to channel an increasing proportion of production through cooperatives and other Government agencies. This has had an unsettling effect on the distribution network built by domestic producers.

4. The question of fertilizer distribution was considered at length by the Quairaishi Committee of the National Commission on Agriculture. The Committee recommended that the share of cooperatives and other public agencies in each State may not be less than 50%; it may even range up to 75%; the exact percentage above 50% should be decided by negotiations between the manufacturers and State Governments/cooperatives. Where the percentage share of these agencies is already more than 50%, it should not be reduced. The Government has not yet announced its decision on this recommendation.

5. The acute fertilizer shortages starting from 1972 had led to malpractices such as adulteration, hoarding, overcharging, etc. Faced with this situation, the Government promulgated many measures. An order promulgated on July 1, 1972 under the Essential Commodities Act aims at ensuring equitable distribution of fertilizer between States in accordance with supply plans agreed at biannual Zonal Conferences of representatives of the Central and State Governments and the fertilizer industry. The Statewise supply plans try to take into account the requirements of different States, indigeous and imported fertilizer availability, the areawise operational capacity of railways, and the domestic producers'

preferred areas of absorption of their production. However, this system of regulating supplies to and stocks at different States has many drawbacks. During times of acute fertilizer shortages, States generally under-report stocks and overestimate their needs. Further, now that the fertilizer supply has eased because of comfortable stocks, increased domestic production and substantial imports already in the pipeline, the inclusion of fertilizers under the Essential Commodities Act needs reconsideration. Representatives of industry and trade feel that this measure should be repealed.

6. The widespread shortages in 1972 also led to the introduction of many controls on the distribution system in various States. The Fertilizer Control Order of 1957 was declared a "Special Order" on October 6, 1972. This Order aims at ensuring that the quantity allocated to a State is consumed in that very State by preventing its unauthorized movement out of the State. It prohibits inter-State movement of fertilizers other than those authorized by Government agencies. Another measure introduced by the Government was to link part of fertilizer supplies to a particular State with grain procurement achieved in that State.

7. As a result of the above measures, the smooth flow of fertilizers to consumers has been hampered. In the context of improved fertilizer supply situation at present, there is need for a more balanced approach to evolve a workable system to ensure equitable distribution. Many State governments have relaxed the permit system and restrictions on fertilizer movements.

Transportation

8. Fertilizer materials, products and raw materials, account for less than 4% of the freight movement in India. There are day-to-day limitations that appear but mostly due to inability to plan rolling stock movement efficiently rather than overall availability of wagons. Fertilizer materials usually move on a priority basis, second only to defense movement and foodgrain, within the port and railway systems. Local or short hauls, less than 150 km, are usually handled by trucks, contracted out to private trucking companies, and no major problems were reported. Except for isolated cases discussed below, inland transport is not a major concern.

9. Port congestion in India remains a serious problem and fertilizer raw material movement often is delayed. Where factories, such as Mangalore and SPIC have their own port facilities, there usually is no problem. However in the major ports such as Bombay, Calcutta, Madras and Goa, vessels reportedly wait 3-6 weeks for unloading, and the crude port handling systems result in spillages and delays.

10. There are at least two special cases where inland transport is a limitation; (i) NH_3 shipments and (ii) meter gauge rail systems. Ammonia rail transport is new in India (although quite common in US, Europe and Mexico) and only 70 cars (32-ton capacity each) are available. To maximize use of excess ammonia capacity, about 100 additional tank wagons are needed to assure movement between IFFCO (Gujarat), Nangal (Punjab), and Trombay (Maharastra); and on the east coast between Haldia, Durgapur and Barauni.

IFFCO has excess ammonia production that could be converted in two FCI plants if sufficient transport and storage space were available. Eventually NH_3 movement between Baroda (GSFC) and Trombay will be possible as will ammonia imports through Trombay and Haldia. The immediate purpose of the tank wagons would be to maxmize production. But in the long run they would probably be used to ship ammonia to consuming points, principally Punjab, for direct application purposes. This development has just been started but in the next 5-10 years significant quantities of ammonia could be used in this way, particularly as irrigation and cooperative land management systems are developed.

11. Meter gauge lines limit transport either in the lower capacity of the line or in requiring an additional transfer point to a broad gauge line in several cases. Udaipur, Rajasthan, where large phospate deposits are being exploited, is a typical case. Here, shipment to almost every major consumer involves a transfer onto a broad gauge line. Zuari Agro in Goa is served only by meter gauge and because of a mountainous terrain shipment is limited to the present plant capacity at best. There are long range plans to convert the entire line to broad gauge but a plan under study would double the meter gauge along the 30-50 km of steep incline and thereby relieve the bottleneck. Total freight movement through the port in Goa is effected, as well as at Zuari.

12. Difficulties in coal transport have already been noted in the Energy Sector part of the 1974 Economic Report for India. Factories such as Nangal and Trombay that are far removed from the coal fields will likely have problems in receiving their requirements. However, these factories are installing dual coal/fuel oil systems so operation should not be affected by lack of coal.

13. Fuel oil and naphtha supplies will not be a problem for most factories, particularly those located near existing refineries, pipelines or at port locations. However, the Northwest Refinery at Mathura is likely to be delayed for lack of financing (and decreased demand forecasts) and factories at Nangal as well as the NFL plants to be erected at Bhatinda and Panipat could be affected by limited oil transport. A detailed report by MPC is being prepared on petroleum/coal movement for the fertilizer industry, which should permit a more careful analysis of the feedstock supply situation over the next few years. GOI will be asked to develop and implement a detailed plan of action to assure feedstock, fuel and product movement for the fertilizer industry.

14. The most immediate solution for assuring petroleum feedstock supplies would be to expand the Hindustan Petroleum refinery from 3.5 to 6.0 million TPY plus utilize fully the 5.3 million TPY capacity at Burmah-Shell (both in Bombay) plus possibly erect a product pipeline from Bombay to Poona from where rail shipment to the Northwest would be easier. This expansion appears particularly attractive in view of the recent off-shore oil discovery near Bombay.

Dealer Network

15. In the fertilizer business where consumers are numerous and live in remote villages, adequate market coverage by dealer networks and dealers' location close to consuming points are important. Further, they can also play the role of effective "change agents" for moulding the farmers' attitude towards fertilizer use.

16. According to a FAI survey made in 1969/70, there were 6,058 wholesale and 56,867 retail outlets in the country. Thus, over 90% of the total dealers in the country represented retail outlets. Zonewise, the South had the largest number of dealers (29%), followed by the East (23%), the Central Zone (14%), the West (14%) and the North (13%).

17. In the country as a whole, the percentage share of cooperatives and private retailers were 56% and 44% respectively in the distribution of fertilizers. This ratio varied from zone to zone and from state to state. Whereas the cooperative network was dominant in Central, Northern and Western Zones, the private retailers outnumbered cooperatives in East and South Zones.

18. The cooperatives have historically occupied a dominant place in fertilizer distribution. Prior to October 1966, the Central Fertilizer Pool distributed the entire available N fertilizers through cooperatives. The private retailers handled only superphosphate, mixtures and domestically produced complex fertilizers. The progressive relaxation of the distribution system allowing domestic producers to market their produce, however, enabled them to develop their own retail network.

19. In the fertilizer trade involving widespread distribution, marketing costs account for a significant portion of the retail price. The marketing costs involve costs of transportation, handling, storage, overheads, promotional expenses, and retailers' net profit. The overall marketing and distribution costs vary widely from one part of the country to the other and transportation cost forms the largest single element of marketing costs.

20. The retail marketing margin is fixed by the Government. This margin was not raised for the last seven years in spite of the fact that transport costs, interest rates, and the amount of finance required to stock a given quantity of fertilizer has more than doubled since then. It was only in July 1975 that the Government finally raised the margin from Rs 80 to Rs 115. Studies by the National Cooperative Development Corporation (NCDC) and FAI indicate that the margin should be between Rs 220 and Rs 240 per ton for fertilizer retail business to be profitable. As a result of the current low margin, dealers and cooperatives are now reluctant to hold stocks. This has exacerbated the storage problem at the factory level. To overcome this problem, the Central Pool is stocking fertilizer in several States.

21. In a country as vast as India with only a few supply points (ports and factories), the main burden of movement of fertilizers has fallen on the railways. This is done partly through assigning priority for fertilizer movement and partly by forward planning of movement.

22. A system of quarterly planning of fertilizer movement by rail has been introduced to rationalize movement and to optimize utilization of the limited availability of rail capacity. This planning has helped considerably in improving the distribution of fertilizer by rail. Where-ever rail transportation is not available, domestic producers and the Pool have to use the more expensive road transport.

23. A recent FAI study shows that about three-fourths of the total fertilizer distributed in the country moves by rail, and such transportation accounts for roughly 3% of the total commercial haulage by the railways. The railway share in fertilizer distribution is forecast to drop slightly to 67% by the end of the Fifth Plan through a coordinated rationalization of rail and road movement of fertilizers.

24. The shorter hauls of secondary movement of fertilizers from major distribution points to retailers are more economical by road because of the following factors: (1) accessibility of interior areas is better by road than by rail; (2) road transport saves transhipment and reduces handling cost and losses; (3) speedier and safer delivery of the product is ensured; (4) small quantities can be moved by road more economically; (5) loss due to pilferage, spillage, etc. is considerably less; (6) road transport is comparatively cheaper for shorter hauls; and (7) trucks are easy to hire and they ensure point-by-point deliveries. Transportation in full truck loads instead of in small quantities, and the planning for return cargo will reduce the freight charges.

25. The longer load distances from the supply points not only entail higher freight per unit of material but also affect timely deliveries.

26. Further, provision of proper and adequate warehousing facilities at dealer level lends viability to his operations by enabling him to stock the product in time. This aspect deserves greater attention than has been the case hitherto. In addition, there is an imperative need to (a) upgrade the quality of warehouses used for fertilizer stocking so that they meet certain minimum standards; and (b) train dealers both at wholesale and retail levels in scientific storage facilities.

Industrial Projects Department
July 1975

INDIA: FERTILIZER INDUSTRY CREDIT

CREDIT SITUATION

1. Credit in the fertilizer business is needed at two stages in addition to meeting the working capital requirements of manufacturers: (a) distribution credit for stocking fertilizers at various points; and (b) production credit for farmers to enable them to invest in costly inputs until the harvest is sold. Although cooperatives are the major organized source of agricultural finance, they cover only a small section of the total rural population. The share of commercial banks for agricultural credit continues to be relatively meagre probably due to the banks' unwillingness to enter into high risk areas. Their lending procedures involve delays in clearance, emphasis on provision of security, and high margins on credit advanced.

2. The Bill Market Scheme introduced by the Government in November 1970 is a useful mode of providing distribution credit. The scheme seeks to promote the use of short-term trade bills of exchange as instruments of credit linked with transactions of sale and purchase. Under this scheme, instead of financing the dealers entirely against the stocks of fertilizers, the banks could also discount the bills of exchange covering sale and purchase of fertilizers. The banks need to encourage this scheme by developing additional discounting houses and by offering more liberal bill discounting facilities.

3. The Government of India established the Credit Guarantee Corporation of India on April 1, 1971 to provide an additional incentive to the commercial banks to step up their assistance to agriculture/fertilizer industry. Under the scheme a guarantee cover up to a specified limit of the loans advanced by banks for fertilizer dealers with a turnover of Rs 500,000 (US$64,100) is available to banks. This has reduced the risk element in lending to small dealers in fertilizer trade. However, with the sharp increase in fertilizer prices since June 1974, there is a need to review the credit guarantee scheme.

4. The role of cooperatives in providing credit has increased over the years. However, a disquieting feature of cooperative credit has been the mounting overdues at various levels. The major causes of overdues are lack of will and discipline among cultivators to repay loans, defective lending policies pursued by cooperatives, apathy of management to take quick action against recalcitrant members, and absence of a favorable climate for repayment of cooperative dues. In order to increase the flow of funds to the fertilizer trade and ensure their effective utilization, the working of cooperative credit societies needs to be strengthened.

5. The credit squeeze introduced by the Government in 1974 to control inflation in the country reduced the available funds for agricultural financing, dampening the demand for key inputs like fertilizers. This situation is now being rectified by loosening credit.

6. Starting from 1974, the Government introduced a permit system under which the cooperatives were to sell fertilizers only on credit and against permits obtained from local government officials. The aim of the permit system was to ration supplies evenly among farmers, and also to prevent sales to "black marketeers". But the administration of the system has proved to be extremely difficult. Many farmers have been unable to obtain permits to buy fertilizers. There is strong evidence from field studies by FCI and National Council of Applied Economic Research that the permit system suppressed fertilizer consumption growth more than price increases. Because of widespread dissatisfaction with the permit system, almost all States have relaxed the system, though it has not been given up.

Industrial Projects Department
August 1975

INDIA: FERTILIZER INDUSTRY CREDIT
HISTORICAL DEVELOPMENT OF FERTILIZER INDUSTRY
CHRONOLOGY OF FERTILIZER MANUFACTURE

Approx. Year of First Manufacture	Fertilizer Material Manufactured	Factory which first Manufactured	Total No. of Units Operating (as on 1-4-74)
1906	Single superphosphate	E.I.D. Parry, Ranipet	30
1906	Fertilizer mixtures		661
1933	Ammonium sulphate:		12
	a. by product of steel industry	a. Tata Iron & Steel Co.	7
1941	b. Using sulphuric acid	b. Mysore Chemicals & Fertilizers	2
1947	c. gypsum as raw material	c. FACT, Alwaye	4
1959	Ammonium sulphate nitrate	FCI, Sindri	1
	Urea	FCI, Sindri	13
	Ammonium chloride	New Central Jute Mills Co., Varanasi	1
1960	Ammonium phosphate	FACT, Alwaye	2
1961	Calcium ammonium nitrate	FCI, Nangal	2
1965	Nitrophosphate	FCI, Trombay	1
1967	Diammonium phosphate	Gujarat State Fertilizer	1
1968	Triple superphosphate	Dharamsi Morarji	1
	Urea ammonium phosphate	Coromandel Fertilizers	1
	NPK complexes	FCI, Trombay	3

NOTE: Units manufacturing more than one end-product are correspondingly accounted for more than once in the last column given above.

SOURCE: Fertiliser Association of India

End-productwise capacity installed before and during plan periods 1906 to 1974-75 (April-March)

Fertiliser	Before First Plan 1906-1951	I Plan 1951-52 to 1955-56	II Plan 1956-57 to 1960-61	III Plan 1961-62 to 1965-66	Annual Plans 1966-67	1967-68	1968-69	Fourth Plan 1969-70	1970-71	1971-72	1972-73	1973-74	I Year of Fifth Plan 1974-75**
	..........tonnes of material..........												
Ammonium sulphate (20.6% N)	254,730 (6)	355,000 (1)	53,800 (2)	—	28,000 (1)	186,610 (2)	100,000 (1)	—	—	35,000*	6,600	6,600*	—
Cumulative total	254,730 (6)	609,730 (7)	663,530 (9)	662,930[1] (8)	690,930 (9)	870,830[2] (10)	970,830 (11)	970,830 (11)	970,830 (11)	932,510ϕ (11)	939,110 (12)	945,710 (12)	945,710 (12)
Urea (46% N)	—	—	23,470 (1)	253,000 (2)	—	280,500 (2)	474,320 (3)	100,000 450,000 (1)	—	210,000 (1)	—	1000,000 (3)	1656,000 (3)
Cumulative total	—	—	23,470 (1)	276,470 (3)	276,470 (3)	556,970 (5)	1031,290 (8)	1581,290 (9)	1581,290 (9)	1780,420ϕ (10)	1780,420 (10)	2780,420 (13)	4436,420 (16)
Ammonium sulphate nitrate (26% N)	—	—	121,920 (1)	121,920 (1)	121,920 (1)	121,920 (1)	121,920 (1)	121,920 (1)	121,920 (1)	50,000ϕ (1)	50,000 (1)	50,000 (1)	50,000 (1)
Calcium ammonium nitrate (25% N)	—	—	380,000 (1)	297,000 (1)	—	—	—	240,000*	—	—	—	—	—
Cumulative total	—	—	380,000 (1)	677,000 (2)	677,000 (2)	617,000@ (2)	560,000@ (2)	800,000 (2)	800,000 (2)	800,000 (2)	800,000 (2)	800,000 (2)	800,000 (2)
Ammonium chloride (25% N)	—	—	8,000+ (1)	17,000* 40,640	—	—	—	—	—	—	—	—	—
Cumulative total	—	—	8,000+ (1)	65,640 (2)	65,640 (2)	65,640 (2)	65,640 (2)	65,640 (2)	65,640 (2)	64,750ϕ (2)	64,750 (2)	64,750 (2)	64,750 (2)
Single superphosphate (16% w.s. P_2O_5)	492,230 (11)	—	281,060 (6)	345,440 (8)	108,530 (2)	22,500 (1)	—	—	—	—	9,000 (1)	116,990* (1)	—
Cumulative total	492,230 (11)	492,230 (11)	773,290 (17)	1118,730 (25)	1227,260 (27)	1249,760 (28)	1249,760 (28)	1249,760 (28)	1249,760 (28)	1249,760 (28)	1258,760 (29)	1375,750 (29)	1375,750 (29)
'Pelofos' (18% P_2O_5)	—	—	—	—	—	—	—	—	—	—	—	45,000 (1)	45,000 (1)
Triple superphosphate (45% P_2O_5)	—	—	—	—	—	27,000 (1)	—	—	—	—	—	—	200,000 (1)
Cumulative total	—	—	—	—	—	27,000 (1)	27,000 (1)	27,000 (1)	27,000 (1)	27,000 (1)	27,000 (1)	27,000 (1)	227,000 (2)
Ammonium phosphate **sulphate**	—	—	16,500 (1)	118,500 51,480 (1)	—	—	—	—	—	46,000*	—	—	—
Cumulative total	—	—	16,500 (1)	186,480 (2)	186,480 (2)	186,480 (2)	186,480 (2)	186,480 (2)	186,480 (2)	222,980ϕ (2)	222,980 (2)	222,980 (2)	222,980 (2)
Diammonium phosphate (18-46-0)	—	—	—	—	—	108,000 (1)	108,000 (1)	108,000 (1)	108,000 (1)	108,000 (1)	108,000 (1)	108,000 (1)	108,000 (1)
Nitrophosphate	—	—	—	270,000 (1)	—	180,000@@ (1)	180,000 (1)	180,000 (1)	180,000 (1)	180,000 (1)	180,000 (1)	180,000 (1)	180,000 (1)
Urea ammonium phosphate	—	—	—	—	—	260,000 (1)	260,000 (1)	260,000 (1)	260,000 (1)	260,000 (1)	260,000 (1)	260,000 (1)	260,000 (1)
NPK complex fertilisers	—	—	—	—	—	—	—	—	—	360,000[3] (1)	—	—	375,500[4] (1)
Cumulative total	—	—	—	—	—	—	—	—	—	360,000[3] (1)	360,000 (1)	360,000 (1)	735,500[3,4] (2)

* Expansion.
@@ On account of change over of grade from 16-13-0 to 20-20-0.
@ On account of change over of grade of FCI, Nangal and HSL Rourkela from 20.5% N to 25% N.
1 One by-product A/S factory was closed down during this period.
2 One synthetic A/S factory was closed down during this period.
3 Constitute grade 17-17-17 and grade 14-28-14.
4 Constitutes grade 10-26-26, 12-32-16 and 14-36-12.
\+ Not meant for agricultural purposes.
** Anticipated by 31.3.75.
( ) The figures in brackets indicate the number of manufacturing units.
ϕ Due to aging of plant, the capacities of some units have been revised.

SOURCE: F.A.I.

Industrial Projects Department
July 1975

INDIA - FERTILIZER INDUSTRY CREDIT

DESCRIPTION OF FERTILIZER CORPORATION OF INDIA (FCI)

A. Existing Operating Divisions of FCI

1. FCI is the largest fertilizer company in India with six operating units, plus the Planning and Development Division, which are described below. Production capacities in these operating units as well as FCI's new projects are summarized in Table 1. Historical performance of the operating divisions is given in Annex 3-3 Capacity utilization has averaged about 66% for nitrogen and about 88% for phosphate over the past four years (1971-1975). Gorakhpur and Nangal have had relatively little difficulty (except recent power shortages) and have consistently operated at high efficiency. Sindri and Durgapur have continuing operating problems and operate considerably below desirable levels of capacity utilization. Trombay has showed good performance in recent years with the net profit reaching about Rs 106.5 million (nearly US$14 million) in 1975.

2. The overall performance of FCI has been relatively poor. As indicated above, the performance of its individual units vary widely for complex reasons and these are discussed below.

Trombay (Maharashtra State)

3. The existing Trombay plant has an annual design capacity of 240,000 tons of NPK fertilizer (15-15-15); 99,000 tons of urea; and 30,000 tons of methanol. Intermediate products include ammonia, nitric acid and sulfuric acid. In addition, some minor quantities of industrial chemicals such as argon, concentrated nitric acid, sodium nitrate and ammonium bicarbonate are produced. The Trombay complex includes necessary facilities such as maintenance shops, storage, utilities, offices and townships; it is near to the Bombay port and has good rail and road connections. An expansion of the Trombay plant to add 355,000 TPY nitrophosphate production capacity has just been commenced and will be completed by mid 1977. IDA approved a credit of US$33 million for this project and other works in June 1974.

Gorakhpur (Uttar Pradesh State)

4. This plant, which produces urea only, began production in early 1968. Gorakhpur was financed with a Japanese credit plus funds from GOI and was built by Toyo (Japan) at a total cost of about US$45 million. This cost is considered high due to imbalances and excessive spare capacity of some equipment. The plant units at Gorakhpur are ammonia and urea, with low-grade naphtha serving as the feedstock. The ammonia plant is designed to have two streams, each with a capacity of 175 TPD of ammonia. Partly because the plant uses electrically-driven reciprocating compressors, it has a relatively high operating cost and high dependence on outside power. The project operates well and can easily exceed 100% of design capacity on a daily basis. Output has been seriously impaired by power supply problems; were the reliability of power supply to improve in Uttar Pradesh, the performance of this plant should steadily increase.

5. In January 1972, IDA approved a US$10 million credit to Gorakhpur to increase its capacity from 180,000 TPY to 314,000 TPY of urea by 1975.

Nangal (Punjab State)

6. The Nangal plant produces heavy water and calcium-ammonium nitrate (CAN) fertilizer containing 25% N, using a process involving intensive use of power. Initial production began in 1961 with a rated capacity of 80,000 TPY nitrogen. Power supply has been severely restricted, thus limiting production to 60-70% of capacity. Ammonia and urea capacity expansion is underway, utilizing an IDA credit of US$58 million. Included in the expansion program is a provision to reduce Nangal's heavy reliance on power by using a new process in the old plant.

Namrup (Assam State)

7. The Namrup factory produces urea and ammonium sulfate. The plant started commercial production in January 1969 but has not achieved full production so far. The factory has small process units for ammonia, urea and ammonium sulfate. A detailed evaluation of Namrup has not been made but it is doubtful if the existing facilities can ever be profitable without major modifications. The plant is being expanded to produce 330,000 TPY of urea, with the new units expected to go on stream in 1975. As the total market for fertilizer in Assam is limited, most of the increased production must be shipped to the neighboring States of Bihar and Uttar Pradesh.

Sindri (Bihar State)

8. The Sindri plant produces ammonium sulfate, double salt, urea and some industrial chemicals. Most of the existing production facilities are old and inefficient, involving high maintenance costs; and the plant has an excessively high employment of about 8,700 persons. It operates at about 55% capacity, with major causes for low capacity utilization being plant and equipment failures; and the high cost of gypsum feedstock for ammonium sulfate is also responsible for the plant's operating losses. Sindri's financial performance has deteriorated sharply in recent years and it is a major reason for FCI's poor financial results. A rationalization program is underway for additional production facilities for phosphoric acid and triple superphosphate (TSP), and reduction in ammonium sulfate production costs. In addition, a modernization program is underway to increase urea production. Much of the existing plant will be retired when the new ammonia/urea project comes into operation.

Planning and Development (P&D) Division (Bihar State)

9. The P&D Division is the engineering and research and development arm of FCI. It is located adjacent to the Sindri plant in Bihar. It has a total staff of about 3,200 with about 800 engineers and designers working directly on engineering, planning and technical service functions for FCI units. In addition, the division develops and manufactures catalysts for use in ammonia plants and has extensive pilot plant and research development facilities. The catalyst manufacturing program is technically sound and some catalysts have

been sold for use in fertilizer plants in India. Over the next few years as the catalyst consumption grows in the country, FCI catalyst production should become profitable.

10. The P&D Division has several license agreements with international process engineering firms, the most notable being: Montecatini-Edison, Italy, for ammonia and urea; Lurgi, Germany, for rectisol CO_2 removal; Shell, the Netherlands, for fuel oil gasification; Koppers, Germany, for coal gasification; and Nissan, Japan, for phosphoric acid. Licensing arrangements for other process technology are obtained when needed for other projects. The Division has developed its own process know-how for ammonium sulfate, ammonia synthesis gas purification and some others. For all of the present ammonia-urea plants under implementation, the Division has been responsible for engineering, design and project schedule as well as procurement based on process design packages from various licensors. Where suppliers' credits are involved, the foreign process collaborator handles most procurement from outside India.

11. Project implementation responsibilities under the FCI's organization in the past have not been clearly defined and, as a result, the completion of a number of projects has been delayed in some cases up to three years. Except for the Nangal and Trombay IV projects there have not so far been project managers for each project with overall responsibility; instead the function has been divided between a site project manager appointed by and directly responsible to the General Manager of the particular works operating unit and a project coordinator appointed by and directly responsible to the General Manager of P and D division. Under this system progress of the work at the site has been under the control of the Works General Manager whereas P and D division has been responsible for maintaining the project schedule. This arrangement is now being streamlined however and in the case of the Sindri ammonia/urea project the project coordinator will be responsible through the P and D General Manager to the Managing Director while the site project manager will be responsible to the Projects Director. This arrangement is expected to result in improved coordination and more expedient decision making. The general engineering capability of P and D division is sound. Typical design drawings, specifications and general projects records for a number of ongoing projects were reviewed and appeared to be of a high standard.

B. FCI's Expansion Program

12. FCI will be one of the world's largest fertilizer producers after its expansion program is completed in 1979. It has nine major projects (including three expansions) under implementation at present. The capacities and expected commissioning dates are given in Table 1. All these projects are being executed by the P&D Division of FCI with the assistance of various process and engineering firms.

13. Durgapur, Namrup (expansion) and Barauni are similar plants based on process designs obtained from Montecatini-Edison (Italy), and include process units for ammonia and urea. These projects are being financed with Italian credits and funds from GOI. Haldia (capacity: 152,000 TPY of N and 75,000 TPY of P_2O_5) will be producing both urea and nitrophosphates. The Sindri Rationalization Project includes a triple superphosphate (TSP) unit and facilities for

sulfuric and phosphoric acid production. Haldia is the first of the fuel oil based ammonia plants under construction with an ammonia plant capacity of 600 TPD and facilities for the production of methanol. The ammonia is converted partly to urea and is utilized partly for the production of nitrophosphates. The facilities include a soda ash plant based on the use of by-product chalk. The knowhows used are from Shell, Lurgi, Techniment, Stamicarbon, Nissan and Polimex. The project is scheduled for completion by 1977. Much of the engineering for it is domestic, including a subcontract with FACT. GOI is providing all funds including foreign exchange from Belgian and Bulgarian suppliers' credits.

14. Talcher and Ramagundam as well as the Korba plant are larger ammonia-urea units with ammonia to be produced by coal gasification. Montecatini-Edison is the major engineering collaborator with additional assistance from Koppers (Germany), Lurgi (Germany), and Technoexport (Czechoslovakia) Coal gasification is a relatively unproven technology in large commercial plants and the projects are ambitious undertakings. They are in the early design stage and, because of anticipated design problems, are not expected to be completed before 1977.

15. All the new projects would be financed about half by equity and half debt. All expenses including interest during construction on new projects are being capitalized so that FCI's profit performance will not be affected by these projects until production starts. Three projects under construction - Durgapur, Namrup (expansion) and Barauni - have experienced about three-year delays in implementation, primarily because of design, procurement, and project management problems. Work on the IDA-financed Gorakhpur and Nangal Expansion Projects started in 1972 and 1973 respectively. Agreements on procurement between GOI and IDA are designed to prevent delays on these projects.

Table 1

INDIA: FERTILIZER INDUSTRY CREDIT

A. FCI EXISTING UNITS AND PLANNED EXPANSION PROGRAM

Name	Location	Products	Capacity '000 TPY N	Capacity '000 TPY P_2O_5	Year of Commis-sioning
Existing Units					
Trombay	Maharashtra	Urea, Nitrophosphate	81	36	1966
Gorakhpur	Uttar Pradesh	Urea	80		1968
Nangal	Punjab	Calcium Ammonium Nitrate	80		1961
Namrup	Assam	Urea, Ammonium Sulphate	45		1962
Sindri	Bihar	Urea, Ammonium Sulphate, Ammonium Sulphate Nitrate	75		1952
Durgapur	West Bengal	Urea	152	—	1974
		Total	513	36	
Projects Under Construction					
Namrup (Expansion)	Assam	Urea	152		1977
Barauni	Bihar	Urea	152		1977
Gorakhpur (Expansion)	Uttar Pradesh	Urea	51		1977
Sindri (Rationalization)	Bihar	Triple Superphosphate		156	1977
Trombay IV	Maharashtra	Nitrophosphate	75	75	1977
Nangal (Expansion)	Punjab	Urea	152		1978
Ramagundam	Andhra Pradesh	Urea	228		1978
Talcher	Orissa	Urea	228		1979
Haldia	West Bengal	Urea, Nitrophosphate	152	75	1979
Korba	Madhya Pradesh	Urea	228		*
Sindri (Modernization)	Bihar	Urea	130 1/		1979
		Total	1,548	306	
Projects in Planning Stage					
Trombay V	Maharashtra	Nitrophosphate, Urea	130		*
Paradeep	Orissa	Urea, NPK Compounds	345	300	*
		Total	475	300	
		GRAND TOTAL	2,536	642	

* Firm estimates not available.
1/ Net addition.

Industrial Projects Department
August 1974

INDIA: FERTILIZER INDUSTRY CREDIT

FCI's RECENT OVERALL PRODUCTION PERFORMANCE

1. FCI's overall production capacity in terms of nutrients is given below together with the actual production of 1973/74 and the expected production for 1974/75. The resulting capacity utilizations and all-India figures are also given:

	1973/74			1974/75	
Operating Division	Capacity (000 tons)	Production (000 tons)	% Utiliz.	Production (000 tons)	% Utiliz.
Nitrogen					
Sindri	75 1/	70	71%	67	68%
Nangal	80	62	78%	38	48%
Gorakhpur	80	64	80%	69	86%
Trombay	81	64	79%	66	81%
Namrup	45	36	80%	36	80%
Durgapur	152 2/	--	0%	12	8%
FCI Total	513	296	58%	288	56%
All India	2,009	1,070	53%	1,185	59% 2/
Phosphate					
Trombay	36	32	89%	30	83%
FCI Total	36	32	89%	30	83%
All India	557	390	70%	326	59

1/ Design capacity is 99,000 TPY of N but has been downgraded because of old equipment.

2/ Durgapur, although mechanically completed earlier, was officially commissioned only in 1974/75.

2. While for 1973/74 the production performance was still better than the industry average, FCI's overall capacity utilization for 1974/75 is expected to be only 56%. This poor performance is mostly due to the very low production at Durgapur, which has been under commissioning for a number of years and which will from 1974/75 onwards be treated as a regular operating division of FCI. The capacity utilization in 1974/75 is further depressed by the reduction of power availability at Nangal which is expected to show a utilization of only 48%. Sindri's performance will be about the same as last year. Gorakhpur, Trombay, and Namrup will show utilizations of 80% and higher. An analysis made by FCI indicates that the low capacity utilization can mainly be explained by the low equipment performance at Durgapur and Sindri and the non-availability of power.

FCI's Recent Financial Performance

3. For the year ending March 31, 1975 FCI is expecting only a marginal profit. The unit-wise breakdown is given below:

	(Rs millions)	
	1973/74	1974/75
Sindri	(72)	(73)
Nangal	43	30
Trombay	79	156
Namrup	(3)	10
Gorakhpur	(1)	21
Durgapur	--	(75)
	46	69
Less--Interest	--1/	42
--Deferred Revenue	--1/	4
Net Profit (before adjustments for prior years)	46	23

1/ Allocated to individual units.

Despite the fertilizer price increases during 1974/75 the financial position of FCI has not improved, basically because of the continued financial strain of the Sindri unit, the low production of Nangal, and the cash drain at Durgapur. So far, Durgapur expenditures have been capitalized but the board of FCI will most probably, decide to put the official commissioning date down as June 1, 1974 and will charge all revenues and expenditures from that date onwards to FCI's income statement. Durgapur will constitute a very heavy burden which, together with the anticipated losses at Sindri, will prevent FCI from showing any significant financial improvement in the near future.

4. Concerning the financial ratios which have to be met by FCI, it was agreed between IDA and FCI at the time of the Sindri negotiations that FCI will give IDA all the necessary information and recalculate the current ratio, and debt service coverage for the last three years in accordance with a methodology which has been mutually agreed upon.

FCI's Financial Future

5. For the next four to five years FCI's financial position will be characterized by the very large expansion program the financial requirements of which will by far exceed the internal cash generation. There is an overall squeeze on India's national budget, and allocations to FCI to cover its project financing requirements are not likely to be provided with sufficient timeliness, thus lack of financing is likely to hold up the speedy execution of FCI's projects. This situation is further affected by FCI's difficulty to estimate realistically its own internal cash generation and its overall fund requirements. In the past, FCI has consistently underestimated its fund requirements and overestimated its own cash generation, particularly for periods exceeding the one-year budget horizon. Many of the underlying reasons are external to FCI, like the lack of power at Nangal or the extremely high escalation of equipment prices, but the extent of the over-or underestimation and the rapid and significant change in the forecasts indicate that financial planning at FCI is basically a year to year affair and lacks the discipline required by a private sector company that does not have the easy access to the Government budget as FCI had in the past. This has been discussed with FCI and the Government, and it has been impressed upon them that they should take the utmost care in preparing five year forecasts which FCI will from now on prepare in March every year.

6. The size of FCI's operations with six operating divisions and about 14 major expansion or new projects and the very poor communication facilities further complicate efficient financial control. Since quite some time it has therefore been suggested to split FCI into a number of smaller companies, which would at least help to strengthen the financial management and would make strict financial control a more manageable task.

7. FCI has estimated its fund requirements for all its ongoing projects and a rough estimate of its own cash generation which are summarized below. Details are shown in the supervision reports for FCI in the Sindri and Nangal projects.

	(Rs Million) FY 1976 - 1979	($ Million) FY 1976 - 1979
Project Funds Required		
Local	6,771	868
Foreign	2,560	328
Total	9,331	1,196
Expected Financing		
Local from		
--Internal Cash Generation	375	48
--Government Budget Allocations	6,396	820
Total	6,771	868
Foreign from		
--Credits already allocated	1,498	192
--Unidentified Foreign Exchange Sources	1,062	136
	2,560	328
Total	9,331	1,196

8. As can be seen from the above, the bulk of the local funds has to be provided through budget allocations from the Government, with only about 4% coming from FCI's own internally generated funds. While the Government and FCI maintain that the allocation of funds have not and will not hold up projects, it is likely that during the bargaining process of FCI's budget preparation, less funds than required will be made available. A case in point is the 1975/1976 budget, where FCI figures that it needs a total of Rs 2,260 million for project financing, but where the budget at present indicates only Rs 2,140 million or 95% of the required amount.

9. The foreign exchange required to continue the ongoing investment program has not been tied up yet and about 41% of the total foreign exchange has still to be found and/or allocated. The bulk of the foreign exchange still to be found would be needed for Korba (Rs 312 million) and Trombay V (Rs 390 million). The future of both of these projects is quite uncertain, and it is clear, that a temporary stop on these projects would significantly lower FCI's foreign and local fund requirements. This would enhance the chances, that the other projects, competing with Trombay V and Korba for the same scarce local and foreign funds, would not be delayed by a lack of funds. It is already clear that the Government and FCI have decided on a go-slow for the Korba project.

Industrial Projects Department
February 1975

PRODUCTIVITY IN THE INDIAN FERTILISER INDUSTRY 1/

Abstract

The fertiliser plant performance is dependent on several important factors like age, size, feedstock, process, products, utility facility, etc.

The overall productivity of Indian fertiliser industry is not satisfactory as compared to that in the developed regions, although efficiencies of some of the new plants are as efficient as, if not better than, similar plants in the developed countries.

The productivity and the reasons for low production in the Indian fertiliser industry have been analysed according to the above mentioned factors. We trust this analysis will facilitate a more exhaustive treatment of the subject and throw up guidelines for future action.

It is generally said that the productivity in the Indian Fertiliser Industry is low. But very rarely, if ever, has this observation been substantiated by any meaningful comparison with conditions obtaining in the fertiliser industry in other parts of the world. Such a comparison has been made more difficult by lack of ready availability of suitable data.

Nevertheless, we in the Fertiliser Association of India have embarked upon this task. Presented here is a critical analysis based on the limited data that is currently available.

It is common knowledge that in India we have a heterogeneous mix of plants each having its own characteristics. Units vary in age, some of these are well over 25 years old. Our domestic plants are based on different feedstocks; they have adopted different processes even with the same feedstocks. Their sizes vary from literally a pigmy (at least by today's standard) to giants even by world standards. Nor is the porduct mix the same in all the plants. Quite a diversity indeed, dictated undoubtedly by a host of reasons. Under such circumstances, a discussion of the overall capacity-utilisation is likely to be misleading.

At this stage may we utter a word of caution. The task that we have undertaken is complex. There are many unknown and interesting factors which have an impact not amply clear. It is not, therefore, the intention to suggest, leave alone assert, that what follows is necessarily the complete picture. Our comments will be mere indicators; and we hope that these leads can be picked up and followed by others who are more competent to delve deeper into the subject.

We reckon that for a more purposeful analysis, it would be useful to categorise the existing plants into various groups which would lend to each unit therein certain amount of similarity, and then analyse the productivity groupwise. We have split the existing units into the following six groups, according to:

(i) age,
(ii) size,
(iii) feedstock used,
(iv) process adopted,
(v) product mix,
(vi) importance of fertiliser output relative to its overall operations, and
(vii) plants having captive power source.

For purpose of convenience we have taken into account the production performance of all the domestic nitrogenous, phosphatic and complex plants during the Fourth Five Year Plan period, namely, 1969-70 to 1973-74. Their capacity and production in terms of nutrients and capacity utilisation (productivity) as percentage are given in Table I.

According to Age

The existing plants have been categorised under four 'Age Groups'—pre-1960; between 1960 and 1965; between 1965 and 1970 and post-1970. This plantwise—yearwise productivity given in Table I has been rearranged according to the age of the plants in Table 2.

It is generally accepted that operations in a new plant take 2 to 3 years to stabilise. It is, therefore, not unreasonable to expect that production in units like MFL, Goa, Cochin and Durgapur had not completely stabilised during the period under review.

An examination of the data given in Table 2 clearly shows that the production performance of the plants established before 1960 is distinctly lower than the others. In each of the next two groups, while there is considerable disparity between the performances of various plants, with some plants in the third category (i.e., those set up between 1965-70) faring worse than the older plants, there is no denying that the average performance of the latter plants appears to be much superior to the earlier plants.

The average performance for 1972-73 of the plants established between 1960 and 1965 works out to 63 per cent and that for 1973-74 62 per cent. The corresponding figures for the units established between 1965 and 1970 excluding Neyveli (as it has continuously suffered from problems of raw materials and other technological problems) are 87 and 77 per cent respectively. It is obvious that the newer plants have performed very much better than the older ones. It can be safely asserted from this analysis that the older the plant, the poorer its performance. Conversely, productivity in more modern plants is distinctly better.

This is not surprising. This phenomenon is, due, *inter se*, to two predominant factors, i.e., improved technology and better physical fitness due to younger age of plants. This is the reason for rapid obsolescence in advanced countries particularly for chemical industries — a luxury we in India cannot afford due to our socio-politico-economic conditions.

According to Size

For this purpose, the existing units

1/ Reproduced from FAI Fertilizer News, March 1975

TABLE 1-A *Production performance of nitrogenous and complex fertiliser plants in India during the Fourth Plan Period*

(April-March)

Plant		1969-70			1970-71			1971-72			1972-73			1973-74			Date of commissioning
		Capacity	Production	Per cent capacity utiln.	Capacity	Production	Per cent capacity utiln.	Capacity	Production	Per cent capacity utiln.	Capacity	Production	Per cent capacity utiln.	Capacity	Production	Per cent capacity utiln.	
1. FACT, Alwaye	N	70,000	30,000	43	92,000	30,000	33	92,000	36,364	40	82,000	28,592	35	82,000	36,000	44	June 1947
	P_2O_5	27,000	11,000	41	36,200	12,000	33	36,200	11,948	33	36,200	10,873	30	36,200	17,000	47	Sept., 1971
2. FCI, Sindri	N	1,17,000	74,000	63	1,17,000	74,000	63	1,17,000	57,222	49	90,000	55,364	62	90,000	57,000	65	Nov., 1951 - Oct. 1959
3. NCJML, Varanasi	N	10,160	3,000	30	10,160	6,000	59	1,01,160	4,611	46	10,000	3,465	35	10,000	4,000	40	Nov., 1959
4. FCI, Nangal	N	80,000	80,000	100	80,000	55,000	69	80,000	56,531	71	80,000	53,981	67	80,000	62,000	77	Feb., 1961
5. HSL, Rourkela	N	1,20,000	30,000	25	1,20,000	24,000	20	1,20,000	46,352	39	1,20,000	49,097	40	1,20,000	46,000	38	Dec., 1962-August 1969
6. EID-Parry, Ennore	N	15,970	9,600	60	15,970	8,680	54	15,970	10,940	69	15,970	11,680	73	15,970	10,340	65	Mar., 1963 - Jan. 1968
	P_2O_5	10,430	7,240	70	10,430	5,890	57	10,430	8,370	80	10,430	8,830	85	10,430	8,050	77	
7. FCI, Trombay	N	90,000	44,000	49	81,000	63,000	78	81,000	68,353	85	81,000	60,709	75	81,000	56,000	69	Oct., 1965 - Nov. 1965
	P_2O_5	45,000	17,000	38	36,000	24,000	67	36,000	40,675	113	36,000	36,012	100	36,000	32,000	89	
8. NLC, Neyveli	N	70,000	43,000	61	70,000	32,000	46	70,000	19,751	28	70,000	20,910	30	70,000	15,000	21	Mar., 1966
9. GSFC, Baroda	N	2,16,000	1,10,000	51	2,16,000	1,47,000	68	2,16,000	1,85,440	86	2,16,000	2,02,603	94	2,16,000	1,61,000	75	May 67 - June 69
	P_2O_5	51,840	21,000	41	51,840	25,000	48	51,840	24,146	47	51,840	31,779	61	51,840	28,000	55	
10. CFL, Vizag	N	80,000	68,000	85	80,000	75,000	94	80,000	64,595	81	80,000	58,917	74	80,000	54,000	68	Dec., 67 - Feb., 68
	P_2O_5	73,000	64,000	88	73,000	58,000	79	73,000	64,410	88	73,000	62,336	85	73,000	61,000	84	
11. FCI, Namrup	N	45,000	25,000	56	45,000	27,000	60	45,000	29,819	66	45,000	33,718	75	45,000	36,000	80	Feb., 68 - Jan. 69
12. FCI, Gorakhpur	N	80,000	73,000	91	80,000	68,000	85	80,000	76,000	95	80,000	66,733	83	80,000	64,000	80	Feb., 68 - Jan. 69
13. SCI, Kota	N	1,12,000	81,000	72	1,12,000	1,14,000	102	1,10,000	1,07,276	98	1,10,000	1,27,525	116	1,10,000	1,10,000	100	Feb., 1969
14. IEL, Kanpur	N	2,00,000	17,000	9	2,00,000	1,07,000	54	2,00,000	1,28,524	64	2,00,000	1,60,282	80	2 00,000	1,15,000	57	Dec., 1969
15. MFL, Madras	N	—	—	—	—	—	—	1,90,000	42,413	22	1,64,000	1,04,832	64	1,64,000	1,24,000	76	July 71 - Oct. 71
	P_2O_5	—	—	—	—	—	—	85,000	12,908	31	85,000	53,520	63	85,000	52,000	61	
16. ZACL, Goa	N	—	—	—	—	—	—	—	—	—	—	—	—	1,70,000	65,000	45	Jan., 73 - May, 73
17. FACT, Cochin	N	—	—	—	—	—	—	—	—	—	—	—	—	1,52,000	14,000	9	April, 73 - July, 73
18. FCI, Durgapur	N	—	—	—	—	—	—	—	—	—	—	—	—	1,52,000	6,000	3	June 73 - Oct. 73
19. Coke Ovens	N	26,750	16,000	60	26,750	16,000	60	26,630	14,738	55	26,630	16,084	60	27,990	14,560		
20. Single & Triple Superphosphate Factories	P_2O_5	2,24,030	1,01,888	47	2,26,180	1,00,655	45	2,29,460	1,27,104	55	2,12,170	1,28,819	61	2,36,120	1,26,791	54	
	N	13,32,880	7,04,600	53	1,34,580	8,46,680	63	15,33,760	9,49,110	62	14,70,600	10,54,594	70	19,45,960	10,49,900	54	
	P_2O_5	4,31,300	2,22,128	52	5,33,650	2,25,545	53	5,21,930	2,90,032	56	5,04,640	3,32,169	66	5,81,630	3,24,841	56	

Ref : *Fertiliser Statistics*, FAI, 1968-69 to 1972-73.

Table 2—Fertiliser plants according to age

Plant	Per cent capacity utilisation				
	1969-70	1970-71	1971-72	1972-73	1973-74
(a) Established before 1960					
1. FACT, Alwaye	43	33	40	35	44
2. FCI, Sindri	63	63	49	62	63
3. NCJM, Varanasi	30	59	46	35	40
(b) Established between 1960 and 1965					
4. FCI, Nagal	100	69	71	67	77
5. HSL, Rourkela	25	20	39	40	38
6. EID-Parry, Ennore	60	54	69	73	65
7. FCI, Trombay	49	78	85	75	69
(c) Established between 1965 and 1970					
8. NLC, Neyveli	61	46	28	30	21
9. GSFC, Baroda	51	68	86	94	75
10. CFL, Vizag	85	94	81	74	60
11. FCI, Namrup	56	60	66	75	80
12. FCI, Gorakhpur	91	85	95	83	80
13. SCI, Kota	72	102	98	116	100
14. IEL, Kanpur	9	54	64	80	57
(d) Established after 1970					
15. MFL, Madras	—	—	22	64	76
16. ZACL, Goa	—	—	—	—	45
17. FACT, Cochin	—	—	—	—	9
18. FCI, Durgapur	—	—	—	—	3

Ref: *Fertiliser Statistics*, FAI, 1968-69 to 1972-73.

have been classified under four sizes, namely, below 50,000 tonnes per annum of nitrogen, between 50,000 to 100,000 tonnes, between 100,000 to 200,000 and over 200,000 tonnes. The relevant data is presented in Table 3. Although it is not possible to arrive at any definite conclusion, it would appear that the performance of the stabilised plants with a capacity exceeding 100,000 tonnes has been marginally better than the rest.

According to Feedstock Used

All the existing plants have been reclassified as (a) naphtha-based, (b) coke and lignite-based, (c) natural gas, refinery gas and cokeoven gas-based, (d) electricity-based, and (e) based on more than one feedstock (ref.: Table 4). In the last category are included plants like Sindri which use coke, coke-oven gas and naphtha, the Rourkela plant which uses cokeoven gas and naphtha, and the Trombay plant which uses refinery gas and naphtha.

It may be seen from Table 4 that except FACT, the rest of the naphtha-based plants (barring Goa, Cochin and Durgapur where production is yet to stabilise), have been performing well. The average capacity utilisation of the plants at Ennore, Baroda, Visakhapatnam, Gorakhpur, Kota and Kanpur during 1972-73, at around 86 per cent is good by any standard.

The performance of plants based on coke and lignite as feedstock has been very poor (averaging about 42 per cent). The only plant based completely on natural gas is the FCI unit at Namrup. Although its performance has improved over the years, its best achievement so far has been only about 80 per cent compared to the average of 86 per cent of the plants based on naphtha. Normally, plants based on natural gas, perform much better than those based on other feedstocks. The comparatively low productivity of the Namrup plant is unusual and is attributed to inadequate and irregular supply of electric power from the State Electricity Board.

The Nangal Plant is based on electrolysis of water. It has worked to 100 per cent capacity whenever the full power required, namely, 164 MW, is made available to the plant. Its low productivity in the last four years is only due to the shortage of power.

Table 3—Fertiliser plants according to size

Plant	Per cent capacity utilisation				
	1969-70	1970-71	1971-72	1972-73	1973-74
(a) Capacity over 200,000 tpa N					
1. GSFC, Baroda	51	68	86	94	75
(b) Capacity between 100,000 and 200,000 tpa N					
2. HSL, Rourkela	25	20	39	40	38
3. SCI, Kota	72	102	98	116	100
4. IEL, Kanpur	9	54	64	80	57
5. MFL, Madras	—	—	22	64	76
6. ZACL, Goa	—	—	—	—	45
7. FACT, Cochin	—	—	—	—	9
8. FCI, Durgapur	—	—	—	—	3
(c) Capacity between 50,000 and 100,000 tpa N					
9. FACT, Alwaye	43	33	40	35	44
10. FCI, Sindri	63	63	49	62	63
11. FCI, Nangal	100	69	71	67	77
12. FCI Trombay	49	78	85	75	69
13. NLC, Neyveli	61	46	28	30	21
14. CFL, Vizag	85	94	81	74	68
15. FCI, Gorakhpur	91	85	95	83	80
(d) Capacity below 50,000 tpa N					
16. NCJM, Varanasi	39	59	46	35	40
17. EID-Parry, Ennore	60	54	69	73	65
18. FCI, Namrup	56	60	66	75	80

Ref: *Fertiliser Statistics*, FAI, 1968-69 to 1972-73.

Table 4—Fertiliser plants according to feedstock

Plant	Per cent capacity utilisation					Remarks
	1969-70	1970-71	1971-72	1972-73	1973-74	
(a) Naphtha as feedstock						
1. FACT, Alwaye	43	33	40	35	44	
2. EID-Parry, Ennore	60	54	69	73	65	
3. GSFC, Baroda	51	68	86	94	75	
4. CFL, Vizag	85	94	81	74	68	
5. FCI, Gorakhpur	91	85	95	83	80	
6. SCI, Kota	72	102	98	116	100	
7. IEL, Kanpur	9	54	64	80	57	
8. MFL, Madras	—	—	22	64	76	
9. ZACL, Goa	—	—	—	—	45	
10. FACT, Cochin	—	—	—	—	9	
11. FCI, Durgapur	—	—	—	—	3	
(b) Coal, coke, lignite as feedstock						
12. FCI, Sindri	63	63	49	62	82	Using also naptha
13. NCJM, Varanasi	30	59	48	35	40	
14. NLC, Neyveli	61	46	28	30	21	
(c) Natural gas, refinery gas and C.O.G.						
15. FCI, Namrup	56	60	66	75	80	
(d) Electricity as feedstock						
16. FCI, Nangal	100	69	71	67	77	
(e) Using more than one feedstock						
17. FCI, Sindri	63	63	49	62	62	Coal, naphtha, C.O.G.
18. HSL, Rourkela	25	20	39	40	30	C.O.G., naphta
19. FCI, Trombay	49	78	85	75	69	Naphta, refin. gas

Ref: *Fertiliser Statistics*, FAI, 1968-69 to 1972-73.

The plants using more than one feedstock have not performed satisfactorily. This is understandable as considerable complications arise due to multiplicity of processes to be adopted when more than one feedstock is to be processed in the same plant. Among the units in this category, the performance of Trombay unit is distinctly superior to the others.

Indian experience points to the need for a single feedstock for each unit and the plant being designed accordingly. Of these, naphtha would appear to be the best suited. No wonder that the Indian fertiliser industry has so far shown a marked preference for naphtha as a feedstock and all plants commissioned since 1967 to date were naphtha based till now when the changes in the international oil scene have forced us to opt for alternatives like fuel oil and coal.

According to Process Adopted

The units and their productivity reclassified under the various processes adopted like partial oxidation, steam reforming and miscellaneous processes are shown in Table 5. The plants based on steam reforming of naphtha appear to have performed the best of the lot. For example, the overall average performance of the plants at Baroda, Visakhapatnam, Kota and Kanpur at 91 per cent during 1972-73 is commendable. The average productivity of the plants based on partial oxidation process barring FACT, i.e., Ennore, Gorakhpur, and Trombay at 76 per cent is also fairly satisfactory. Other units using miscellaneous processes have not fared as well. To sum up, plants using steam reforming process of naphtha have performed much better than those using other processes.

The lesson here is obvious. For a country like India with limited resources and which has to rapidly augment domestic production to meet the ever increasing demand, we must adopt proven, even though less sophisticated, technology and equipment. We cannot afford the luxury of being used as guinea pigs for experimenting with newer processes.

Table 5—Fertiliser plants according to process adopted

Plant	Per cent capacity utilisation				
	1969-70	1970-71	1971-72	1972-73	1973-74
(a) Partial oxidation process					
1. FACT, Alwaye	44	33	40	35	44
2. EID-Parry, Ennore	60	54	69	73	65
3. FCI, Gorakhpur	91	85	95	83	80
4. FCI, Trombay	49	78	85	75	69
(b) Steam reforming process					
5. FCI, Namrup	56	60	66	75	80
6. GSFC, Baroda	51	68	86	94	75
7. CFL, Vizag	85	94	81	74	68
8. SCI, Kota	72	102	98	116	100
9. IEL, Kanpur	9	54	64	80	57
10. MFL, Madras	—	—	22	64	76
11. ZACL, Goa	—	—	—	—	45
12. FACT, Cochin	—	—	—	—	9
13. FCI, Durgapur	—	—	—	—	3
(c) Miscellaneous process					
14. FCI, Sindri	63	63	49	62	63
15. NCJM, Varanasi	30	59	48	35	40
16. HSL, Rourkela	25	20	39	40	38
17. FCI, Nangal	100	69	71	87	77
18. NLC, Neyveli	61	46	28	30	21

Ref: *Fertiliser Statistics*, FAI, 1968-69 to 1972-73.

TABLE 1-B CAPACITY UTILIZATION BY SECTORS

	1969-70	1970-71	1971-72	1972-73	1973-74
Private Sector					
1. SCI, Kota	72	102	98	116	100
2. IEL, Kanpur	9	54	64	80	57
3. Zuari Agro, Goa	-	-	-	-	45
4. CFL, Vizag	85	94	81	74	68
Joint Sector					
1. GSFC, Baroda	51	68	86	94	75
2. MFL, Madras	-	-	22	64	76
Public Sector					
1. HSL, Rourkela	25	20	39	40	38
2. FACT, Alwaye	43	33	40	35	44
3. FACT, Cochin	-	-	-	-	9
4. FCI, Durgapur	-	-	-	-	4
5. FCI, Sindri	63	63	49	62	63
6. FCI, Nangal	100	69	71	67	77
7. FCI, Trombay	49	78	85	75	69
8. FCI, Gorakhpur	91	85	95	83	80
9. FCI, Namrup	56	60	66	75	80
10. Neyveli	61	46	28	30	21

THE OIL INDUSTRY AS A SOURCE OF FEEDSTOCK FOR THE FERTILIZER INDUSTRY

India has small reserves of natural gas, sufficient to provide feedstock for only two fertilizer plants, the FCI Namrup plant in Assam and the IFFCO Kalol plant in Gujarat. For all the other fertilizer plants it has to rely on petroleum products, namely naphtha and fuel oil provided by the oil industry. The traditional feedstock has been naphtha, principally because the naphtha reforming process, applied for the production of ammonia, is a well known process and was until recently the only one commercially available for the manufacturer of nitrogen fertilizer from petroleum feedstock.

In the last few years commercialization of a process based on the partial oxidation of hydrocarbons has made it possible to use heavier, and therefore cheaper, feedstocks for ammonia production. Unfortunately, the capital cost requirements of such a process is somewhat higher than that required in the naphtha reforming. Although it is extremely difficult to estimate the cost differential between the two processes on a comparable basis, figures ranging from 30% to 50% have been quoted by engineering firms.

The Government of India, through the Ministry of Petroleum and Chemicals, decided in 1971 to adopt fuel oil as the feedstock for all ammonia plant to be built in India. Although they were aware of the additional capital cost which would be required, the higher price of naphtha, when compared to fuel oil, and the availability of surplus fuel oil in the local market appeared to be sufficient reasons to justify such a decision from an economic as well as a supply point of view. Indeed refinery planning in India has broadly aimed to achieve a high level of self-sufficiency with respect to refinery products. In view of the fact that a high proportion of the demand consists of middle distillates, the tendency has sometimes been to think of other products as potentially surplus.

Thus in the 1960's the indigenous fertilizer and petrochemical plants were based on naphtha as feedstock, because a surplus of light distillates was otherwise anticipated. Recently the GOI has attempted to reduce the use of crude oil, by substituting fuel oil with coal, and the resultant prospective surplus of heavy fuel oil would warrant in their view the establishment of a new generation of fertilizer plants based on fuel oil rather than naphtha. This shift can easily be seen from Tables 1, 2 and 3 feedstock requirements of the various fertilizer plants, in operation or being built in India.

In the present situation, a rather different approach may be justified, in which the design of refineries is more closely matched to the pattern of product demand. Rather than expanding total refining capacity in line with prospective increase in the demand for middle distillates, it might be better to use heavy ends, which should become available because of the switch from fuel oil to coal, as an input into secondary processes, as for example coking, hydrocracking or catalytic cracking, which would yield further quantities of light and middle distillates.

Table 1

Estimated Naphtha Requirements for Fertilizer Plants

('000 tons)

Year ending March 31 Project		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1.	Sindri	26	26	26	26	26	20	-	-	-	-
2.	Trombay	75	75	80	80	80	80	80	80	80	80
3.	Gorakhpur	94	90	100	110	110	110	110	110	110	100
4.	Durgapur	35	85	120	130	130	130	130	130	130	130
5.	FACT Udl.	60	65	55	55	55	55	55	55	55	55
6.	Cochin	70	98	120	135	135	135	135	135	135	135
7.	Rourkela	80	80	80	110	110	110	110	110	110	110
8.	Madras	143	190	210	220	220	220	220	220	220	220
9.	Barauni	10	105	130	140	145	145	145	145	145	145
10.	IFFCO	10	50	55	60	60	60	60	60	60	60
11.	EID Parry	13	13	11	-	-	-	-	-	-	-
12.	GSFC	110	110	130	130	130	130	130	130	130	130
13.	Vizag	85	80	80	80	80	80	80	80	80	80
14.	Kota	100	135	145	145	145	145	145	145	145	145
15.	Kanpur	200	200	200	200	200	200	200	200	200	200
16.	Goa	195	195	210	210	210	210	210	210	210	210
17.	Tuticorin	30	160	200	220	220	220	220	220	220	220
18.	Mangalore	-	90	120	140	140	140	140	140	140	140
19.	Maharashtra Cooperative	-	-	-	-	-	40	40	45	45	45
	Total	1,296	1,847	2,072	2,191	2,196	2,230	2,210	2,215	2,215	2,215

SOURCE: Data supplied by the Ministry of Petroleum and Chemicals, India.

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Table 2

Fuel Oil/Feedstock Requirements
for Fertilizer Plants

('000 tons)

Year Ending March 31	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1. Sindri Modernization	-	-	-	70	160	200	200	200	200	200
2. Trombay Expansion	-	-	-	-	140	170	200	200	200	200
3. Nangal Expansion	-	25	120	200	220	220	220	220	220	220
4. Haldia	-	-	-	70	110	150	150	150	150	150
5. Phatinda	-	-	-	70	170	220	220	220	220	220
6. Phulpur	-	-	-	-	70	170	210	210	210	210
7. Kota Expansion	-	-	-	-	40	220	260	300	300	300
8. Panipat	-	-	-	-	-	150	200	220	220	220
9. Mathura	-	-	-	-	-	100	200	220	220	220
10. Paradeep	-	-	-	-	-	-	140	280	320	320
11. Kakinada	-	-	-	-	50	170	200	210	210	210
12. GSFC Expansion	-	-	-	50	200	260	300	300	300	300
Total	-	25	120	460	1,160	2,030	2,500	2,730	2,770	2,770

SOURCE: Data supplied by the Ministry of Petroleum and Chemicals, India.

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Table 3

Fuel Oil Requirements for Fertilizer Plant

('000 tons)

Year Ending March 31	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Units										
1. Trombay	35	50	50	50	50	50	50	50	50	50
2. FACT Udl.	25	25	25	25	25	25	25	25	25	25
3. Cochin	30	50	70	80	80	80	80	80	80	80
4. M.F.L.	60	70	80	80	80	80	80	80	80	80
5. EID	8	10	10	-	-	-	-	-	-	-
6. GSFC	50	60	70	100	130	130	130	130	130	130
7. Vizag	30	35	35	35	35	35	35	35	35	35
8. Kota	25	25	25	25	25	25	25	25	25	25
9. Goa	80	85	90	90	90	90	90	90	90	90
10. Tuticorin	25	100	150	150	150	150	150	150	150	150
11. Mangalore	-	20	25	30	30	30	30	30	30	30
12. IFFCO	20	40	50	55	55	55	55	55	55	55
Total	388	570	680	720	750	750	750	750	750	750

SOURCE: Data supplied by the Ministry of Petroleum and Chemicals, India.

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INDIA - FERTILIZER INDUSTRY CREDIT

FCI On-Going Project Costs and Financing Requirements
(in US$ Millions)

I. On-Going Projects (Estimated to be commissioned FY 1976/77 or later)

	Project Cost Estimate 1/			FX Financing Gap 2/	LC Required to Completion
	Foreign Exchange	Local Currency	Total		
Namrup	29.7	49.1	78.8	0.1	7.4
Gorakpur	11.2	12.3	23.5	-	4.0
Barauni	28.6	63.2	91.8	1.0	10.5
Nangal	75.1	58.4	133.5	16.1	47.4
Trombay IV	33.0	46.1	79.1	-	43.6
Talcher	52.6	136.4	189.0	2.6	56.7
Ramagundam	51.8	131.9	183.7	1.8	56.5
Durgapur	31.5	55.4	86.9	0.6	3.1
Haldia	51.4	199.2	250.6	10.5	159.9
Sindri					
a. Rationalization & Renovation	18.8	44.8	63.6	12.9	13.8
b. Modernization	91.0	83.6	174.6	-	82.3
Korba	53.9	204.7	258.6	40.0	201.0
Miscellaneous Schemes	5.1	27.6	32.7	-	6.7
Total	533.7	1,112.7	1,646.4	85.6	692.9

II. GOI Financial Support for FCI Projects

	Total GOI Contribution to FCI Projects 3/					
	FY 1976-79			FY 1980 & Onwards		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
a. On-Going Projects	86	628	714	-	65	65
b. Modernization 4/	1	52	53	-	-	-
c. New Projects 5/	113	295	408	62	165	227
	200	975	1,175	62	230	292

1/ Based on FCI estimates as of May 1975. An exchange rate of Rs 7.80 = US$1.00 is used. Of the total $1,646.4 million project costs, $681.3 million has been disbursed as of March 31, 1975.

2/ Excludes foreign exchange spent by GOI up to March 31, 1975.

3/ The internal cash generation of FCI during FY 1976-1979 is not expected to provide funds to even partially finance the on-going projects and may even be inadequate to support existing operations. Hence the total local currency financing from GOI may exceed the project requirements indicated above.

4/ The modernization projects are those covered under the plant improvement (POIP) component of the Trombay IV credit ($13 million in foreign exchange) and the proposed Fertilizer VII Industry Credit ($40 million in foreign exchange).

5/ New projects are Trombay V and Paradeep.

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Fertilizer Investment Program-Project Costs and Financing Requirement[1]
(in US$ Millions)

	Project Cost Estimates			Financing Gap to be Provided by GOI		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
I. On-Going Projects (Estimated to be commissioned FY 1976/77 or later)						
FCI (11)[2]	534	1,113	1,647	86	693	779
NFL (2)	180	253	433	100	253	353
FACT (Cochin II)[3]	27	42	69	7	22	29
IFFCO (Phulpur)[4]	109	112	221	-	59	59
Khetri	25	40	65	-	10	10
Madras Expansion[5]	2	13	15	-	-	-
	877	1,573	2,450	193	1,037	1,230
Required During FY 1976/77 - FY 1978/79				193	972	1,165
Required During FY 1979/80 or Onwards				-	65	65
				193	1,037	1,230
II. Modernization Projects (POIP & Fertilizer VII)[6]						
FCI	52	60	112	1	52	53
Other Public Sector (FACT, Neyvelli, Rourkela)	21	37	58	-	26	26
Private/Mixed Sectors	29	58	87	-	-	-
Total	102	155	257	1	78	79
III. Proposed New Projects						
Trombay V[2]	50	130	180	50	130	180
Paradeep[2]	125	330	455	125	330	455
Mathura	100	130	230	60	130	190
GSFC II	100	130	230	65	15	80
Shaw-Wallace	100	130	230	-	60	60
Maharastra Cooperative Fertilizers & Chemicals (MCFC)	18	39	57	-	-	-
Total	493	889	1,382	300	665	965
Required During FY 1976/77 - FY 1978/79				240	500	740
Required During FY 1979/80 or later				60	165	225
				300	665	965

1/ Unless otherwise indicated, the costs shown above are based on estimates of the appraisal mission. An exchange rate of Rs 7.80 = US$ 1.00 is used.
2/ FCI estimate as of May 1975.
3/ Based on February 5, 1975 project supervision estimate.
4/ Based on project appraisal estimate.
5/ Based on company (MFL) estimate as of February 1975.
6/ Excludes HPCL refinery expansion project and technical assistance.

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TROMBAY IV POIP COMPONENTS

Previous Assistance for Plant Operation Improvement

Under IDA Credit 481-IN, $17 million was provided in May 1974 for the plant operation improvement (POIP) of FCI and FACT plants. However, the use of these funds has been slow because FCI had to appoint technical experts to make detailed studies of the plants having problems. On the basis of these findings, FCI has prepared a plan for the use of the funds. The following table shows a list of items for which Bank approval has been given and for which procurement is underway:

Plan for Using $17 Million
Under IDA Credit 481-IN

		Cost, $ Million		
I. FCI Projects	Scope of Planned Activities	Foreign	Local	Total
Durgapur	Implementation of the Technimont survey recommendations	3.7	6.5	10.2
Trombay	Sulfuric acid plant modernization	0.5	1.5	2.0
	Ammonia plant renovation	0.7	0.5	1.2
	In-plant power generation	3.6	4.9	8.5
Sindri	Aluminium fluoride production	1.9	4.1	6.0
Gorakhpur	Spare for wasteheat boiler	0.3	0.2	0.5
	Low pressure & high pressure decomposers for urea plant	0.8	0.7	1.5
General	Consultancy services for Trombay, Nangal, Sindri and Durgapur	1.1	0.9	2.0
	15 tank wagons for ammonia transportation	0.4	1.0	1.4
	Sub-Total	13.0	20.3	33.3
II. FACT	Cochin I debottlenecking	1.3	2.8	4.1
	Udyogamandal Plant modernization	2.7	5.5	8.2
	TOTAL	17.0	28.6	45.6

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INDIA - FERTILIZER INDUSTRY CREDIT

Financing Sources of Fertilizer Investment Program
(in millions of US dollars)

Projects/Sources	Foreign Exchange	Local Currency	Total
I. Ongoing Projects[1/]			
IBRD/IDA	321	-	321
Italian Credits	112	-	112
Japanese Credits (NFL)	80	-	80
Other Bilateral Credits & FX Sources	116	-	116
Internal Enterprise Funds	-	82[2/]	82
Local Financial Institutions	-	24[3/]	24
Already Disbursed (up to March 1975) by GOI	55	430	485
GOI (FY 1975/76-FY 1978/79)	193	972	1,165
GOI (FY 1979/80)	-	65	65
Sub-Total	877	1,573	2,450
II. Modernization (Fert. VII & Trombay IV Credit)			
IDA[4/]	101	16	117
Internal Enterprise Funds	-	40	40
Local Financial Institutions	-	21	21
GOI	1	78	79
Sub-Total	102	155	257
III. Proposed New Projects			
ODM (Shaw-Wallace)	85	-	85
Japanese Credit (Mathura)	40	-	40
KfW (GSFC II)	35	-	35
Other FX Sources	33[5/]	-	33
Project Sponsors/State Govt.[6/]	-	46	46
Local Financial Institutions [7/]	-	178	178
GOI (FY 1975/76 - FY 1978/79)	240	500	740
GOI (FY 1979/80)	60	165	225
Sub-Total	493	889	1,382

1/ Of the $321 million IBRD/IDA foreign exchange funds, some $45 million has been disbursed as of March 31, 1975. Of the $308 million foreign exchange funds from other sources (Italian, Japanese, others), $180 million has been disbursed as of March 31, 1975.

2/ Rajasthan State (Khetri) $40; IFFCO $29, and Madras $13 million respectively. Some $40 million of this $82 million is estimated to have been disbursed as of March 31, 1975.

3/ For IFFCO (Phulpur) project.

4/ Fertilizer VII: $100 million (excluding $4 for HPCL and $1 million for technical assistance); Trombay IV Credit $17 million.

5/ Assumes $15 million for Shaw Wallace. $18 million is for MCFC which will be purchased with local currency (borrowed from financial institutions and raises the funding from institutions to $196 million for new projects).

6/ Shaw Wallace - $15 million; GSFC II - $11 million; MCFC - $16 million (State/Cooperative/GOI).

7/ It is estimated that local financial institutions can provide about US$230 million in local funds for the fertilizer industry assumed to be allocated as follows:

GSFC II	$100 million
Shaw-Wallace	$ 55 "
MCFC	$ 41 "
IFFCO (Phulpur)	$ 24 "
SPIC	$ 10 "
Total:	$230 million

Industrial Projects
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

FOREIGN EXCHANGE COST OF FERTILIZER CONSUMPTION

A The Foreign Exchange Cost of Fertilizer Consumption

1. Table 2 provides an estimate of the foreign exchange cost of fertilizer consumption, covering only the import of finished products and raw materials and excluding capital charges as well as maintenance expenditures. The foreign exchange cost of fertilizer consumption is expected to gradually increase from about US$810 million in 1976/77 to US$1,200 million by 1980/81 (in current dollars) as a result of higher consumption levels. The foreign exchange cost per nutrient ton consumed, however, will decline by 14% from US$209 (1976/77) to US$179 (1980/81) during the same period. The share of fertilizer product imports--representing the shortfall between consumption and local production--will also decline from 56% of the 1976/77 foreign exchange cost to 35% by 1980/81 as increasing local production supply a larger proportion of requirements.

2. Actual product imports during 1976/77, however, may be less than the estimated deficit as stocks have been built up during 1974/75 and 1975/76 when the deficits were only 72% of product imports (Table 1). Some build-up in stocks is necessary as inventories were greatly reduced during 1971/72 through 1973/74 when product imports were less than the deficit. Unfortunately, fertilizer import costs increased steeply during 1974/75 and 1975/76, with the average import cost reaching US$708 per ton of nutrient in 1975/76 compared to US$153 per ton of nutrient during 1972/73. Thus, the inventory build-up during 1974/75 and 1975/76--approximately 0.88 million nutrient tons--cost about US$520 million, or US$590 per nutrient ton. The projected import cost for 1976/77, as a consequence of the decline in international prices starting in mid-1975, is only about US$435 per nutrient ton.

3. The calculation of the foreign exchange cost of phosphate production assumes that one-third of phosphate rock requirements will be supplied from local sources. While there are existing local phosphate rock suppliers, their output is not expected to provide one-third of requirements towards the end of this decade. However, there are phosphate deposits in the Rajasthan area that can be developed and it has been assumed that phosphate rock from this or similar sources will be available within the next three or four years. Considering the higher freight costs for phosphate rock and the escalating capital costs for phosphoric acid plants, phosphate production based on imported rock is only marginally economic compared to imports of finished phosphate fertilizer. Consequently, the development of domestic phosphate rock deposits should have a high priority among development projects in India.

B. The Effect of a Delay in Completing Projects

4. While the industry has the potential of increasing output to keep pace with the growth in demand, some caution must be exercised. Most of the

capacity additions, representing about 35% of the nutrient capacity in 1979/80 are scheduled to come on stream during 1977/78 and thereafter. Even a modest one-year delay in this group of projects could reduce production by about 10% during the four-year period 1977/78 through 1978/81--for a total of about 1.46 million tons of nutrient. The foreign exchange cost of fertilizer consumption during this four-year period will increase by US$718 million (in current dollars), or an annual average of US$180 million. The fertilizer deficit which is expected to range from 1.0 to 1.2 million nutrient tons from now till 1980/81, would instead range from 1.3 to 1.6 million nutrient tons. The impact of a one-year delay in the completion of this group of projects is most pronounced during 1979/80--when the deficit could increase by 60% from 1.0 to 1.6 million tons of nutrient and the foreign exchange cost of fertilizer consumption will increase by US$270 million from US$985 million to US$1,255 million (in current dollars).

ANNEX 4-5
Table 1

INDIA - FERTILIZER INDUSTRY CREDIT

THE COST OF FERTILIZER PRODUCT IMPORTS
(in current US$)

Year	Deficit of Fertilizer Products 1/ Nutrient (million TPY)	Deficit: Value(CIF) (million US$) 2/	Deficit: Average Price ($/ton Nutrient) 3/	Imports of Fertilizer Products Nutrient (million TPY)	Imports: Value(CIF) (million US$)	Imports: Average Price ($/ton Nutrient)
1971/72 (Actual)	1.37			0.97	115.3	119
1972/73 "	1.31			1.22	187.2	153
1973/74 "	1.32			1.26	354.8	282
1974/75 "	1.12			1.60	768.1	480
1975/76 (Estimate)	1.11			1.54	1,089.7	708
1976/77 (Forecast)	1.05	455.8	434			
1977/78 "	1.15	464.8	404			
1978/79 "	1.00	320.8	321			
1979/80 "	1.00	316.0	316			
1980/81 "	1.20	425.0	354			

1/ Deficit is defined as the difference between consumption and local production of finished fertilizer products. Deficits for 1973/74 to 1980/81 are from Annex 2-4.

2/ Taken from Table 2 (only for products, excludes raw materials).

3/ The decline in the projected average price per ton of nutrient from 1976/77 through 1979/80 is due to two factors:
(a) the increasing share of potassium (K_2O) in the nutrient deficit (from 48% in 1976/77 to 80% in 1979/80); potassium, on a nutrient weight basis ($/ton of nutrient), is cheaper than nitrogen and and phosphate; and
(b) the decline in fertilizer and phosphate rock prices during 1976/77 through 1978/79.

Industrial Projects Department
June 1975

ANNEX 4-5
Table 2

INDIA - FERTILIZER INDUSTRY CREDIT

FOREIGN EXCHANGE COST OF FERTILIZER CONSUMPTION 1/
(in millions of constant 1975 US$)

Fiscal Year Ending March 31	Case I - All Projects Completed as Scheduled 2/					Case II - One Year Delay in Projects to be Commissioned 1977/78 and Onwards 3/				
	1977	1978	1979	1980	1981	1977	1978	1979	1980	1981
Nutrient										
A. Nitrogen (N)										
1. Imported Products 4/	248	209	40	-	-	248	266	250	219	112
2. Imported Materials 5/	140	174	228	268	288	140	167	193	232	269
Sub-total	388	383	268	268	288	388	433	443	451	381
B. Phosphate (P_2O_5)										
1. Imported Products 6/	65	60	78	78	117	65	64	94	90	117
2. Imported Materials 7/	173	188	195	200	218	173	185	187	194	218
Sub-total	238	248	273	278	335	238	249	281	284	335
C. Potassium (K_2O)										
1. Imported Products 8/	94	112	125	143	161	94	112	125	143	161
D. Total Foreign Exchange Cost	720	743	666	689	784	720	794	849	878	877
Average Foreign Exchange Cost in Constant 1975 $/nutrient ton consumed	187	162	123	109	117	187	173	157	144	131
Price Inflators (1975/76 = 100)	112	122	132	143	153	112	122	132	143	153
E. Total Foreign Exchange Cost in Current US$	806	906	879	985	1,200	806	969	1,121	1,256	1,342
Average Foreign Exchange Cost in Current $/nutrient ton consumed	209	197	163	161	179	209	211	207	206	200
F. FOB Price Assumptions (constant 1975 $/metric ton) 9/										
1. Phosphate Rock	65	55	45	40	40					
2. TSP	170	155	150	150	150					
3. Urea	260	215	160	160	160					
4. Muriate of Potash	70	70	65	65	65					

1/ Consumption as projected in Annex 2-4. The imported products above correspond to the deficits in Annex 2-4 and need not equal actual imports.
2/ All on-going projects and proposed new projects but excluding Trombay V, Paradeep, Mathura and Korba.
3/ See Annex 2-4 for list of projects scheduled for commissioning in FY 1977/78 and onwards. Estimated production for this case are shown in Annex 2-4.
4/ Based on FOB price forecasts for urea (46% N) plus $25 per ton of urea for ocean transport.
5/ Based on US$67 (constant 1975 dollars) worth of imported materials per ton of N product. Derived from the cost of fuel oil at $55/ton (equivalent to US$61/ton of N) plus 10% for other materials.
6/ Based on FOB price forecasts for TSP (46% P_2O_5) plus $30/ton for ocean freight.
7/ Based on Bank FOB price forecasts for phosphate rock plus $30/ton for ocean freight multiplied by a factor of 3.9 (3 tons of rock/ton of P_2O_5 plus 30% of the rock cost for other materials) to arrive at CIF cost of imported materials per ton of P_2O_5 produced. One-third of production is assumed to utilize domestic phosphate rock and materials which have no foreign exchange cost component.
8/ Based on Bank FOB price forecasts for muriate of potash plus $40/ton for ocean freight multiplied by factor of 1.7 to arrive at CIF price per ton of K20.
9/ May 27, 1975 Bank commodity price forecasts through calendar year 1978 (1978/79), with prices remaining the same (except for phosphate rock) in real terms thereafter. Prices during 1975/76 are as follows: Phosphate Rock - $70/ton; TSP - $250/ton; urea - $300/ton; and potash - $70/ton.

Industrial Projects Department
June 1975

INDIA: FERTILIZER INDUSTRY CREDIT

DESCRIPTION AND ANALYSIS OF FCI SUB-PROJECTS

1. Five sub-projects of the Fertilizer Corporation of India are proposed for consideration under the Fertilizer Industry Credit along with other sub-projects described in Annexes 5-2 to 5-9. The total cost of the FCI sub-projects are estimated at Rs 616 million (US$79.0 million), including Rs 308 million (US$39.5 million) foreign exchange cost. The main purpose of the sub-projects is to improve capacity utilization in FCI plants (Table 1). The sub-projects are expected to be completed within three years. Following is a description of those sub-projects.

I. DURGAPUR INPLANT POWER GENERATOR

Introduction

2. In the fertilizer plants even slight interruption of power results in stoppage of continuous processes whose restarting period is considerable, even if power is restored immediately. Further, their delicate machinery is susceptible to damage from frequency variations and voltage dips. Moreover, continuous high temperature and high pressure in process fluids are critical for fertilizer plants. Any interruption in power supply causes sudden loss of temperature and pressure in the vessels and pipelines, thus causing thermal and mechanical stresses. In plants using the partial oxidization process, the power dips may pose an explosion hazard.

Durgapur Situation

3. Recurrence of power failures, voltage dips and fluctuations has been common in the Durgapur unit of FCI, leading to production losses as well considerable damage to equipment. Durgapur has also been affected by mechanical problems ever since it commenced production in 1973/74, and those problems have not yet been fully resolved. The plant has an installed capacity of 152,000 TPY of N in the form of 330,000 TPY of urea, but has not been able to operate at even 20% capacity thus far.

4. Power supply problems have compounded the mechanical problems of Durgapur. From the past record, it is estimated that the plant loses at least 22-day production a year, i.e., at least 20,000 tons of urea, because of power problems. At the current ex-factory price of Rs 1,183 (US$152) per ton of urea in India, the production loss amounts to about Rs 23.7 million (US$3 million) a year.

Existing System

5. The existing steam supply consists of three coal-fired service boilers each with an effective capacity of 55 tons/hr and a rated capacity of 60 tons/hr at 40 atm pressure. These boilers, in addition to supplying process steam, are used to meet the steam demand of the existing three turbine generators each with 0.75 MW nominally rated capacity which at present supply the "emergency and safety load" required to save critical equipment from severe damage in case of power failure.

6. Durgapur requires steam at three pressures for its processes: (1) high pressure steam at 135 ata; (2) medium pressure steam at 34 ata; and (3) low pressure steam at 4 ata. Currently the low and medium pressure steam is derived from the high pressure steam. As a result, any shortage of high pressure steam is reflected in the low and medium pressure steam. It is estimated that Durgapur at present has a high pressure steam shortage of 40 tons/hr and a medium pressure steam shortage of 30 tons/hr. Therefore, it is necessary to augment steam supply to maintain production on a continuous basis.

Proposed System

7. After studying various alternatives to solve power and steam supply problems, Development Consultants Private Ltd., a competent Indian consulting firm, has recommended the following: (1) installation of one 15 MW single, automatic extraction condensing turbine generator; (2) addition of two 60 ton/hr capacity boilers each raising steam at 135 ata and 500°C, along with related facilities as well as modification of the existing steam generation system. About 40 tons/hr of high pressure steam from the new boilers would be fed directly to process and about 30 tons/hr would be extracted from the turbine for supply to process. The balance steam would be passed to the condensing section of the power generation equipment. It is assumed that steam generators, turbine, boiler feed pumps and drives, a portion of power cycle piping, valves, support, control and instrumentation would be imported. The total cost of the proposed system is estimated at Rs 161.7 million (US$20.7 million), including Rs 68 million (US$8.7 million) in foreign exchange (Table 2).

Power Requirement

8. The following table shows the power requirements of various units of Durgapur:

	Power Requirement (MW)
Ammonia Plant	9
Urea Plant	7
Steam and Power Generation Units & Auxiliaries	4
Miscellaneous	1
	21

Out of the 21 MW of power required, 15 MW constitute the protective load -- that is the quantity essential to safeguard the plant from production loss and repeated shocks from power supply problems, maintain continuity to main processes and avoid prolonged time required for restarting. Though the protective loan will not be adequate to help run the plant at full capacity, it will at least enable the plant to run continuously critical processes which cannot be restarted and brought into production easily after interruptions of power supply. Further, with the implementation of the proposed system, the existing three small turbine generators could serve as standby after the much-needed maintenance work. They will come into operation when either the purchased power source or the new inplant power generators run into problems, thus always providing two separate sources of power for critical requirement.

Contracted Power Supply

9. Currently the fertilizer plant has an agreement with Durgapur Projects Ltd. (DPL) for the purchase of 16 MW in the first year of operation (1973/74) rising to 23 MW in the tenth year. Considering the estimated total power requirement of 21 MW and the proposed inplant generation of 15 MW, it will still be necessary to purchase 6 MW from DPL. To meet this demand for outside power without paying any significant penalty, it will be necessary to negotiate with DPL a billable demand of 75% of the contract demand which could be 8-10 MW. However, during maintenance work of the proposed generators over 45-60 days in a year, it will be necessary to meet most of power requirements from DPL. Therefore, this should be negotiated and maintenance work scheduled suitably taking into account the availability of extra power from DPL.

Cost-Benefit Analysis

10. As noted in para. 4, the proposed sub-project is estimated to augment production of Durgapur by at least 20,000 tons of urea valued at the present ex-factory price about Rs 23.7 million. The incremental production costs are estimated at Rs 16.5 million (US$2.1 million) excluding depreciation. As for total benefits, to the additional revenue from incremental production should be added the net savings in total power costs to Durgapur because of producing 15 MW of power internally rather than purchasing it from outside, and the net savings in maintenance costs for the entire plant because of uninterrupted power supply. It is estimated that Durgapur will be able to produce power at 10.5 paise per kwh compared to the recently revised price for outside power of 15.85 paise per kwh. Because of this differential, the annual power cost saving to Durgapur would be at least Rs 6.4 million (US$0.8 million). Further, the net savings in maintenance costs for the plant from uninterrupted power supply is estimated at Rs 25 million (US$3.2 million) at least. Thus the direct and indirect net benefits from the inplant power generation system would be Rs 55.1 million (US$7.1 million). The financial rate of return for the project is 18% and the economic rate of return, 26%. The basis for the calculation of financial and economic rates is detailed in Tables 3 and 4. However, there are certain benefits which cannot be calculated in monetary terms. For example, without the proposed sub-project, equipment is most likely to age faster because of frequent power fluctuations, dips and failures.

Further, due to frequent shut downs, the costly catalysts (Durgapur uses 8 tyes of catalysts) and refractory lining may be damaged. These problems would definitely lead to additional production losses and increases in production costs.

II. GORAKHPUR INPLANT POWER GENERATOR

11. The Gorakhpur unit of FCI was commissioned in 1967/68 with an annual installed capacity of 80,000 tons of N. The unit has two trains of ammonia and two trains of urea. In terms of urea, it has an installed capacity of 160,000 tons per year (TPY). A third unit of ammonia as well as urea are currently being added. When the expansion is completed in 1975/76, the annual urea capacity will reach 285,000 TPY. In terms of N, the annual capacity will increase by 51,000 tons to 131,000 tons. The expansion work is undertaken with the IDA Credit (279-IN) of US$10 million equivalent which became effective in early 1972. The total cost of the expansion program is estimated at Rs 191 million (US$24.5 million equivalent).

12. The Gorakhpur unit has been facing difficulties in recent years due to unreliable power supply from the Uttar Pradesh State Electricity Board (UPSEB) from which it draws power. The problem has been compounded by variation in frequency and voltage dips. Power cuts to the extent of 50% of the contracted quantity has been common for about three months in a year. This situation is likely to continue in the future. In that case, when Gorakhpur expansion is completed next year, the annual production loss because of power supply problems is likely to be 30,000 tons of urea which at the current ex-factory price of Rs. 1,183 (US$152) per ton, is worth about Rs 35.5 million (US$4.6 million eq). Other benefits are: (1) an estimated net saving in power costs of Rs 2.1 million (US$0.3 million); and (2) at least a net saving of Rs 25 million (US$3.2 million) in maintenance costs for the plant.

Existing System

13. At present there is no inplant power generation facility at Gorakhpur and all steam generated is used by process. There are three coal-fired boilers generating steam at approximately 41 ata and 418°C. The maximum steam generating capacity of these boilers is 45 tons/hr each. However, since the boilers have been operating for about eight years, it is likely that their effective generating capacity would decline to about 40 tons/hr.

Proposed System

14. Under the proposed system, two new steam units of 55 tons/hr each will be installed to generate steam at 105 ata and 505°C. (The steam parameters could be changed to approximately 106 ata and 538-540°C if necessary.) In addition, the following power generating units will be installed: (1) a 12.5 MW single automatic controlled extraction condensing turbine generator set, having throttle steam at 105 ata, 505°C and bleeding at 41 ata and 413°C; and (2) a 12.5 MW double extraction turbine generator set,

at 14 ata and 2.5°C. The existing steam generating units are proposed to be used to supplement the new system. Most of the equipment for the proposed sub-project has been ordered. The total cost of the sub-project is estimated at Rs 184 million (US$23.5 million) including Rs 84.7 million (US$10.8 million) in foreign exchange (Table 5). The total coal requirement of the new system is estimated at 223,000 tons per year on a 330-day operation basis. Coal is available from Karnapura coalfields of the National Coal Development Corporation. Railway and road facilities exist for transportation of coal from there to Gorakhpur.

Total Power Demand

15. The power requirement of Gorakhpur will reach 54 MW by 1975/76 when the expansion project is commissioned. Currently, the project authorities have a contract with UPSEB for purchasing about 38 MW of power. With the installation of the generating units with a total capacity of 25 MW, the normal average demand for UPSEB power would be 29 MW. However, during the outage of one 12.5 MW inplant set, the demand on UPSEB would go up to 41.5 MW. It is therefore assumed that the new contract with UPSEB would be for a maximum demand of 42.5 MW. Out of this, according to the existing FCI stipulation, only 75% (i.e. 32 MW) will be used to calculate the minimum billable demand even if the actual use of UPSEB power by Gorakhpur is less than that. Therefore, the difference between the billable demand and normal average requirement from UPSEB (after the Gorakhpur inplant power generator is installed) would be 3 MW, and a penalty payment will have to be made on this. At current UPSEB power rate of 18 paise/kwh, it amounts to Rs 4.3 million a year (US$0.6 million). This is an insignificant penalty to pay compared to the benefits that will accrue from having inplant power generation facilities. Further, it is to be noted that the inplant facilities will be able to generate power cheaper at 14.85 paise/kwh, assuming a coal cost of Rs 100/ton. This will result in a saving of about Rs 6.4 million (US$0.8 million) annually from internally 25 MW of power. The financial rate of return for this sub-project is 14% and the economic rate of return, 22%. Details of calculation of the rates of return are given in Tables 3 and 6.

IV. TROMBAY STEAM GENERATING AND WATER TREATMENT PLANTS

Introduction

16. The Trombay unit of FCI was commissioned in 1965/66 to produce mainly urea and ammonium nitrate phosphate ("suphala"). In terms of nutrient tons, its installed capacity is 81,000 tons of N and 36,000 tons of P. Trombay is the only FCI unit which produces complex fertilizers at present. Five of its other units produce only N fertilizers. The Trombay modernization project now nearing completion will raise the N capacity to 113,000 tons and P capacity to 54,000 tons by 1975/76. Under implementation is also the Trombay IV Expansion Project being financed with IDA Credit (481-IN). It is expected to be commissioned in 1977/78 when the N capacity of the Trombay unit will be further raised to 188,000 tons and P capacity to 129,000 tons. Another major expansion, Trombay V, is at an advanced stage of planning to boost the N capacity by 119,000 tons to 307,000 tons by 1979/80 or 1980/81.

17. Trombay's performance has improved in recent years, with the capacity utilization reaching in 1974/75 about 83% for N and 89% for P (Table 1).

Steam Requirement

18. The steam requirements of the existing Trombay project are met by oil/gas-fired boilers but those boilers have become old and require major repairs. Further, Trombay IV would require considerable steam for process.

19. Under Trombay IV, Rs 17.1 million (US$2.2 million), including Rs 9.4 million (US$1.2 million) in foreign exchange, was earmarked for a steam generating unit with two coal-fired boilers each of 40 tons/hr capacity. Further, a water treatment plant, a related facility, was allocated Rs 1.5 million (US$0.2 million), including Rs 0.8 million (US$0.1 million) in foreign exchange. In addition, coal and ash handling facilities to serve the steam generating system were allocated Rs 6 million (US$0.8 million), including Rs 2.7 million (US$0.4 million) in foreign exchange. However, subsequent review of the proposed steam generating facilities by Development Consultants Private Ltd. and IDA staff have led to the following recommendations: (1) the boilers be fuel-fired instead of coal-fired as the timely deliveries of coal are not assured because of transport problems; (2) coal and ash handling facilities be dropped as they are not necessary for the fuel-fired boilers; and (3) one large boiler of 170 ton/hr capacity be installed instead of two boilers of 40 tons/hr capacity each so that the needs of not only Trombay IV but also the existing Trombay project could be met, and equipment standardization could be achieved with the boiler system proposed for Trombay V. FCI has accepted these recommendations which are realistic.

20. The modified steam generating unit along with the water treatment plant is estimated to cost Rs 100 million (US$12.8 million), including Rs 73.7 million (US$9.5 million) in foreign exchange (Table 7). Out of the total foreign exchange cost, the proposed credit will cover US$7.8 million and the remaining US$1.7 million has already been provided for under the credit for Trombay IV.

21. The expanded steam generation facilities are crucial for Trombay IV and the existing Trombay plant. It is estimated that but for the expanded system which will cost Rs 75.4 million (US$9.7 million) more than originally estimated, the production from the existing Trombay plant would decline by at least 15% on an average in the future if it continues to rely on its old steam generating facilities. This production loss is equivalent to 10,500 tons of urea and 24,000 tons of ammonium nitrate phosphate.

22. Details of the calculation of the financial and economic rates of return are given in Tables 3 and 8. The financial rate of return on the incremental cost is 15% and the economic rate of return, 26%.

V. AMMONIA STORAGE AND TANK WAGONS

Ammonia Storage

23. The existing ammonia storage facilities at FCI plants are limited (800-1,500 tons each) except at Trombay where the storage capacity is about 15,000 tons. Past experience of FCI shows that the operation of the ammonia plant and the downstream units cannot always be synchronized, especially in large-scale fertilizer projects. This problem could be overcome to a large extent by providing for large-scale intermediate storage facilities for ammonia at selected locations.

24. Provision of large-scale ammonia storage capacity will also facilitate movement of ammonia between various FCI plants as well as with outside units. To some extent, ammonia is transported at present from Kalol (IFFCO Plant) to Trombay as well as Madras using about 50 tank wagons. Adequate intermediate storage facilities supplemented by more ammonia tank wagons would further facilitate such movement.

25. FCI is proposing to install four medium-sized storage stations in strategic locations with a total capacity of 25,000 tons of ammonia. The capital cost of this is estimated at Rs 133.8 million (US$17.2 million), including Rs 62.8 million (US$8.1 million) in foreign exchange.

Ammonia Tank Wagons

26. Currently 50 ammonia tank wagons are in use, of which 25 are owned by FCI and the rest by IFFCO. The IFFCO-owned wagons are expected to be acquired gradually by FCI. In addition, FCI has already placed orders for 15

more wagons under the POIP part of IDA Credit 481-IN. FCI has estimated that it would need 35 more tank wagons (each with 30-ton capacity) to move ammonia from surplus to deficit units. They are expected to be purchased from Bharat Heavy Electricals (BHE). BHE is capable of producing 6-7 such tank wagons per month. The proposed credit will cover only the foreign exchange cost (US$1 million) of producing the required 35 wagons. The total cost of the wagons is estimated at Rs 26.1 million (US$3.3 million).

Benefits

27. The establishment of ammonia storage stations supplemented by increasing the number of tank wagons will have considerable impact on fertilizer production in the country. These facilities will help store 25,000 tons of ammonia and transport on an average at least 150 tons of ammonia per day, considering the time for turn around, waiting and maintenance. In a year, FCI units will be assured of at least 150 TPD i.e. 49,500 tons of additional ammonia delivery a year from surplus plants in India and also from imports. This much ammonia, if used entirely to produce urea, results in an additional production of about 85,400 tons valued at the present prices at Rs 101 million (US$13 million) a year.

28. In addition, those facilities will also help in the proposed experimental development of direct application of ammonia, and the proposed expansion of small-scale granulation units in various parts of the country.

29. Details of calculation of rates of return on this sub-project is given in Tables 3 and 9 . The financial and economic rates of return are estimated at 21% and 37% respectively.

VI. POLLUTION CONTROL AND OTHER EQUIPMENT

Pollution Control

30. FCI is proposing to establish a Central Pollution Control Wing to advise its fertilizer plants on bringing down gaseous and liquid effluents to promote environmental protection. The control unit will also advise the plants on monitoring pollution levels. The unit will need modern equipment for the detection of dust traces, acid gases, etc. Those equipment are estimated to cost Rs 2 million (US$0.3 million) in foreign exchange.

31. Non-Destructive Testing (NDT)

FCI's Planning and Design Organization has a non-destructive testing (NDT) laboratory which serves not only FCI plants but also outside fertilizer projects. There is now a regular NDT schedule for each of the operating units as well as projects under implementation. With the increasing number of fertilizer projects in India, it has become necessary to strengthen the NDT laboratory central cell and also to open regional cells at strategic centers.

While the central cell will deal with long-range NDT programs, the daughter cells will meet the short-term and emergency needs of operating units. To strengthen and expand the NDT laboratory, it is necessary to acquire modern equipment for industrial vibration testing, noise analysis, ultrasonic inspection, etc. In addition, two selected technicians of the NDT laboratory would need training in the NDT laboratories of Europe, Japan and the US. The foreign exchange cost of equipment and training is estimated at Rs 6 million (US$0.8 million).

Industrial Projects Department
November 1975

CAPACITY AND PRODUCTION OF FCI PLANTS

FCI	Year of Commis-sioning	Capacity N	Capacity P	N Production 1971/72	N Production 1972/73	N Production 1973/74	N Production 1974/75	N Capacity Utilization (%) 1971/72	N Capacity Utilization (%) 1972/73	N Capacity Utilization (%) 1973/74	N Capacity Utilization (%) 1974/75
		('000 tons)									
I. Operating Units											
Sindri	1951/52	75 1/	-	63	56	59	53	84	75	79	71 3/
Nangal	1960/61	80	- 1/	56	53	62	40	70	66	78	50 3/
Trombay	1965/66	81	36 1/	61	63	58	60	75	78	72	74
Gorakhpur	1967/68	80	-	76	69	64	72	95	86	80	90
Namrup	1968/69	45	-	30	35	36	40	67	78	80	89
Durgapur	1973/74	127 2/	-	-	-	6	17	-	-	5	13
Total		488	36	286	276	285	282				

1/ Production and capacity utilization were as follows:

	Production ('000 tons)	Capacity Utilization (%)
1970/71	25	67
1971/72	33	92
1972/73	37	103
1973/74	32	89
1974/75	32	89

2/ Excluding 25,000 tons of capacity which needs upgrading.
3/ Capacity utilization declined mainly because of power shortages.

SOURCE: Ministry of Petroleum and Chemicals

Industrial Projects Department
July 1975

INDIA: FERTILIZER INDUSTRY CREDIT

FCI - DURGAPUR INPLANT POWER GENERATOR
CAPITAL COST ESTIMATES

	-----Rs million------			-----US$ million-----		
	Foreign	Local	Total	Foreign	Local	Total
Equipment and Spares	48.2	13.3	61.5	6.2	1.7	7.9
Ocean Freight	2.9	-	2.9	0.4	-	0.4
Duties and Taxes	-	20.4	20.4	-	2.6	2.6
Inland Transportation	-	2.1	2.1	-	0.3	0.3
Design and Engineering	-	8.9	8.9	-	1.1	1.1
Civil Works	-	7.8	7.8	-	1.0	1.0
Erection and Commissioning 1/	0.4	7.9	8.3	0.1	1.0	1.0
Base Cost Estimates (BCE)	51.5	60.4	111.9	6.6	7.7	14.3
Contingencies: Physical (10% of BCE)	5.2	6.0	11.2	0.7	0.8	1.5
Price (20%)	11.3	13.3	24.6	1.4	1.7	3.1
Installed Cost	68.0	79.7	147.7	8.7	10.2	18.9
Working Capital	-	0.5	0.5	-	0.1	0.1
Project Cost	68.0	80.2	148.2	8.7	10.3	19.0
Financial Charges	-	13.5	13.5	-	1.7	1.7
Total Financing Required	68.0 2/	93.7	161.7	8.7 2/	12.0	20.7

1/ Including supervision and preoperating expenses.
2/ Includes Rs 16 (US$2) million of indirect foreign exchange.

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INDIA: FERTILIZER INDUSTRY CREDIT

FCI SUB-PROJECTS
ASSUMPTIONS FOR FINANCIAL AND ECONOMIC RATES OF RETURN

The following assumptions have been used to calculate rates of return:

Prices and Production Costs1/

	Financial	Economic
	Rs/Ton	
Urea	1,150	1,443
Production Cost of Urea	822	674
Ammonium Nitrate Phosphate (ANP)	1,460	1,446
Production Cost of ANP	1,100	723
Calcium Ammonium Nitrate (CAN)	652	784
Production Cost of CAN	420	353
Ammonia	2,400	2,490

Life of Sub-Projects

The life of inplant power generators is assumed to be 25 years whereas the life of fertilizer sub-projects is assumed to be 12 years.

Start of Production

All sub-projects except Nangal Product Diversification are assumed to be commissioned April 1, 1978. The Nangal sub-project is expected to be commissioned October 1, 1978.

Production Build-Up

As all sub-projects except Nangal are for removal of bottlenecks, they are expected to yield full benefits from the first year of operation itself. However, in the case of Nangal, the production build-up as a percentage of capacity in the new unit to produce ANP is assumed to be gradual: First year, 75%; second year, 80%; and from third year onwards, 90%.

1/ Excluding depreciation, financial charges and taxes.

Industrial Projects Department
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INDIA: FERTILIZER INDUSTRY CREDIT

INPUTS FOR FINANCIAL AND ECONOMIC RATES OF RETURN
FCI: DURGAPUR INPLANT POWER GENERATOR
(Rs million)

Fiscal Years	Financial			Economic		
	Capital Cost C1	Operating Costs C1	Benefits B1	Capital Cost C1	Operating Costs C1	Benefits B1
1975/76	32.0	-	-	28.0	-	-
1976/77	81.0	-	-	71.0	-	-
1977/78	48.7	-	-	42.3	-	-
1978/79	-	16.5	54.4	-	13.5	60.3
1979/80	-	16.5	54.4	-	13.5	60.3
1980/81	-	16.5	54.4	-	13.5	60.3
1981/82	-	16.5	54.4	-	13.5	60.3
1982/83	-	16.5	54.4	-	13.5	60.3
1983/84	-	16.5	54.4	-	13.5	60.3
1984/85	-	16.5	54.4	-	13.5	60.3
1985/86	-	16.5	54.4	-	13.5	60.3
1986/87	-	16.5	54.4	-	13.5	60.3
1987/88	-	16.5	54.4	-	13.5	60.3
1988/89	-	16.5	54.4	-	13.5	60.3
1989/90	-84.6 1/	16.5	54.4	-74.0 1/	13.5	60.3

1/ Including salvage value of the generator after operation for the life of the fertilizer plant (12 years), and the recovery of initial working capital.

	Financial	Economic
Rate of Return (%)	18 %	26%

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INDIA: FERTILIZER INDUSTRY CREDIT

FCI - GORAKHPUR INPLANT POWER GENERATOR
CAPITAL COST ESTIMATES

	Rs million			US$ million		
	Foreign	Local	Total	Foreign	Local	Total
Equipment and Spares	60.6	11.7	72.3	7.8	1.5	9.3
Ocean Freight	3.1	-	3.1	0.4	-	0.4
Duties and Taxes	-	22.2	22.2	-	2.8	2.8
Inland Transportation	-	2.4	2.4	-	0.3	0.3
Design and Engineering	-	10.0	10.0	-	1.3	1.3
Civil Works	-	7.9	7.9	-	1.0	1.0
Erection and Commissioning	0.5	9.0	9.5	0.1	1.1	1.2
Base Cost Estimates (BCE)	64.2	63.2	127.4	8.2	8.1	16.3
Contingencies: Physical(10% of BCE)	6.4	6.3	12.7	0.8	0.8	1.6
Price (20%)	14.1	14.0	28.1	1.8	1.8	3.6
Installed Cost	84.7	83.5	168.2	10.8	10.7	21.5
Working Capital	-	0.8	0.8	-	0.1	0.1
Project Cost	84.7	84.3	169.0	10.8	10.8	21.6
Financial Charges	-	15.0	15.0	-	1.9	1.9
Total Financing Required	84.7 1/	99.3	184.0	10.8 1/	12.7	23.5

1/ Including Rs 23 million (US$3 million) of indirect foreign exchange costs.

Industrial Projects Department
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ANNEX 5-1
Table 6

INDIA: FERTILIZER INDUSTRY CREDIT

INPUTS FOR FINANCIAL AND ECONOMIC RATES OF RETURN
FCI: GORAKHPUR INPLANT POWER GENERATOR
(Rs million)

	Financial			Economic		
Fiscal Years	Capital Cost C_1	Operating Costs C_1	Benefits B_1	Capital Cost C_1	Operating Costs C_1	Benefits B_1
1975/76	92.0	-	-	81.0	-	-
1976/77	74.0	-	-	65.0	-	-
1977/78	18.0	-	-	15.8	-	-
1978/79	-	24.7	61.6	-	20.2	70.4
1979/80	-	24.7	61.6	-	20.2	70.4
1980/81	-	24.7	61.6	-	20.2	70.4
1981/82	-	24.7	61.6	-	20.2	70.4
1982/83	-	24.7	61.6	-	20.2	70.4
1983/84	-	24.7	61.6	-	20.2	70.4
1984/85	-	24.7	61.6	-	20.2	70.4
1985/86	-	24.7	61.6	-	20.2	70.4
1986/87	-	24.7	61.6	-	20.2	70.4
1987/88	-	24.7	61.6	--	20.2	70.4
1988/89	-	24.7	61.6	-	20.2	70.4
1989/90	-97.0 1/	24.7	61.6	-85.0 1/	20.2	70.4

1/ Including salvage value of the power generator after operation for the life of the fertilizer plant (12 years), and the recovery of initial working capital.

	Financial	Economic
Rate of Return (%)	14%	22%

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INDIA: FERTILIZER INDUSTRY CREDIT

FCI - TROMBAY STEAM GENERATING AND WATER TREATMENT UNITS
CAPITAL COST ESTIMATES

	Rs million			US$ million		
	Foreign	Local	Total	Foreign	Local	Total
Equipment and Spares	55.0	5.3	60.3	7.0	0.7	7.7
Ocean Freight	0.6	-	0.6	0.1	-	0.1
Duties and Taxes	-	4.0	4.0	-	0.5	0.5
Inland Transportation	-	1.5	1.5	-	0.2	0.2
Design and Engineering	-	2.7	2.7	-	0.3	0.3
Civil Works	-	2.5	2.5	-	0.3	0.3
Erection and Commissioning	0.2	2.5	2.7	0.1	0.3	0.4
Base Cost Estimate	55.8	18.5	74.3	7.2	2.3	9.5
Contingencies: Physical(10% of BCE)	5.6	1.8	7.4	0.7	0.2	0.9
Price (20%)	12.3	4.0	16.3	1.6	0.5	2.1
Installed Cost	73.7	24.3	98.0	9.5	3.1	12.6
Working Capital	-	1.0	1.0	-	0.1	0.1
Project Cost	73.7	25.3	99.0	9.5	3.2	12.7
Financial Charges	-	1.0	1.0	-	0.2	0.2
Total Financing Required	73.7 1/	26.3	100.0	9.5 1/	3.4	12.9

1/ Including Rs 23 million (US$3 million) of indirect foreign exchange.

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ANNEX 5-1
Table 8

INDIA: FERTILIZER INDUSTRY CREDIT

INPUTS FOR FINANCIAL AND ECONOMIC RATES OF RETURN
FCI: TROMBAY STEAM GENERATING PLANT
(Rs million)

Fiscal Years	Financial: Capital Cost C_1	Financial: Operating Costs C_1	Financial: Benefits B_1	Economic: Capital Cost C_1	Economic: Operating Costs C_1	Economic: Benefits B_1
1975/76	35.0	-	-	33.6	-	-
1976/77	23.7	-	-	22.8	-	-
1977/78	16.7	-	-	16.0	-	-
1978/79	-	28.0	47.1	-	19.6	49.9
1979/80	-	28.0	47.1	-	19.6	49.9
1980/81	-	28.0	47.1	-	19.6	49.9
1981/82	-	28.0	47.1	-	19.6	49.9
1982/83	-	28.0	47.1	-	19.6	49.9
1983/84	-	28.0	47.1	-	19.6	49.9
1984/85	-	28.0	47.1	-	19.6	49.9
1985/86	-	28.0	47.1	-	19.6	49.9
1986/87	-	28.0	47.1	-	19.6	49.9
1987/88	-	28.0	47.1	-	19.6	49.9
1989/90	-0.8[2/]	28.0	47.1	-0.8[2/]	19.6	49.9

1/ Excluding Rs 13.3 million (US$1.7 million) allocated under Trombay IV credit.
2/ Recovery of incremental working capital.

	Financial	Economic
Rate of Return (%)	15%	26%

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ANNEX 5-1
Table 9

INDIA: FERTILIZER INDUSTRY CREDIT

INPUTS FOR FINANCIAL AND ECONOMIC RATES OF RETURN
FCI: AMMONIA STORAGE AND TRANSPORTATION PROJECT
(Rs million)

Fiscal Years	Financial: Capital Cost C1	Financial: Operating Costs C1	Financial: Benefits B1	Economic: Capital Cost C1	Economic: Operating Costs C1	Economic: Benefits B1
1975/76	32.0	-	-	30.7	-	-
1976/77	64.0	-	-	61.4	-	-
1977/78	63.9	-	-	61.4	-	-
1978/79	-	57.1	98.2	-	46.9	123.3
1979/80	-	57.1	98.2	-	46.9	123.3
1980/81	-	57.1	98.2	-	46.9	123.3
1981/82	-	57.1	98.2	-	46.9	123.3
1982/83	-	57.1	98.2	-	46.9	123.3
1983/84	-	57.1	98.2	-	46.9	123.3
1984/85	-	57.1	98.2	-	46.9	123.3
1985/86	-	57.1	98.2	-	46.9	123.3
1986/87	-	57.1	98.2	-	46.9	123.3
1987/88	-	57.1	98.2	-	46.9	123.3
1988/89	-	57.1	98.2	-	46.9	123.3
1989/90	-2.0 1/	57.1	98.2	-2.0 1/	46.9	123.3

1/ Recovery of initial working capital

	Financial	Economic
Rate of Return (%)	20%	37%

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INDIA - FERTILIZER INDUSTRY CREDIT

NEYVELI - PROJECT DESCRIPTION AND ANALYSIS

A. Introduction

1. The Neyveli Lignite Corporation (NLC), a GOI-owned enterprise is responsible for the exploitation of the lignite[1/] mines located in a 260 square kilometer (km) area about 175 km southeast of Madras in the State of Tamil Nadu. The total lignite deposit is estimated at 2 billion tons, but lignite mining, which has produced a cumulative output of about 32 million tons since 1957, has been limited within a 14 square km area estimated to contain 200 million tons of lignite with a low overburden ratio[2/]. The lignite seam is thin, only about 16 meters and is located between about 60 meters of overburden (mostly tough abrasive sandstone) above and the high pressure artesian aquifers below. About 10 tons (4 cubic meters) of overburden (earth, rocks) and 25 tons of water have to be moved for each ton of lignite produced in the present mine cut but the overburden ratio is increasing as mining proceeds towards less favorable areas.

2. The lignite is used as fuel for a thermal power plant (600 MW capacity), as feedstock for urea fertilizer production (120,000 TPY N capacity) and as raw material for a briquetting and carbonization plant (380,000 TPY carbonized briquette[3/] capacity). In addition, some white china clay is recovered from the lignite mines. NLC has a clay washing plant with a capacity of 6,000 TPY of washed white clay (sold under the trade name - "Nekolin").

3. The Neyveli complex -- the lignite mine, the thermal power plant, the fertilizer plant, the briquetting plant, and the clay washing plant -- are all located in the same area. NLC provides the social infrastructure -- such as township, housing, school facilities, hospital and police services -- for the families of the employees of the company.

B. The Corporate Organization

4. NLC is under the administrative supervision of the Department of Mines, Ministry of Steel and Mines. The Articles of Association of the company provides for the appointment of the Chairman and all Directors only by the President of India. The present Chairman and Managing Director is Mr. Yegneswaran, a mining engineer by profession. The corporation is organized along three main operating divisions -- mines, chemicals (fertilizer, briquetting and clay washing) and power -- and two staff groups -- finance and administration. Total employment was 17,867 persons as of January 1975.

1/ Lignite or "brown coal" is half-baked coal, with about half the calorific value of coal. The Neyveli lignite contains 50% moisture, 3-17% ash (average of 7%) and has a calorific value of about 2,500 kcal/kg.

2/ Overburden is the term used in open pit (or open cast) mining to refer to the amount of earth or rock above the seam of lignite (or coal) being mined. The overburden ratio refers to the weight (or volume) of earth or rock material that must be excavated for each ton of mined product.

3/ The briquette is sold under the "LECO" trade-name.

C. Mining Operations

5. Lignite mining capacity and output is determined by the earth (overburden) removal capacity which in turn is determined mostly by the conveyor capacity. Existing equipment can move about 13.2 million M^3 of overburden annually and this limits lignite production to about 3.5 million TPY. The annual requirements of the power plant, the fertilizer plant and the briquetting plant is about 7 million TPY of lignite as shown below:

Annual Lignite Requirements
(Millions TPY)

	Lignite Requirement	%
Power Plant (600MW)1/	4.8	65
Fertilizer Plant2/	0.3	4
Briquetting Plant3/	1.5	20
Others (fuel for process steam plant)3/	0.8	11
Total	7.4	100

1/ At 65% average load factor.
2/ At the existing attainable capacity utilization of 36%. At 90% capacity output, lignite requirement would be 0.85 million TPY.
3/ At 90% capacity utilization.

6. The mining capacity is being expanded in two stages: The first stage, to be completed by 1977/78, will raise output to 4.5 million TPY of lignite and the second stage, to be completed by 1980/81, will increase production to 6.5 million TPY of lignite. Even if the fertilizer plant switches to fuel oil feedstock, the estimated output of 6.5 million TPY by 1980/81 would still be slightly less than the requirements of the other facilities (7.1 million TPY of lignite). The first stage expansion is estimated to cost Rs 116.2 (US$15) million and all major equipment orders have been placed. The second stage expansion will cost Rs 870 (US$112) million and the West German Government has approved a credit for the foreign exchange cost of this second stage program (124 million D.M. or US$50 million equivalent). Tenders for equipment have been placed and orders are expected to be placed before the end of this year. The projected lignite production, and the consumption by the different plants are shown below for both cases where there is and where there is no conversion to fuel oil feedstock for the fertilizer plant.

CASE 1

Projected Lignite Output and Consumption with
Fertilizer Plant Using Lignite Feedstock
(in million TPY)

Year	Lignite Output	Lignite Consumption: Power Plant	Fertilizer Plant	Briquetting Plant	Others	Total
1975/76	3.3	2.67	0.29	0.18	0.16	3.30
1976/77	3.8	3.09	0.34	0.19	0.18	3.80
1977/78	4.2	3.02	0.34	0.48	0.36	4.20
1978/79	4.5	3.47	0.34	0.43	0.26	4.50
1979/80	5.5	3.61	0.34	1.08	0.47	5.50
1980/81	6.5	4.32	0.34	1.30	0.54	6.50

CASE 2

Projected Lignite Output and Consumption with
Fertilizer Plant Using Fuel Oil Feedstock
(in million TPY)

Year	Lignite Output	Lignite Consumption: Power Plant	Fertilizer Plant	Briquetting Plant	Others	Total
1975/76	3.3	2.62	0.34	0.18	0.16	3.30
1976/77	3.8	3.09	0.34	0.19	0.18	3.80
1977/78	4.2	3.30	0.20	0.48	0.22	4.20
1978/79	4.5	3.80	-	0.43	0.27	4.50
1979/80	5.5	3.87	-	1.08	0.55	5.50
1980/81	6.5	4.55	-	1.30	0.65	6.50

7. The average lignite mining cost (1975/76) is about Rs 47 (US$6) per ton including provisions for depreciation, interest expense and overhead charges. The lignite transfer price to the other operating units allows a 10% return on equity capital (share capital plus any positive retained earnings) for the mining operation and the lignite is thus priced at about Rs 55 (US$7) per ton in this report.

D. Power Plant Operations

8. The Power Plant has three 100 MW generators and six 50 MW units for a total capacity of 600 MW. Two of the 50 MW units were modified and starting May 1974 utilized fuel oil due to the non-availability of lignite. However, the power plant still operates at a load factor of only 43% (1973/74) compared to the norm of 65%. The power plant generates about

0.7143 MWH per ton of lignite, while the fuel oil units provide about 3.663 MWH per ton of fuel oil. Thus, about 5.1 tons of lignite are needed to substitute for one ton of fuel oil in power generation. The full cost of power generation (including depreciation and interest) is about Rs 111/MWH based on lignite and Rs 289/MWH based on fuel oil[1/].

9. Except for about 200 to 300 thousand MWH of power utilized within the Neyveli complex annually, the bulk of the output (90% during 1973/74) is sold to the Tamil Nadu State Electricity Board (TNSEB). The most recent pricing arrangement with the TNSEB, starting 1976/77, would price power based on the actual full generating costs including depreciation and interest charges, plus a 10% return on equity. The previous arrangement was based on 1972/73 operating costs plus an 8% return on equity -- or about Rs 90/MWH.[2/] The new arrangement, based on estimated 1976/77 operating costs, would price power based on lignite at about Rs 5/MWH above costs.

10. The projected power generation is as follows:

Projected Power Generation

(in thousand MWH)

	CASE 1 (Fertilizer based on lignite)		CASE 2 (Fertilizer Based on Fuel Oil)	
Year	Lignite-Fired	Fuel Oil-Fired	Lignite-Fired	Fuel Oil-Fired
1972/73 (Actual)	1730	-	1730	-
1973/74 (Actual)	2016	-	2016	-
1974/75 (Estimate)	1870	280	1870	280
1975/76 (Forecast)	1900	550	1900	550
1976/77	2210	550	2210	550
1977/78	2160	550	2360	550
1978/79	2480	550	2710	550
1979/80	2580	550	2760	550
1980/81	3090	-	3250	-

E. Briquetting and Carbonizing Operations

11. The briquetting plant uses about 4.6 tons of lignite to produce one ton of carbonized briquette which is marketed under the trade name "LECO". Several valuable by-products, such as char dust, phenols, carbolic acid, cresols and middle oils are also recovered in these operations. Leco is a smokeless fuel used in the households as well as in industry. On a calorific basis, one ton of Leco is equivalent to 4 tons of firewood or 1.3 tons of charcoal. Leco was sold for about Rs 640 per ton (1974/75) but will be sold for Rs 655 per ton starting 1975/76.

12. The plant has a capacity of 380,000 TPY of Leco. However, production has been limited to about 25,000 tons during 1973/74 and 1974/75,

1/ 1975/76 results with lignite priced at Rs 55/ton. The electricity from the fuel oil units are sold for Rs 295/MWH. The comparative power generating cost for coal fired power plants in Tamil Nadu is about Rs 180/MWH.

2/ However, during 1974/75 and 1975/76, the electricity (based on lignite) sales price was raised and ranged from Rs 115-119/MWH to account for cost increases.

about 7% of capacity, because of the non-availability of lignite. The fertilizer plant, then the power plant, has priority over the briquetting plant in terms of lignite supply. The briquetting plant has a breakeven point of 60% capacity utilization given a Leco price of Rs 655/ton and the operating costs during 1975/76.

13. The projected production of Leco is not affected by the decision to change the feedstock of the fertilizer plant. The briquetting unit is estimated to operate at 10% of capacity in 1975/76 and gradually reach 75% capacity utilization by 1980/81 as more lignite becomes available (see lignite allocation to the briquetting operations in section C and use a factor of 4.6 tons lignite/ton of Leco).

F. Existing and Proposed Fertilizer Operations

14. The existing ammonia-urea plant has a capacity of 165,000 TPY of urea (75,000 TPY N). The urea unit has four streams each with a 125 TPD urea capacity. Though the four units have never operated simultaneously due to lack of ammonia, each has operated well. No problems are anticipated in operating all four streams at the same time. The ammonia unit uses lignite as feedstock. The original design specification envisaged using about 3 to 4 tons of lignite (containing 3-5% ash) per ton of urea. The current lignite quality varies from 5 to 12% ash content and although the lignite for the fertilizer feedstock is chosen from the better quality output, the average ash content is still about 7%. This has caused clinkering problems when the furnace is operated at high temperatures. To eliminate this problem, the operating temperature of the furnace has to be reduced -- thereby requiring more lignite -- about 5.75 tons, per ton of urea production. Nonetheless, the basic inefficiency of the process sets a limit of about 60,000 TPY urea production, some 36% of capacity.

15. A proposed feedstock conversion program, using fuel oil, will allow production to reach 90% of capacity, or about 148,500 TPY of urea. The conversion would utilize about 0.6 tons of fuel oil per ton of urea. This implies that for fertilizer feedstock at Neyveli, one ton of fuel oil will replace about 9.6 tons of lignite. Since only 5.1 tons of lignite are needed to replace one ton of fuel oil in power generation, the case for the feedstock conversion program is strong. The lignite can be used to generate more electricity.

16. The feedstock conversion project will cost an estimated Rs 152 (US$19.5) million including Rs 59 (US$7.5) million in foreign exchange. Although GOI has converted some loans into equity last year (1973/74) to ease the debt service burden of the company, the debt equity ratio, due to substantial cumulative losses, is about 65:35 and the company is not expected to have significant cash generation to help finance the project. The appraisal mission recommends that the entire capital cost of the project be provided by GOI as equity.

17. The comparative production costs for the existing lignite-based operation and the proposed fuel oil-based project are shown in Table 8

(financial) and Table 9 (economic). Because of the corporate overhead charges to cover the social infrastructure costs such as education, medical services, etc., the estimated 1978 financial production cost (in constant 1975 rupees) of fertilizer is high, about Rs 2,102/ton of urea for the existing operation and Rs 1,169/ton for the proposed project. Corporate overhead charges contribute Rs 190/ton to the cost of the existing operations and is projected to account for Rs 77/ton in the proposed project.

18. The GOI has agreed to subsidize urea production at Neyveli starting 1975/76. The company's urea output will not be subject to most of the import equalisation tax and the ex-factory price will be Rs 1,500/ton instead of Rs 1,100/ton. This higher price will cover on the average 70% of the cost of production during 1975/76 through 1977/78 including corporate overhead charges, but excluding interest payments. The proposed project would reduce production cost and the financial forecast shows that the financial and cash position of the fertilizer unit will improve substantially, providing cashflow of about Rs 10 million annually by 1980/81.[1/] In addition, the lignite released to the power plant will increase power output. The additional power generation will also contribute about Rs 9 million annually (in constant 1975 rupees -- after deducting the variable power generating costs). Thus, some Rs 19 million annually will be added to the company's cash flow starting 1980/81.

19. With the present (1975/76) international urea prices at high levels, it would be economically advantageous for India to operate the Neyveli fertilizer plant -- even with lignite as feedstock. But as international urea prices decline towards 1978, the economic cost of importing urea will become lower than the economic cost of producing urea based on lignite at the Neyveli plant. Thus, from the economic standpoint the Neyveli plant should not continue to operate based on lignite beyond 1978, and perhaps even earlier considering that the power plant can utilize all the lignite that can be mined to generate electricity at a much lower cost compared to power generation using fuel oil.

20. The proposed project will provide urea at an economic cost of about Rs 960 (US$123) per ton, including provisions for corporate overhead charges. The projected CIF price in 1978 is Rs 1,445 (US$185) per ton. Thus the project will make the Neyveli fertilizer unit an economic producer. The economic rate of return for the conversion project is 41%.

1/ On the other hand, a cash outflow of Rs 45 million/year would be incurred if the existing operation is continued.

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INDIA - FERTILIZER INDUSTRY CREDIT

NEYVELI - ASSUMPTIONS FOR THE CORPORATE FINANCIAL FORECASTS

A. Sales Price Assumptions

	Product	In Constant 1975 Rupees	In Current Rupees
1. Outside Sales	Power (from lignite)	Rs 135/MWH	
	Power (from fuel oil)	Rs 295/MWH	
	Urea	Rs 1150/ton starting 1978/79	Rs 1500/ton during 1975/76-1977/78
	Leco	Rs 655/ton	
2. Internal Transfers			
	Power	Rs 120/MWH plus tax of Rs 12/MWH	-
	Lignite	Rs 55/ton	-
	Process steam	Rs 25/ton	-

B. Price Inflators (from Annex 7-1 and Annex 4-5)

	Year	Index		Year	Index
1.	1975/76	100	4.	1978/79	132
2.	1976/77	112	5.	1979/80	143
3.	1977/78	122	6.	1980/81	153

C. Technical Coefficients

Product	Variable Raw Material and Utilities Consumption
1. Power (from lignite)	1.4 tons lignite/MWH
2. Power (from fuel oil)	0.273 tons fuel oil/MWH
3. Urea (from lignite)	a. 5.75 tons lignite/ton of urea b. 6.8 tons steam/ton of urea c. 3.33 MWH/ton of urea
4. Urea (from fuel oil)	a. 0.6 tons fuel oil/ton of urea b. 5.17 tons steam/ton of urea c. 1.42 MWH/ton of urea
5. Leco	a. 4.6 tons of lignite/ton of leco b. 5.0 tons of steam/ton of leco c. 0.5 MWH/ton leco
6. Lignite	a. 0.014 MWH/ton of lignite (plus 0.1 million MWH/year of fixed consumption)
7. Process steam	a. 0.296 tons lignite/ton of steam b. 0.0287 MWH/ton of steam

D. Production Costs in Constant 1975 Rupees

	Products and Units				
	Lignite (ton)	Power (MWH) from lignite	Power (MWH) from fuel oil	Leco (ton)	Process Steam (ton)
1. Variable Costs (Rs/Unit)					
External Costs	7.6	6.0	250.0	45.0 1/	1.2
Transferred Costs for:					
Lignite	-	77.0	-	253.0	16.4
Power	1.6	-	-	60.0	3.4
Steam	-	-	-	125.0	-
Total Variable Costs	9.2	83.0	250.0	483.0	21.0
2. Fixed Costs Excluding Depreciation and Interest (Rs million/year)					
Corporate (social) Overhead 2/	15.2	11.3	2.3	4.5	1.5
External Costs 1/	60.8	17.7	16.7	13.5	1.8
Transferred Cost for Power	12.0	-	-	-	-
Total Fixed Costs	88.0	29.0	19.0	18.0	3.3

1/ Net of by-product sales and recoveries.
2/ Includes power consumption estimated at 0.02 million MWH/year.

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ANNEX 5-2
Table 2

INDIA - FERTILIZER INDUSTRY CREDIT

Neyveli Fertilizer Project - Capital Cost Estimates[1]
(in US$ Millions)

	Foreign Exchange (FX)			Local Currency (LC)					
	Direct Imports (CIF)	FX Component of Local Purchases	Total FX	Duties (40% of CIF)	Local Handling of Direct Imports (2% of CIF)	LC Component of Local Purchases	Total Local Currency	Total Local Purchases (Delivered)	Total Project Costs
EQUIPMENT									
Ammonia	3.8	0.6	4.4	1.5	0.1	2.5	4.1	3.1	8.5
Downstream Units	0.3	---	0.3	0.1	---	0.2	0.3	0.2	0.6
Offsites[2]	---	---	---	---	---	1.2	1.2	1.2	1.2
Spares (7% of above)	0.3	---	0.3	0.1	---	0.3	0.4	0.3	0.7
Sub-Total (A)	4.4	0.6	5.0	1.7	0.1	4.2	6.0	4.8	11.0
Licenses and Engineering	1.1	---	1.1	---	---	1.0	1.0	1.0	2.1
Civil Works	---	---	---	---	---	0.6	0.6	0.6	0.6
Erection and Supervision	0.1	---	0.1	---	---	0.6	0.6	0.6	0.7
Pre-Operating Expenses	---	---	---	---	---	0.4	0.4	0.4	0.4
Base Cost Estimate (BCE)	5.6	0.6	6.2	1.7	0.1	6.8	8.6	7.4	14.8
Physical Contingencies (7%)	0.4	---	0.4	0.1	---	0.5	0.6	0.5	1.0
Price Escalation (14%)	0.8	0.1	0.9	0.3	---	1.0	1.3	1.1	2.2
Installed Plant Cost	6.8	0.7	7.5	2.1	0.1	8.3	10.5	9.0	18.0
Additional Working Capital[3]	---	---	---	---	---	1.5	1.5	1.5	1.5
Interest During Construction[4]	---	---	---	---	---	---	---	---	---
Total Financing Required	6.8	0.7	7.5	2.1	0.1	9.8	12.0	10.5	19.5

1/ At the exchange rate Rs 7.80 = $ 1.00.
2/ Includes a fuel oil tank (4000 ton capacity) and feedlines to fertilizer plant.
3/ For additional fuel oil stock, urea inventory and accounts receivable.
4/ No interest during construction on the assumption that the entire project cost, including the IDA credit, will be provided by GOI as equity.

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INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Price Escalation Schedule

A. Annual Inflation Rates

Calendar Year	Average Annual Price Inflation Rates, %: International Prices	Domestic Equip. and Services	Domestic General Prices
1. 1975	12	12	15
2. 1976	10	10	10
3. 1977	8	8	8
4. 1978	8	8	8

B. Expenditure Commitment Schedule

FY Ending March 31	Expenditure Commitment, %: Direct Imports	Local Purchases (Excluding Working Capital and Duties)
1. 1976	60	60
2. 1977	40	30
3. 1978	--	10
	100	100

C. Price Escalation Factor Per $100 of Base Cost Estimate

FY Ending March 31	Direct Imports		Local Purchases	
	% Compounded Rate through Middle of FY	% Escalation Factor	% Compounded Rate through Middle of FY	% Escalation Factor
1. 1976	9	5.4 a/	9	5.4
2. 1977	20	8.0	20	6.0
3. 1978	30	---	30	3.0
	Total Factor, %	13.4		14.4
	say	14%		14%

D. Price Deflators to Constant, 1975 US Dollars and Rupees (June 30, 1975=1.00)

	Price Deflators Applicable as of: Mid-FY 1976	Mid-FY 1977	Mid-FY 1978
1. International Prices	0.97	0.88	0.82
2. Domestic (General) Prices	0.97	0.87	0.80

a/ Calculated as the weighted compounded escalation rates. That is, 9% multiplied by the fraction (i.e., 0.6) of expenditure committed during the FY.

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INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Disbursement Schedule and Conversion of Capital Costs to Constant Terms
(in US$ Million)

I. Disbursement and Financing Schedule

	Implementation Period			
A. Project Costs	Year I (FY 1976)	Year 2 (FY 1977)	Year 3 (FY 1978)	Total
1. Direct Imports	2.1	3.7	1.0	6.8
2. Local Currency Disbursements				
(a) FX Component of Local Purchases	0.2	0.3	0.2	0.7
(b) LC Component of Local Purchases & Services	2.1	3.8	2.5	8.4
(c) Working Capital	---	---	1.5	1.5
(d) Duties	0.4	1.4	0.3	2.1
(e) Interest During Construction	---	---	---	---
Sub-Total (a to e)	2.7	5.5	4.5	12.7
Total Disbursements	4.8	9.2	5.5	19.5
B. Financing Sources				
1. IDA	2.1	3.7	1.0	6.8
2. GOI	2.7	5.5	4.5	12.7
Total Sources	4.8	9.2	5.5	19.5

II. Conversion of Capital Costs to Constant Terms for Financial and Economic Rate of Return Calculations

	Year I	Year 2	Year 3	Total
A. Price Deflators to Constant 1975 US Dollars and Rupees a/				
1. Foreign Exchange Costs	0.97	0.88	0.82	
2. Local Currency Costs	0.97	0.87	0.80	
B. Disbursements in Constant 1975 US Dollars for Rate of Return Calculation				
1. Financial Rate of Return				
(a) Direct Imports	2.0	3.3	0.8	6.1
(b) Local Currency Disbursements b/	2.6	4.8	3.6	11.0
Total	4.6	8.1	4.4	17.1
2. Economic Rate of Return				
(a) Foreign Exchange Cost c/	2.2	3.5	1.0	6.7
(b) Domestic Resource Cost d/	2.0	3.3	3.2	8.5
Total	4.2	6.8	4.2	15.2

a/ Taken from Price Escalation Schedule of Table 3.
b/ Excluding interest during construction.
c/ Including FX component of local purchases.
d/ Excluding duties, interest during construction and FX cost of local purchases.

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INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Urea Financial Production Cost Estimate for 1976/77 Onwards
(In 1975 Rupees)

Item	Unit	Unit Cost (Rs/Unit)	Existing Operation (Lignite)[a/] Units/ton Urea	Existing Operation (Lignite)[a/] Rs/ton Urea	Existing Operation (Lignite)[a/] Million Rs/Year	Proposed Project (Fuel Oil)[b/] Units/ton Urea	Proposed Project (Fuel Oil)[b/] Rs/ton Urea	Proposed Project (Fuel Oil)[b/] Million Rs/Year	Adjusted Project Production Costs[c/] Rs/ton Urea	Adjusted Project Production Costs[c/] Million Rs/Year
Urea Production			------------ 60,000 TPY		--------------	------------148,500 TPY		------------	------148,500 TPY	------
I. Variable Production Costs										
A. Direct Costs										
1. Fuel Oil	tons	603.0	---	---	---	0.60	361.8	53.7	361.8	53.7
2. Chemicals & Consumables	---	---	---	210.0	12.6	---	40.5	6.0	40.5	6.0
3. Bags	pieces	4.5	20.0	90.0	5.4	20.0	90.0	13.4	90.0	13.4
Sub-Total				300.0	18.0		492.3	73.1	492.3	73.1
B. Transferred Costs										
1. Lignite [d/]	tons	55.0	5.75	316.2	19.0	---	---	---	---	---
2. Process Steam [e/]	tons	25.0	6.8	170.0	10.2	5.17	129.2	19.2	129.2	19.2
3. Power (including 10% duty) [f/]	MWH	132.0	3.33	439.6	26.4	1.42	187.4	27.8	187.4	27.8
Sub-Total				925.8	55.6		316.6	47.0	316.6	47.0
Total Variable Production Costs				1,225.8	73.6		808.9	120.1	808.9	120.1
II. Fixed Production Costs										
1. Salaries, Wages & Factory Overhead			---	280.0	16.8	---	113.1	16.8	---	---
2. Maintenance Materials [g/]			---	166.7	10.0	---	64.0	9.5	64.0	9.5
3. Insurance & Other Charges (Net of credits for by-product)			---	---	---	---	8.8	1.3	8.8	1.3
4. Depreciation [h/]			---	210.0	12.6	---	85.5	12.7	85.5	12.7
Total Fixed Production Costs				656.7	39.4		271.4	40.3	158.3	23.5
III. Sales and Administrative Costs (Fixed)										
1. Selling & Administrative Charges			---	30.0	1.8	---	12.1	1.8	12.1	1.8
2. Corporate Overhead Charges			---	190.0	11.4	---	76.8	11.4	---	---
Sub-Total				220.0	13.2		88.9	13.2	12.1	1.8
Total Cost of Sales Before Interest Charges										
(a) 1976/77 to 1979/80				2,102.5	126.2		1,169.2	173.6	979.3	145.4
(b) 1980/81 Onwards (due to reduction in depreciation charges for existing units to Rs 1.4 million/year)				1,915.8	115.0		1,169.2	173.6	979.3	145.4

a/ At 36% capacity utilization equivalent to 60,000 TPY of urea output.
b/ At 90% capacity utilization equivalent to 148,500 TPY of urea output.
c/ Incremental production cost which excludes salaries and corporate overhead charges which can not be avoided by the corporation even if it shuts down the fertilizer unit completely.
d/ The lignite transfer price is calculated based on estimated total production cost including depreciation, interest and corporate overhead charges attributable or allocated to the mines plus a fair return (10%) on equity or share capital, whichever is larger. The estimated total production cost for 1975/76 is Rs 47/ton.

e/ The steam transfer price is also calculated in the same manner as the lignite transfer price. The estimated 1975/76 total steam production cost is Rs 53/ton, but, by 1976/77, the cost is projected to decrease and a transfer price of RS 25/ton has been used.
f/ The power transfer price is also calculated in the same manner as the lignite transfer price. It is Rs 120 per MWH and duties for self-generation of 10% (Rs 12/MWH) have been added which raises the price to Rs 132/MWH.

g/ Rs 6.5 million/year for existing facilities that will be retained in the project. The new facilities will add another Rs 3.0 million per year calculated as approximately 50% of the cost of spares (plus 7% for contingency) in the capital cost estimate.
h/ The depreciation on existing facilities (lignite based operation) is reduced to Rs 1.4 million annually from 1980/81 onwards. For the proposed project, the existing facilities that will be retained will contribute Rs 1.5 million annually to depreciation from 1980/81 onwards. Depreciation for the project will be Rs 25.3 million/ year during 1978/79-1979/80.

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INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Economic Production Costs [a]
(in 1975 Rupees or US Dollars)

Items	Existing Operation[b] Rs/ton of Urea	Existing Operation[b] Rs Million per Year	Proposed Project[c] Rs/ton of Urea	Proposed Project[c] Rs Million per Year
I. Foreign Exchange Costs (FX)				
A. Variable Costs				
1. Lignite (20% FX)	63.2	3.8	---	---
2. Fuel Oil, CIF US$ 55 or Rs 430/ton	---	---	258.0	38.3
3. Chemicals and Consumables (60% FX)	126.0	7.6	24.3	3.6
4. Power (20% of cost before duty; e.g., Rs 24/MWH)	79.9	4.8	34.1	5.1
5. Process Steam (10% FX)	17.0	1.0	12.9	1.9
6. Bags (25% FX)	22.5	1.4	22.5	3.4
Sub-Total	308.6	18.6	351.8	52.3
B. Fixed Costs				
1. Maintenance Materials (40% FX)	66.7	4.0	25.6	3.8
Total Foreign Exchange Costs	375.3	22.6	377.4	56.1
II. Domestic Resource Costs (DRC)				
A. Variable Costs				
1. Lignite (80% DRC)	253.0	15.2	---	---
2. Local Handling of Fuel Oil, Rs 45/ton	---	---	27.0	4.0
3. Chemicals and Consumables (30% DRC)	63.0	3.8	12.2	1.8
4. Power (80% of cost before duty; e.g., Rs 96/MWH)	319.7	19.2	136.3	20.2
5. Process Steam (90% DRC)	153.0	9.2	116.3	17.3
6. Bags (60% DRC)	54.0	3.2	54.0	8.0
Sub-Total	842.7	50.6	345.8	51.3
B. Fixed Costs				
1. Maintenance Materials (40% DRC)	66.7	4.0	25.6	3.8
2. Insurance, Selling & Administrative Expenses (100% DRC)	30.0	1.8	20.9	3.1
3. Salaries, Wages and Overhead (100% DRC)	470.0	28.2	189.9	28.2
Sub-Total	566.7	34.0	236.4	35.1
Total Domestic Resource Costs	1,409.4	84.6	582.2	86.4
III. Total Economic Production Costs	1,784.7	107.2	959.6	142.5

a/ Based on financial costs except for fuel oil.
b/ At 36% capacity utilization or 60,000 TPY urea.
c/ At 90% capacity utilization or 148,500 TPY urea.

INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Additional Cash Generation from Operations[a/]
For Corporation as a Whole
(in Millions of 1975 Rupees)

Fiscal Year	From Proposed Fertilizer Project[b/]	From Additional Power Generation[c/]	Total Cash Generation
4 (1979/80)	(12.7)	9.1	(3.6)
5	4.2	9.1	13.3
6 - 14	9.9	9.1	19.0
15	24.2	9.1	33.0

a/ Cash generation from operations before debt service payments and income taxes.

b/ Taken from Table 8. Defined as the net financial benefit of the proposed project.

c/ Based on 345,000 TPY of lignite, a power output of 0.7143 MWH per ton of lignite (or 246,400 MWH per year), a sales price of Rs 120/MWH (before tax) and a variable power generation cost (including lignite at Rs 55/ton or Rs 77/MWH) of Rs 83/MWH (based on 1975/76 costs).

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INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Cost/Benefit Streams for Financial Rate of Return
(in Millions of 1975 Rupees)

Fiscal Year	Proposed Project (Fuel Oil) Capital Costs a/	Urea Output (1000 Tons) b/	Production Costs c/	Sales Value of Output d/	Net Benefit Stream	Existing Operation (Lignite) Capital Costs	Urea Output (1000 Tons)	Production Costs c/	Sales Value of Output d/	Net Benefit Stream	Incremental Net Benefit Stream e/
1 (1975/76)	35.9	50	101.3	75.0	(62.2)	---	50.0	101.3	75.0	(26.3)	(35.9)
2	63.2	60	113.6	81.0	(95.8)	---	60.0	113.6	81.0	(32.6)	(63.2)
3	34.3	30	73.6	37.0	(70.9)	---	60.0	113.6	74.7	(38.9)	(32.0)
4 (1978/79)	---	82.5	107.5	94.8	(12.7)	---	60.0	113.6	69.0	(44.6)	31.9
5	---	132.0	147.6	151.8	4.2	---	60.0	113.6	69.0	(44.6)	48.8
6	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
7	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
8	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
9	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
10	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
11	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
12	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
13	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
14	---	148.5	160.9	170.8	9.9	---	60.0	113.6	69.0	(44.6)	54.5
15	(14.3) f/	148.5	160.9	170.8	24.2	(11.0) g/	60.0	113.6	69.0	(33.6)	57.8
									Financial Rate of Return		27%

a/ Capital Costs are taken from Table 4 and converted using the exchange rate Rs 7.80 = US$ 1.00.
b/ Production during years 1 to 3 are based on lignite, starting on year 4, production is based on fuel oil.
c/ Production costs are taken from Table 5 but excludes depreciation charges.
d/ Based on an ex-factory price of Rs 1500 per ton of urea in current terms from 1975/76 through 1978/79 and a price of Rs 1150/ton in constant 1975 rupees thereafter.
e/ Net benefit stream of proposed project less the net benefit stream of the existing operations.
f/ Recovered non-depreciable assets converted to 1975 rupees by a factor of 0.8 .
g/ Recovered working capital (estimated at Rs 11 million in 1975 rupees) of existing operations.

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INDIA - FERTILIZER INDUSTRY CREDIT
Neyveli Fertilizer Project
Cost/Benefit Streams for Economic Rate of Return
(In Millions of 1975 Rupees)

Fiscal Year	Proposed Project (Fuel Oil) Capital Costs a/	Urea Output (1000 Tons) b/	Production Costs c/	Economic Value of Output d/	Net Benefit Stream	Existing Operation (Lignite) Capital Costs	Urea Output (1000 Tons)	Production Costs c/	Economic Value of Output d/	Net Benefit Stream	Incremental Net Benefit Stream e/
1 (1975/76)	32.8	50.0	95.6	130.8	2.4	---	50.0	95.6	130.8	35.2	(32.8)
2	53.0	60.0	107.2	138.0	(22.2)	---	60.0	107.2	138.0	30.8	(53.0)
3	32.8	30.0	70.5	58.5	(44.8)	---	60.0	107.2	117.0	9.8	(54.6)
4	---	82.5	96.4	125.4	29.0	---	60.0	107.2	91.2	(16.0)	45.0
5	---	132.0	131.0	200.6	69.6	---	60.0	107.2	91.2	(16.0)	85.6
6	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
7	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
8	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
9	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
10	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
11	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
12	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
13	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
14	---	148.5	142.5	225.7	83.2	---	60.0	107.2	91.2	(16.0)	99.2
15	(13.9) f/	148.5	142.5	225.7	97.1	(11.0) g/	60.0	107.2	91.2	(5.0)	102.1
									Economic Rate of Return		41%

a/ Capital Costs are taken from Table 4, using Rs 7.80 = US$ 1.00 as the exchange rate.
b/ Production during years 1 to 3 are based on lignite; years 4 and onwards are based on fuel oil.
c/ Economic production costs are taken from Table 6.
d/ The economic prices of urea are derived as follows (in constant 1975 US Dollars):

	1975/76	1976/77	1977/78	1978/79 & Onwards
FOB US$/ton, bagged	300	260	215	160
Ocean freight, $/ton	25	25	25	25
Local handling, $/ton	10	10	10	10
US$/ton of Urea	335	295	250	195
Rs/ton of Urea	2,615	2,300	1,950	1,520

e/ Difference between proposed project net benefit stream and the existing operation net benefit stream.
f/ Non-depreciable assets excluding duties for spares, deflated in constant 1975 terms by the factor 0.8,
g/ Recovered working capital, identical to amount in financial analysis.

Industrial Projects Department
June 1975

ANNEX 5-2
Table 10

INDIA - FERTILIZER INDUSTRY CREDIT

NEYVELI - HISTORICAL AND FORECASTED INCOME STATEMENT WITH THE PROPOSED PROJECT
(in Millions of Current Rupees)

	Actual		Estimate	Forecast					
Fiscal Year	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Production Data									
a) Lignite (million tons)	2.9	3.3	3.3	3.3	3.8	4.2	4.5	5.5	6.5
b) Power (million MWH)	1.73	2.02	2.15	2.45	2.76	2.91	3.26	3.31	3.25
c) Urea (thousand tons)	45.8	31.5	45.0	50.0	60.0	30.0	82.5	132.0	148.5
d) "Leco" (thousand tons)	17.4	24.5	25.0	39.5	41.1	105.3	93.8	235.2	282.9
e) Process Steam (million tons)	NA	NA	NA	0.54	0.61	0.74	0.91	1.86	2.20
Outside Sales (Rs Million)									
a) Power	140.8	184.9	293.9	368.8	453.9	528.9	631.2	656.7	789.4
b) Urea	38.3	26.3	51.5	75.0	90.7	45.1	125.2	217.1	261.3
c) "Leco"	8.1	11.1	16.2	25.9	30.2	84.1	81.1	220.3	283.5
Sub-Total	187.2	222.3	361.6	469.7	574.8	658.1	837.5	1,094.1	1,334.2
Internal Transfers (Rs Million)									
a) Lignite	- excluded from costs below -			181.5	234.1	281.8	326.7	432.6	547.0
b) Power	- excluded from costs below -			44.4	55.1	51.2	58.6	96.1	115.7
c) Process Steam	- excluded from costs below -			13.5	17.1	22.6	30.0	66.5	84.1
Sub-Total				239.4	306.3	355.6	415.3	595.2	746.8
Cost of Production									
a) Lignite	- included in costs below -			118.4	137.8	154.5	170.8	198.2	226.1
b) Power	95.6	110.8	202.8	343.2	413.2	488.2	566.5	619.7	725.4
c) Urea	65.0	62.5	88.2	101.3	127.2	89.8	141.9	211.1	246.2
d) "Leco"	20.4	21.8	32.2	36.8	42.1	83.2	82.8	130.2	233.9
e) Process Steam & Others	(10.1)	1.0	0.6	14.6	18.0	22.9	29.6	60.6	75.7
Sub-Total	170.9	196.1	323.8	614.3	738.3	838.6	991.6	1,219.8	1,507.3
Depreciation Charges									
a) Urea	21.8	21.8	20.3	14.0	12.6	12.6	23.8	23.8	12.7
b) Others	42.4	65.9	69.8	69.6	59.5	63.0	69.3	103.2	139.0
Sub-Total	64.2	87.7	90.1	83.6	72.1	75.6	93.1	127.0	151.7
Interest Expense	51.6	60.1	64.7	74.5	79.2	77.8	70.0	78.0	53.0
Profit (Loss) Before Income Taxes	(99.5)	(121.6)	(117.0)	(63.3)	(8.5)	21.7	98.1	264.5	369.0

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August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

NEYVELI - HISTORICAL AND FORECASTED CASHFLOW AND BALANCE SHEET WITH THE PROPOSED PROJECT
(in Millions of Current Rupees)

	Actual		Estimate	Forecast					
	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
I. Cashflow Statement									
Sources of Funds									
Profit (Loss) before Taxes	(99.5)	(121.6)	(117.0)	(63.3)	(8.5)	21.7	98.1	264.5	369.0
Depreciation	64.2	87.7	90.1	83.6	72.1	75.6	93.1	127.0	151.7
Interest	51.6	60.1	64.7	74.5	79.2	77.8	70.0	78.0	53.0
Cashflow from Operations	16.3	26.2	37.8	94.8	142.8	175.1	261.2	469.5	573.7
Increase in Long-Term Debt[a]	-	31.8	260.6	313.7	264.8	156.2	100.0	29.2	-
Increase in Current Liabilities (net)[b]	(18.9)	32.3	(3.3)	(44.7)	(2.2)	-	(12.7)	(13.0)	(310.7)
Increase in Equity[c]	209.7	-	75.5	423.0	232.6	142.9	-	-	-
Total Sources	207.1	90.3	370.6	786.8	638.0	474.2	348.5	485.7	263.0
Uses of Funds									
Interest (long-term debt)	51.6	60.1	64.7	74.5	79.2	77.8	70.0	78.0	53.0
Principal Repayment (long-term debt)	144.4	-	218.2	281.0	334.4	87.3	170.0	368.5	200.0
Debt Service Payments	196.0	60.1	282.9	355.5	413.6	165.1	240.0	446.5	253.0
Capital Additions	11.1	30.2	87.7	431.3	224.4	309.1	108.5	39.2	10.0
Total Uses	207.1	90.3	370.6	786.8	638.0	474.2	348.5	485.7	263.0
Debt Service Coverage Ratio	0.1	0.4	0.1	0.3	0.3	1.1	1.1	1.1	2.3
II. Balance Sheet as of March 31									
Current Assets	253.4	284.5	338.1	374.3	374.3	374.3	393.0	413.0	730.7
Gross Fixed Assets	1,846.4	1,876.6	1,964.3	2,395.6	2,620.0	2,929.1	3,037.6	3,076.8	3,086.8
Less: Accumulated Depreciation	638.2	726.6	816.7	900.3	972.4	1,048.0	1,141.1	1,268.1	1,419.8
Net Fixed Assets	1,208.2	1,150.0	1,147.6	1,495.3	1,647.6	1,881.1	1,896.5	1,808.7	1,667.0
Deferred Revenue Expense & Other Assets	17.1	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
Total Assets	1,478.7	1,452.3	1,503.5	1,887.4	2,039.7	2,273.2	2,307.3	2,239.5	2,415.5
Current Liabilities	27.0	90.4	140.7	132.2	130.0	130.0	136.0	143.0	150.0
Debt	1,000.0	1,031.8	1,074.2	1,106.9	1,037.3	1,106.2	1,036.2	696.9	496.9
Equity: Share Capital	1,009.7	1,009.7	1,085.2	1,508.2	1,740.8	2,207.9	1,883.7	1,883.7	1,883.7
Retained Earnings (loss)	(558.0)	(679.6)	(796.6)	(859.9)	(868.4)	(846.7)	(748.6)	(484.1)	(115.1)
Equity (net)	451.7	330.1	288.6	648.3	873.4	1,037.0	1,135.1	1,399.6	1,768.6
Total Liabilities	1,478.7	1,452.3	1,503.5	1,887.4	2,039.7	2,273.2	2,307.3	2,239.5	2,415.5
Current Ratio	9.4	3.1	2.4	2.8	2.9	2.9	2.9	2.9	4.8
Debt Equity Ratio	69:31	76:24	79:21	63:37	54:46	52:48	48:52	33:67	22:78

a/ The budgeted (Plan) increase in long-term debt are as follows (in Rs millions):

1974/75	0.0	1977/78	256.2
1975/76	0.0	1978/79	98.5
1976/77	85.9	1979/80	29.2

The difference between the budgeted amounts and the amounts shown in the cashflow statement have been added to keep the increase in current liabilities, which is calculated as the residual, from exceeding 35% of current assets.

b/ Calculated as a residual but limited by the condition that the current ratio should not be less than 2.8.

c/ Assumes the proposed project will be financed with equity and that additional equity is added to achieve a debt equity ratio of about 50:50 by 1978/79.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

ROURKELA - PROJECT DESCRIPTION AND ANALYSIS

A. Capital Cost Estimate

The project will add a naphtha reforming unit which will produce synthesis gas equivalent to 180 TPD of ammonia. The unit will be identical to an existing naphtha reforming unit installed in 1971. The project cost is as follows:

Capital Cost Estimate

Rourkela Feedstock Conversion Project

	In Rs Million			In US $ Million		
	Foreign Exchange a/	Local Curr.	Total	Foreign Exchg. a/	Local Curr.	Total
Equipment & Spares (delivered) b/	49.0	52.1	101.1	6.3	6.7	13.0
Duties & Taxes	-	19.1	19.1	-	2.4	2.4
Design and Engineering	4.0	13.5	17.5	0.5	1.7	2.2
Civil Works, Erection & Commissioning c/	0.8	17.6	18.4	0.1	2.3	2.4
Base Cost Estimate (BCE)	53.8	102.3	156.1	6.9	13.1	20.0
Physical Contingencies (10%)	5.4	10.2	15.6	0.7	1.3	2.0
Price Escalation (18%)	10.7	20.3	31.0	1.4	2.6	4.0
Installed Cost	69.9	132.8	202.7	9.0	17.0	26.0
Additional Working Capital d/	-	1.1	1.1	-	0.1	0.1
Interest During Construction	-	-	-	-	-	-
	69.9	133.9	203.8	9.0	17.1	26.1

a/ Foreign exchange cost includes US$2.0 (Rs 16) million of indirect foreign exchange.

b/ Foreign Exchange cost is CIF; local costs include delivery to site.

c/ Includes preoperating expenses.

d/ For additional naphtha inventory.

B. Plant Capacity and Project Benefit

The Rourkela fertilizer plant produces CAN (25% N) with ammonium nitrate liquor (80% N) as by-product. The CAN capacity is 460,000 TPY (based on 330 stream days/year) equivalent to 115,000 TPY of N and the by-product liquor capacity is equivalent to 10,000 TPY of N.[1/] The intermediate ammonia unit has a capacity of 463 TPD ammonia, equivalent to 125,000 TPY of N. Synthesis gas for the ammonia plant is presently supplied by:

a) A naphtha reformer with a capacity equivalent to 180 TPD ammonia (48,700 TPY N).
b) Coke oven gas from the steel plant. About 48,500 NM^3/hr of coke oven gas is required at full production (equivalent to 281 TPD ammonia) but during the last four years, only 11,000 to 16,000 NM^3/hr has been available (equivalent to 64 to 93 TPD ammonia). A debottlenecking program is underway to raise the supply of coke oven gas to 20,000 NM^3/hr, which would be equivalent to 116 TPD of ammonia.

The proposed project will add another naphtha reformer with a capacity equivalent to 180 TPD of ammonia. This will raise the synthesis gas supply to the equivalent of 476 TPD ammonia and will be more than adequate for the ammonia plant which has a capacity of 463 TPD of ammonia.

The capacities and production with and without the proposed project are as follows. The project is estimated to take 36 months to implement and should start production by the end of 1978.

Ammonia Synthesis Gas Supply Capacity
(in TPD of ammonia equivalent)

	Synthesis Gas Source	Present Facilities		Facilities With Project		Incremental Supply from Project	
		TPD	%	TPD	%	TPD	%
a.	Coke Oven Gas	116[a/]	25	116	25	-	-
b.	Naptha Reformer	180	39	360	78	180	39
	Total	296	64	476	103	180	39
c.	Synthesis Gas Required by Ammonia Plant	463	100	463	100		

a/ Based on the availability of 20,000 NM^3/hr of coke oven gas.

1/ About 92% of the ammonia is converted to CAN and 8% is recovered as ammonium nitrate liquor.

CAN Capacity and Output at 90% Utilization of Synthesis Gas Supply Units

(in TPY of CAN)

	Synthesis Gas Source	Present Facilities		Facilities With Project		Incremental Output from Project	
		TPY	%	TPY	%	TPY	%
a.	Coke Oven Gas[a/]	104,000	23	104,000	23	-	-
b.	Naphtha Reformer	161,300	35	322,600	70	161,300	35
	Total	265,300	58	426,600	93	161,300	35
c.	CAN capacity	460,000	100	460,000	100	-	-
d.	Ammonium Nitrate By-Product Output	7,200	58	11,600	93	4,400	35
e.	By-Product Capacity	12,500	100	12,500	100		

a/ Based on the availability of 20,000 NM^3/hr of coke oven gas.

The proposed project would allow as much as 78% of the synthesis gas requirements to be provided by the two naphtha reforming units but the production forecast assumes that 75% of the ammonia will come from the naphtha reforming units.

Even if the supply of coke oven gas is maintained at the present level of about 15,000 NM^3/hr (equivalent to 87 TPD ammonia), production will still be about 400,600 TPY of CAN, about 87% of the CAN capacity, provided both naptha reforming units operate at 90% capacity. At any rate, the project will increase CAN output by 161,300 TPY, representing 35% of the plant's capacity. The plant could then be able to produce at 93% of the CAN capacity, compared to the 58% that can be achieved after the debottlenecking of the coke oven gas supply unit. The actual production during the last four years has ranged from 40% to 53% of the CAN capacity.

C. Raw Material Requirements for Incremental Output

1. Naphtha - 1.0 tons naphtha feedstock per ton of N (0.82 tons naphtha per ton of ammonia), or about 40,325 TPY of naphtha for the incremental output of 61,300 TPY of CAN.

2. Limestone - 0.3 tons of limestone per ton of CAN, or about 48,390 TPY of limestone.

Industrial Projects Department
October 1975.

ANNEX 5-3
Table 1

INDIA - FERTILIZER INDUSTRY CREDIT

ROURKELA - HISTORICAL PRODUCTION DATA 1/

Year	Average Coke Oven gas production (Steel Plant) (Nm³/hr)	Average supply of Coke Oven gas to Fertilizer Plant (Nm³/hr)	Yearly C.A.N. production (Tons)	% capacity utilization of the Fertilizer Plant (% of N Capacity) 2/
1962-63	38,800	5,490	39,965 (20.5%N)	7.1
1963-64	47,070	15,840	119,837 "	21.4
1964-65	42,530	23,750	181,129 "	32.3
1965-66	47,400	21,040	158,780 "	29.4
1966-67	49,590	25,000	188,236 "	33.6
1967-68	50,650	23,330	189,503 "	33.7
1968-69	53,180	29,480	235,911 " 3/	42.1
1969-70	56,110	20,180	146,061 (20.5%N) 4/	26.1
1970-71-	54,900	13,100	94,215 (25%N)	20.5
1971-72	48,560	11,000	195,408 "	40.3
1972-73	53,610	11,150	196,390 "	42.7
1973-74	48,600	12,280	184,323 "	40.1
1974-75	-	15,900	245,107 "	53.3

1/ Naphtha Reformer Plant of 180 TPD ammonia capacity was commissioned in February '71. The production of C.A.N. from Naphtha reformed gas is included from February '71 onwards.
2/ Capacity is 460,000 TPY of CAN (25%N) or 115,000 TPY of N.
3/ Includes 45,882 tons of 25% N product
4/ Includes 117,304 tons of 25% N product

Industrial Projects Department
August 19, 1975

ROURKELA - Production Cost Estimate
(In constant 1975 rupees)

I. Incremental Production Cost for 161,300 TPY CAN Output

A. Variable Costs[a/]

	Item	Units/ton CAN	Rs/Ton CAN Financial Cost	Economic Cost FX	Economic Cost LC
1.	Naphtha	0.25 tons	211.2	175.0	11.2
2.	Limestone	0.30 "	12.6	-	11.3
3.	Bags & Utilities	-	112.5	-	102.3
		Total Variable	336.3	175.0	124.8

B. Incremental Fixed Costs

		Rs Million/year Financial Cost	Economic Cost FX	Economic Cost LC
1.	Salaries and Overhead	10.0	-	10.0
2.	Maintenance Expenses(2% of Installed Cost)	4.0	1.6	1.6
3.	Depreciation Charges(1/12 of Installed Cost)	16.9	-	-
4.	Other Fixed Costs	1.5	-	1.5
	Total Incremental Fixed Costs	32.4	1.6	13.1

C. Average Production Costs Including Depreciation (at 161,300 TPY CAN output)

		Financial	Economic FX	Economic LC
1.	Rs/ton of CAN	537.2	184.9	206.0
2.	Rs million/year	86.6	29.8	33.2

II. Value of Incremental Output[a/]

		Financial	Economic FX	Economic LC
1.	Rs Million/year from CAN	105.8	132.7	12.6
2.	Rs Million/year from By-Product AN Liquor (4,400 TPY)	4.8	-	4.8
	Total Rs Million/year	110.6	132.7	17.4

a/ Price Assumptions are:

	Item	Financial	Economic FX	Economic LC
1.	Naphtha,Rs/ton(delivered)	845	700	45
2.	Limestone,Rs/ton(delivered)	42	-	38
3.	CAN, Rs/ton (ex-factory)	656	823	78
4.	By-Product Ammonium Nitrate Liquor Rs/ton (ex-factory)	1,100	-	1,100

Note: The financial price of CAN (25%N) has been derived from the urea (46%N) ex-factory price of Rs 1150/ton. It is assumed that on a nutrient basis (Rs/ton of N), the N in CAN will be priced higher by 5% than the N in urea (for both financial and economic prices). The small premium for the N in CAN is to account for the limestone contained in CAN which also has agronomic value. The economic price has been derived from a CIF price of US$ 185/ton for urea. The local currency cost is the economic price for local handling.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

ROURKELA - Cost and Benefit Streams for
Rate of Return Calculations
(in constant 1975 rupees)

Year	Financial Cost and Benefit Streams				Economic Cost and Benefit Streams			
	Capital Costs a/	Operating Costs b/	Value of Output	Net Benefit	Capital Costs a/	Operating Costs	Value of Output	Net Benefit
1 (1975)	10.0	-	-	(10.0)	10.0	-	-	(10.0)
2	40.5	-	-	(40.5)	40.5	-	-	(40.5)
3	76.8	-	-	(76.8)	60.9	-	-	(60.9)
4 (1978) c/	42.8	7.6	10.2	(40.2)	42.8	6.9	13.9	(35.8)
5	-	45.6	61.4	15.8	-	41.6	83.4	41.8
6	-	60.7	92.2	31.5	-	55.0	125.0	70.0
7	-	69.7	110.6	40.9	-	63.0	150.1	87.1
8	-	69.7	110.6	40.9	-	63.0	150.1	87.1
9	-	69.7	110.6	40.9	-	63.0	150.1	87.1
10	-	69.7	110.6	40.9	-	63.0	150.1	87.1
11	-	69.7	110.6	40.9	-	63.0	150.1	87.1
12	-	69.7	110.6	40.9	-	63.0	150.1	87.1
13	-	69.7	110.6	40.9	-	63.0	150.1	87.1
14	-	69.7	110.6	40.9	-	63.0	150.1	87.1
15	-	69.7	110.6	40.9	-	63.0	150.1	87.1
16	(0.8) d/	69.7	110.6	40.9	(0.8) d/	63.0	150.1	87.2

Financial Rate of Return before Taxes 15 % Economic Rate of Return 33 %

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a/ Based on a disbursement schedule (in millions of current rupees) of Rs 10 in 1975, Rs 45 in 1976, Rs 92.5 (including Rs 19.1 for duties) in 1977 and Rs 56.3 in 1978. Duties have been excluded from the economic costs and the capital costs have been deflated to constant 1975 rupees.

b/ Excludes depreciation.

c/ Production starts November 1978 at 50% incremental capacity utilization through 1979, 75% in 1980 and 90% thereafter.

d/ Recovered working capital of Rs 1.1 million disbursed in 1978 and deflated to constant 1975 rupees.

Industrial Projects Department
August 19, 1975

INDIA: FERTILIZER INDUSTRY CREDIT

MADRAS FERTILIZERS LIMITED - PROJECT DESCRIPTION AND ANALYSIS

A. Introduction

1. Madras Fertilizers Limited was incorporated on December 8, 1966 and a turnkey contract for the design, engineering and construction of the works and buildings at Manali 25 km north of Madras (State of Tamil Nadu) was awarded to Chemical Construction Corporation (USA) on July 20, 1967. The plant was accepted from the contractor on June 7, 1971 and went into commercial production the following November. The works has a rated production capacity of 750 TPD ammonia, 885 TPD urea, and 1,100 TPD NPK with about 665 TPD urea and 1,100 TPD NPK in two grades (14-28-14 and 17-17-17) available for distribution.

2. The company is a joint sector undertaking with 51% Government of India (GOI) ownership and the remaining 49% being equally split between Amoco India Incorporated, a subsidiary of Amoco International Oil Company, and National Iranian Oil Company of Iran respectively. The foreign exchange requirements of the project which cost a total of around Rs 650 million were met by equity from Amoco India Inc. and through a loan from the Chemical Bank and Trust Company, New York, arranged by Amoco International. Authorized share capital of the company is Rs 140 million of which Rs 136.5 million is paid up. The company's balance sheet as of March 31, 1973 showed total assets of Rs 689.4 million and a debt to equity ratio of 80:20. For the year ending March 31, 1973 it showed a profit of Rs 550,479 on sales of Rs 351.8 million but a net loss of Rs 14,546 after adjustments from previous years' operations. A total of Rs 97.8 million was provided during the year for depreciation and interest.

3. The ammonia production unit is of Chemico design using Catalyst and Chemicals Incorporated (USA) catalysts and is based on a naphtha steam reformer designed by Topsoe and using Topsoe's reforming catalyst. Naphtha is supplied from Madras Refineries Ltd. about 3 km away by pipeline.. Madras Refineries Ltd. is owned by the same group of shareholders as MFL with the Government holding a 74% majority.

B. Operating Experience

4. When the ammonia unit was first started it was found to be capable of producing at the rate of only 535 TPD instead of to its design capacity of 750 TPD. But instead of closing the plant down for one month to effect modifications as desired by the contractor, MFL agreed with Chemico on a penalty settlement of around US$0.5 million. The plant was then gradually increased to near its full capacity by the company itself. The main tasks undertaken were:

a) repacking of ammonia synthesis converter to prevent recycling of gas;
b) addition of one cell to the cooling water tower;
c) modifications to the CO_2 removal plant;
d) cleaning of heat exchangers which were fouled at the time of erection.

5. Of the annual rated capacity of about 750 TPD ammonia, 530 TPD goes toward the manufacture of urea, and 100 TPD toward NPK leaving a surplus of about 120 TPD which was originally intended for the future production of ammonium chloride and soda ash. However, the company has decided not to proceed with that scheme and instead is now installing a third NPK train to absorb part (50 TPD ammonia) of the surplus.

6. The plant manufactures NPK in two trains at present with a total capacity of about 1,100 TPD but is adding a third train to absorb part of the surplus ammonia capacity. The NPK plant was designed and supplied by Dorr Oliver as subcontractor to Chemico. Civil works for the third train are almost complete but as of January 1975 only the drier had so far been erected. Major contractor for the project is Dorr-Oliver India. The effective date of the contract was May 1, 1974 and scheduled completion time is 25 months. The project will give an additional output of 600 TPD NPK and will consume 50 TPD ammonia, 165 TPD urea, 171 TPD potash, and 106 TPD 52% phosphoric acid. Total cost including spare parts and working capital is expected to be $14.5 million including about $1.4 million in foreign exchange. The NPK trains produce an ammonium phosphate which is almost equivalent to DAP having an ammonia to phosphate ratio of about 1.8 to which potash, sand (used as filler) and urea are blended to give the two end products 17-17-17 and 14-28-14. Requirements of potash and 52% phosphoric acid are imported and stored at the works in a 2,000 ton potash storage building and three phosphoric acid storage tanks of 9,000 ton total capacity (1 x 6,000 and 2 x 1,500). An additional 30,000 tons acid storage is provided at the port but the maximum inventory there during 1973 only reached 12,000 tons. The largest acid ships coming to Madras are of 14,500 tons capacity. Twenty six days' storage is provided in a double-sided storage building for the two grades of NPK in bulk and bags.

7. When operated at the present capacity, the plant consumes the following raw materials and utilities:

naphtha	260,000 TPY
fuel (LPG and furnace oil)	70,000 "
52% phosphoric acid	158,000 "
potash	110,000 "
filler and coating agents	48,000 "
water	5 million imperial gallons/day
power	10-12 MW

8. Water is supplied by the Government of Tamil Nadu from deep wells about 15 miles from the works. Huge quantities of water are reported to be supplied to the Industrial Belt of Tamil Nadu from this source and the works has experienced no shortages to date.

9. Beyond a 500 KW emergency power generating set, the works is totally dependent on the Tamil Nadu Electricity Board (TNEB) for its electric power requirements. The generating authority, however, is reported to have an overall shortage of capacity and to have cut power to all consumers over the past year.

C. Urea Debottlenecking Project

16. The urea debottlenecking project will utilize the surplus 70 TPD ammonia capacity that will still be available after the third NPK train is operating. The project will cost Rs 9.4 (US$1.2) million including Rs 5.5 (US$0.7) million in foreign exchange. The urea capacity will be raised from 885 TPD to 1000 TPD, or about 330,000 TPY based on 330 stream days. The debottlenecking will involve raising the Annex 5-4 capacities of the CO_2 compressors, decomposer, carbonate pump and ammonia condenser. Output at 90% capacity utilization will increase by 33,000 TPY from 264,000 TPY to 297,000 TPY after the debottlenecking program.

D. Ammonia Process Control Project

17. The ammonia computerized process control system being proposed will cost Rs 3.6 (US$0.5) million including Rs 1.8 (US$0.2) million in foreign exchange. The project is expected to reduce naphtha consumption by 2.5% by computerized control of the hydrogen-nitrogen ratio in the make-up synthesis (1.5%) and the synthesis loop (1%). The present naphtha consumption is 1.05 tons of naphtha per ton of ammonia (or 0.63 tons naphtha per ton of urea). Based on the existing urea capacity (885 TPD urea) and the expanded NPK facilities (requiring 150 TPD ammonia), the annual naphtha savings at 90% output is about 5,300 TPY of naphtha. When the urea capacity is increased to 1000 TPD and the entire 750 TPD ammonia capacity is utilized at 90% of capacity, the naphtha savings is about 5,800 TPY. At the 1975 price of Rs 600 per ton of naphtha, these quantities would represent an annual savings of Rs 3.13 and Rs 3.48 million respectively. The process control computer is expected to be installed by mid-1977.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT
MADRAS FERTILIZER LIMITED - CAPITAL COST ESTIMATES

A. Capital Cost Estimate - Urea Plant Debottlenecking

	In Rs Millions			In Millions of US Dollars		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment & Spares (delivered)	3.1	1.0	4.1	0.40	0.13	0.53
Duties	-	1.2	1.2	-	0.15	0.15
Licenses & Engineering	0.4	-	0.4	0.05	-	0.05
Erection & Commissioning	0.4	0.8	1.2	0.05	0.10	0.15
Base Cost Estimate (RCE)	3.9	3.0	6.9	0.50	0.38	0.88
Physical Contingencies (15%)	0.8	0.3	1.1	0.10	0.04	0.14
Price Escalation (18%)	0.8	0.6	1.4	0.10	0.08	0.18
Total	5.5	3.9	9.4	0.70	0.50	1.20

B. Capital Cost Estimate - Ammonia Process Control Project

	In Rs Million			In Millions of US Dollars		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment (delivered)	1.0	0.8	1.8	0.13	0.10	0.23
Duties	-	0.3	0.3	-	0.04	0.04
Licenses & Engineering	0.2	-	0.2	0.02	-	0.02
Erection & Commissioning	-	0.7	0.7	-	0.09	0.09
Base Cost Estimate (RCE)	1.2	1.8	3.0	0.15	0.23	0.38
Physical Contingencies (10%)	0.2	0.2	0.4	0.02	0.02	0.04
Price Escalation (18%)	0.2	0.4	0.6	0.03	0.05	0.08
Total	1.6	2.4	4.0	0.20	0.30	0.50

Industrial Projects Department
June 1975

INDIA - FERTILIZER INDUSTRY CREDIT
MADRAS FERTILIZER LIMITED - UREA DEBOTTLENECKING
1978 Incremental Production Cost Estimates
(in Constant 1975 Rupees)

I. Incremental Output (starting 1978) 33,000 TPY of Urea

II. Financial Production Costs

	Units/ton Urea	Rs/Unit	Rs/ton Urea
A. Variable Costs			
1. Naphtha	0.63 tons	835	526.0
2. Fuel Oil (fuel)	0.17 tons	875	148.8
3. Bags	4.5 pieces	20	90.0
4. Catalysts & Chemicals	---	---	20.0
5. Utilities & Other Expenses	---	---	30.0
Sub-Total			814.8

	Million Rs/Year	Rs/ton Urea
B. Incremental Fixed Costs		
1. Insurance & Taxes (0.5% of capital costs)	0.05	1.5
2. Depreciation (1/12 of capital cost)	0.78	23.6
3. Maintenance Expense (2% of capital cost)	0.19	5.8
Sub-Total	1.02	30.9
Total Incremental Production Cost	27.9	845.7
Cost Excluding Depreciation	27.2	822.1

III. Economic Production Costs

	Units/ton Urea	Rs/Unit	Rs/ton Urea
1. Naphtha	0.63 tons	741 ($95)	466.8
2. Fuel Oil (fuel)	0.17 tons	468 ($60)	79.6
3. Bags (85% of financial cost)			76.5
4. Other variable costs (90% of financial cost)			45.5
5. Fixed Costs (maintenance & insurance, 80% of financial cost)			5.8
Total Economic Production Cost			674.2

Industrial Projects Department
June 1975

INDIA - FERTILIZER INDUSTRY CREDIT
MADRAS FERTILIZER LIMITED - UREA DEBOTTLENECKING
Cost/Benefit Streams for Rate of Return Calculation
(in Millions of Constant 1975 Rupees)

Calendar Year	Financial Cost/Benefit Streams: Capital Costs a/	Financial Cost/Benefit Streams: Incremental Production Costs	Financial Cost/Benefit Streams: Ex-Factory Value of Incremental Output b/	Economic Cost/Benefit Streams: Capital Costs c/	Economic Cost/Benefit Streams: Incremental Production Costs	Economic Cost/Benefit Streams: Economic Value of Incremental Output d/
1 (1975)	(2.5)	---	---	(2.5)	---	---
2	(4.6)	---	---	(2.7)	---	---
3	(1.4)	---	---	(1.4)	---	---
4	---	27.2	37.9	---	22.2	50.2
5	---	27.2	37.9	---	22.2	50.2
6	---	27.2	37.9	---	22.2	50.2
7	---	27.2	37.9	---	22.2	50.2
8	---	27.2	37.9	---	22.2	50.2
9	---	27.2	37.9	---	22.2	50.2
10	---	27.2	37.9	---	22.2	50.2
11	---	27.2	37.9	---	22.2	50.2
12	---	27.2	37.9	---	22.2	50.2
13	---	27.2	37.9	---	22.2	50.2
14	---	27.2	37.9	---	22.2	50.2

Financial Rate of Return = 65 %

Economic Rate of Return = Exceeds 100%

a/ Disbursements are assumed as (in million of current rupees): 2.5, 5.2 (including 2.2 for duties) and 1.7 Rs million during 1975, 1976 and 1977 respectively. Costs have been deflated to constant 1975 rupees.
b/ At an ex-factory price of Rs 11/50 ton in 1978 and thereafter (in constant 1975 rupees).
c/ Excluding duties and deflated to constant 1975 rupees.
d/ At an economic price of US$ 195/ton of urea, composed of a CIF price of $185 and local handling of $10 per ton respectively.

Industrial Projects Department
June 1975

ANNEX 5-4
Table 4

INDIA - FERTILIZER INDUSTRY CREDIT

MADRAS FERTILIZER LIMITED - COMPUTERIZED AMMONIA PROCESS CONTROL

Cost/Benefit Streams for Rate of Return Calculation

(In Millions of Constant 1975 Rupees)

	Financial Cost/Benefit Streams			Economic Cost/Benefit Streams		
Calendar Year	Capital Costs a/	Operating Cost b/	Value of Naphtha Saved c/	Capital Costs d/	Operating Cost	Economic Value of Naphtha Saved e/
1 (1975)	(0.4)	---	---	(0.4)	---	---
2	(2.1)	---	---	(1.4)	---	---
3	(0.8)	0.3	2.2	(0.8)	0.3	2.0
4	---	0.3	4.8	---	0.3	4.3
5	---	0.3	4.8	---	0.3	4.3
6	---	0.3	4.8	---	0.3	4.3
7	---	0.3	4.8	---	0.3	4.3
8	---	0.3	4.8	---	0.3	4.3
9	---	0.3	4.8	---	0.3	4.3
10	---	0.3	4.8	---	0.3	4.3
11	---	0.3	4.8	---	0.3	4.3
12	---	0.3	4.8	---	0.3	4.3
13	---	0.3	4.8	---	0.3	4.3

Financial Rate of Return: 97 % Economic Rate of Return: Exceeds 100%

---

a/ Disbursements are assumed as (in millions of current rupees): 0.4, 2.4 (including 0.8 for duties) and 0.8 Rs million during 1975, 1976 and 1977 respectively. Costs have been deflated to constant 1975 rupees.

b/ Mostly for additional labor. Operating costs are estimated as equivalent to 20 man years @ Rs 15,000 per man year.

c/ Based on installation of computerized system in mid 1977, completion of urea debottlenecking at end of 1977 and 90% capacity utilization. Naphtha savings are 2,650 tons in 1977 and 5,800 tons thereafter and are valued at Rs 835/ton in constant 1975 rupees.

d/ Excludes duties and deflated to constant 1975 rupees.

e/ At an economic price of Rs 741/ton of naphtha.

Industrial Projects Department
June 1975

INDIA - FERTILIZER INDUSTRY CREDIT

GSFC - PROJECT DESCRIPTION AND ANALYSIS

A. Introduction

1. The Gujarat State Fertilizers Company (GSFC) was incorporated under the Companies Act (1956) in February 1962 to manufacture fertilizers. The available finance was limited and would have necessitated a plant with lower capacity. However, a scheme was drawn up to collect Rs 15 million as equity capital from farmers, businessmen and directors, which enabled the financial institutions to give substantial loans and equity to GSFC. The Gujarat State sponsored the project with its participation to the extent of 49% of the equity stock. The balance of 51% share capital was subscribed by the public, including 35,000 farmers and the financial institutions (14% by IDBI and 16% by other nationalized financial institutions). GSFC's authorized share capital is Rs 150 million. The company's balance sheet as of March 31, 1974 showed total assets of Rs 695 million and a debt equity ratio of 40:60. For the year ending March 31, 1974 it showed a profit of Rs 25.4 million on sales of Rs 420 million, which was not distributed as dividend but retained. A total of Rs 86 million was provided during the year for depreciation and interest. GSFC's first phase plants consisting of ammonia, urea, sulphuric acid, phosphoric acid, ammonium sulphate and di-ammonium phosphate were commissioned in March - April 1967. The production of fertilizers started in June 1967. The rated final product capacity was of 323 TPD urea, 470 TPD ammonium sulphate and 340 TPD di-ammonium phosphate. Well before the first phase completion date, GSFC took up an expansion of the ammonia-urea plants to fill the fertilizer supply gap, which was quickly developing. Thus, an additional ammonia plant of 500 TPD capacity and a urea plant of 800 TPD capacity were established and commissioned in September 1967. The urea plant was India's largest single-stream plant and contributed to the success of GSFC as a fertilizer company. In 1972 construction started on a caprolactam plant of 20,000 TPY capacity and an SO_2/Oleum plant together with associated steam generation and water treatment facilities. The caprolactam unit will also produce 80,000 TPY of ammonium sulphate. These units were completed in late 1974.

B. Operating Experience

2. As a result of the commissioning of several plants, the installed capacity in terms of end products and intermediate products is as follows :

Installed Capacity in MT Per Annum (1975)

		TPD	TPY
(a)	**End Products**		
	Urea	1,123	367,000
	Ammonium Sulphate	470	228,000 1/
	Di-ammonium Phosphate	340	108,000
	Caprolactam	-	20,000
(b)	**Intermediate Products**		
	Ammonia	950	315,000
	Sulphoric Acid	470	150,000
	Phosphoric Acid ($100\%\ P_2O_5$)	175	57,000
	Cyclohexane 2/	-	24,000
	Oleum	-	28,000

1/ Including 80,000 TPY produced by the caprolactam plant as co-product.

2/ The bulk of the capacity is for captive consumption for the manufacture of caprolactam and the 4,000 TPY surplus is for industrial sale.

3. GSFC is one of the most successful fertiliser companies in India. Two factors account for this : the completion of projects as scheduled and the high capacity utilization achieved in the urea plants. The high quality of the staff and operating personnel of the company has certainly contributed to the success of the enterprise. GSFC has 2,475 employees presently, out of which 1,360 are technical staff. GSFC's philosophy is to recruit new staff by taking first-class college and high-school graduates in different disciplines of science and engineering for a two-year period of training. At present, about 80% of the technical staff has come through the training program.

4. The fertilizers production at GSFC since the start of the operations is shown below:

Trend of Production (in metric tons)

Product	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75
Urea	64,241	93,499	198,988	253,026	331,846	352,879	263,189	284,164
Ammonium Sulphate	25,203	75,605	51,593	102,171	110,589	125,480	120,264	132,466
Di-Ammonium Phosphate	28,089	55,032	44,664	55,453	54,444	68,785	62,527	62,742
Caprolactam	-	-	-	-	-	-	-	6,410
Ammonia	59,372	99,684	156,207 1/	202,736	253,133	275,928	228,600	253,452
Sulphuric Acid	49,627	88,929	98,179	88,683	95,006	127,979	132,324	121,624
Phosphoric Acid	14,223	29,422	24,529	27,400	26,193	34,630	30,900	31,564
Oleum	-	-	-	-	-	-	1,877	10,668

C. Expansion and Debottlenecking Plans

5. The company is now engaged in a new program of capacity expansion and debottlenecking, involving a capital outlay of about Rs 161 (US$20.6) million including Rs 55 (US$7.0) million in direct foreign exchange 1/. The program includes the following components : (1) purge gas recovery, (2) fluorine recovery/cryolite production, and (3) phosphoric acid plant debottlenecking all of which are proposed to be included in the IDA fertilizer industry credit.

6. The phosphoric acid (PA) plant supplies the P_2O_5 to the ammonium phosphate complex and the operation of the PA plant influences the operation of the connected plants, i.e., DAP and AS. These three plants were established and commissioned in the year 1967-68 and since then they have been in continuous operation. The current year 1975-76 is the eighth year of operations and GSFC has continuously experienced difficulties in achieving high capacity utilization of the PA plant. Even during the initial commissioning of the PA plant, repeated attempts by the plant suppliers, Hitachi Shipbuilding & Engineering Company of Japan, to give guarantee test particularly as to production capacity were not thoroughly successful. A number of additions and alterations have been carried out in the plant from time to time. No doubt these measures have to some extent improved the performance of the concentration section and as a consequence down-time due to scaling of concentrator tubes, changing of diaphrams valves, failure of pump glands, etc. have been minimized. Apart from the attempts

1/ Indirect foreign exchange is about Rs 5 (US$0.7) million. The company will finance the local currency cost from internal funds and borrow the foreign exchange requirements (IDA funds) through IDBI.

of addition and alterations, the most suitable rock feeding arrangement was also kept in view. Unfortunately, the phosphate rock of the required specification is not always available to the company. This has further aggravated the problems of corrosion and erosion in the plant. The plant can reach just 55% capacity output because of the following problems :

(a) Use of different types of phosphate rock.
(b) Poor digestion of phosphate rock.
(c) Inadequate cooling in the rock digestion system.
(d) Poor filteration.

GSFC has contacted Phosphatic Engineering Corporation (USA) to study the problem and suggest the best economic way to achieve rated production capacity and provide cost estimates for the project. The consultant will take about six months to develop the remedial measures. It is anticipated that the suggested modifications will be completed by January 1978.

7. GSFC has two ammonia plants with a total of 950 tons per day capacity, using the ICI naphtha steam reforming process. The feed gas to the ammonia converters consists of hydrogen and nitrogen as reactants and argon and methane as inerts. In the synthesis loop, as the reactants combine to form ammonia, which is withdrawn, the concentration of inerts starts building up. A constant purge of gas is applied to maintain the concentration of inerts constant. At present, the purge gas is burnt in the primary reformer as fuel.

8. The volume of gas purged is 9100 Nm3 per hour and its composition is as follows :

Hydrogen	-	63.6% vol.
Nitrogen	-	21.2% "
Methane	-	10.0% "
Argon	-	4.2% "
Water Vapour	-	Saturated at $40^{o}C$ and 20 $kg/cm^{2}g$
Ammonia	-	0.15 - 0.08% vol.

9. It is possible to recover methane, argon and the mixture of hydrogen and nitrogen (in a ratio of 3 to 1) as ammonia synthesis gas, by installing a separation plant based on cryogenic techniques. The advantages of the proposed plant are that :

(a) An additional production of 63 tons per day ammonia can be achieved by recycling the Hydrogen-Nitrogen mixture to the synthesis reactor. The synthesis loop has spare capacity to accommodate this extra production.

(b) Argon will be separated and sold on the Indian market, filling the supply gap which at present exists in the country. The existing argon producing units (5) have a combined installed capacity of 0.45 million Nm^3/year and the actual production capacity is of the order of only 0.35 million Nm^3/year. The task force on industrial gases set up by Government of India have estimated a demand of 1.5 million by 1979-80.

10. The phosphate rock used as raw material in the phosphoric acid plant have on average about 3 to 4% fluorine present as fluorides. This fluorine is released in the phosphoric acid manufacturing process and is distributed in the various steps of the process as follows :

6 to 10% in the Digester
20 to 25% in the Concentrator
30 to 35% in the Gypsum
Balance about 30% in the finished product.

11. The 25% fluorine released at the concentrator is absorbed in the recirculating cooling water, thus creating a pollution hazard. By recovering this fluorine, the pollution hazard is reduced and the recovered fluorine can be used for the manufacturer of cryolite or aluminium fluoride which at present are being imported to meet the growing requirements of the aluminium industry. The proposed project will recover fluorine from the concentrator in the form of hydrofluosilicic acid. When the concentration of the acid reaches about 15%, the acid is withdrawn to a separate tank. This 15% acid is then further processed to manufacturer cryolite, by reaction with sodium fluoride to form sodium silico fluoride. The sodium silico fluoride is then reacted with soda ash solution to form sodium fluoride, which is partly recycled The silica, which precipitates, is filtered out. The remaining sodium fluoride is then reacted with aluminium sulphate to form cryolite which is washed, calcined and cooled before being bagged.

D. New Ammonia - Urea Complex

12. The Government of India has issued a Letter of Intent to GSFC to establish a new fertilizer plant to manufacture 1,350 TPD ammonia and 1,600 TPD urea. The plant will be based on fuel oil and the required quantity of fuel oil will be available from the nearby Gujarat refinery. It has been decided to form a new company for the new fertilizer project. The State Government of Gujarat and GSFC will be the joint promoters subscribing 51% of the share capital of the new company. Though a new company will be formed, GSFC's involvement in the new fertilizer project will be substantial and continuous. The capital outlay for the new project will be about Rs 1,800 (US$230) million and about 40% (US$100 million) will be in foreign exchange. GSFC has

already received tenders from foreign engineering firms offering process know-how, engineering design services and supplies. The tenders are being evaluated. The Government of India has assured the company that preference will be given to GSFC for the requirement of foreign exchange for the new plant. The present indications are that part of the foreign exchange (US$35 million) would be available from the Federal German Government through Kreditanstalt für Wiederaufbau (KfW).

E. Purge Gas Recovery Project

13. The purge gas recovery project is estimated to cost Rs 88.1 (US$11.3) million including Rs 35.1 (US$4.5) million in foreign exchange. The purge gas separation unit will have a capacity of 9,100 NM^3/hour of purge gas. The project will take 24 months to complete and should be ready by September 1977. It will provide the following benefits:

a) additional production of 63 TPD[1/] ammonia;
b) recovery of about 7,860 NM^3 of argon daily;
c) recovery of 19,660 NM^3 per day of methane, to be used as fuel in the ammonia plant.

F. Fluorine Recovery Project

14. The fluorine recovery project is expected to cost Rs 22.0 (US$2.7) million of which Rs 8.2 (US$1.0) million will be in foreign exchange. At present, the effluents from the phosphoric acid plant are treated with lime and chalk to fix the fluorine into insoluble calcium fluoride. Since chemical treatment of these effluents are mandatory, it would be economically advantageous to combine this treatment with the recovery of commercially valuable fluorine compounds such as cryolite or aluminum fluoride. Active silica is also recovered as a by-product.

15. The fluorine recovery plant will have a capacity of 7,335 TPY of 15% H_2SiF_6 and of 1,555 TPY of cryolite. Demand for cryolite in India is estimated to be 10,000 tons per year by 1980. The present installed capacity for cryolite in India is 7,200 TPY whereas the actual production is approximately 3,600 TPY. Even assuming a higher utilization of 85% of the installed capacity, there will still be a short fall of about 4,000 TPY by 1980. About 0.3 tons of by-product active silica will be recovered per ton of cryolite. The active silica will be used in the phosphoric acid plant at a saving of Rs 1,000 per ton of active silica.

1/ Based on 0.38 tons ammonia per 1,000 NM^3 of synthesis gas ($3H_2:N_2$).

Cryolite Production and Consumption
(tons per year)

Year	Production	Consumption	Deficit
1969 *	2,178	5,949	3,771
1970 *	3,626	5,383	1,757
1971 *	3,759	4,925	1,166
1974-75	4,250	6,500	2,250
1978-79	6,700	10,700	4,000

* **Actuals**

16. The fluorine recovery/cryolite plant will require the following raw materials:

a) soda ash (technical grade)--0.27 tons/ton of cryolite;
b) aluminum hydroxide--0.42 tons/ton of cryolite;
c) caustic soda--0.40 tons/ton of cryolite.

17. The project will be completed in about 30 months and start production by April 1978.

G. Phosphoric Acid Plant Upgrading Project

18. The phosphoric acid plant upgrading project is estimated to cost Rs 51.4 (US$6.6) million including Rs 17.4 (US$2.2) million in foreign exchange. The project will take 27 months to complete and the project benefits should start by January 1978. The phosphoric acid plant, with a capacity of 175 TPD of 100% P_2O_5, has operated at only about 55% of capacity during 1972/73 up to 1974/75. The project is expected to improve the situation and raise capacity utilization to 70% in 1978 and up to 85% during 1979 and subsequent years. The increase from 55% to 85% capacity utilization will add 17,330 TPY of P_2O_5 production.

19. The project will also improve the P_2O_5 recovery from the present average of 82% to about 94% of the P_2O_5 content of the phosphate rock. This will reduce phosphate rock requirements from about 3.8 to 3.3 tons of rock per ton of P_2O_5 output and also reduce sulfur consumption from 1.6 to 1.3 tons per ton of P_2O_5[1/].

1/ The ratios of 3.8 tons phosphate rock and 1.6 tons of sulfur per ton to P_2O_5 are the average for 1973/74 and 1974/75.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

GSFC-Historical and Forecast Financial Statements
(in millions of current rupees)

	Actual 1973	1974	1975	Forecast with Project 1976	1977	1978
I. Income Statement for the Year Ending March 31						
Gross Sales	457.5	415.4	816.9	1,009.4	1,020.7	1,084.0
Other Income	9.3	4.8	5.0	-	-	-
Revenue	466.8	420.2	821.9	1,009.4	1,020.7	1,084.0
Manufacturing & Other Expenses	268.0	277.9	544.7	629.2	658.1	712.0
Interest Expense	22.6	18.4	18.7	15.9	12.2	15.0
Depreciation Charges	57.9	68.0	93.3	88.4	94.0	77.0
Total Expenses	348.5	364.3	656.7	733.5	764.3	804.0
Before Tax Profit	118.3	55.9	165.2	275.9	256.4	280.0
Income Taxes (61%) a/	-	-	-	168.3	156.4	170.8
Net Profit	118.3	55.9	165.2	107.6	100.0	109.2
II. Funds Flow Statement						
Sources of Funds						
New Debt b/	-	-	-	11.5	36.0	11.7
Net Profit	118.3	55.9	165.2	107.6	100.0	109.2
Depreciation	57.9	68.0	93.3	88.4	94.0	77.0
Net Decrease in Working Capital	32.6	87.1	-	-	-	-
Total Sources	208.8	211.0	258.5	207.5	230.0	197.9
Uses of Funds						
Proposed New Projects	-	-	-	11.5	77.0	73.0 c/
Other Capital Investments	164.6	134.0	26.0	25.0	25.0	25.0
Dividends	17.2	20.8	13.6	13.6	20.8	20.8
Decrease in Borrowing	27.0	56.2	62.3	43.4	53.0	47.0
Net Increase in Working Capital	-	-	156.6	35.0	35.0	-
Outside Investments d/	-	-	-	78.7	19.2	32.1
Total Uses	208.8	211.0	258.5	207.5	230.0	197.9

	Actual 1973	1974	1975	Forecast with Project 1976	1977	1978
III. Balance Sheet as of March 31						
Current Assets	236.5	166.6	370.8	405.8	440.8	458.3
Gross Fixed Assets	820.0	965.3	990.6	1,027.1	1,129.1	1,209.6
Less: Accumulated Depreciation	280.2	348.0	440.8	529.2	623.2	700.2
Net Fixed Assets	539.8	617.3	549.8	497.9	505.9	509.4
Investments & Other Assets (net)	11.8	0.4	0.8	79.5	98.7	130.8
Total Assets	788.1	784.3	921.4	983.2	1,045.4	1,098.5
Current Liabilities	72.4	89.7	137.3	137.3	137.3	137.3
Debt	340.8	284.6	222.4	190.5	173.5	138.2
Share Capital	120.0	120.0	120.0	120.0	120.0	120.0
Reserves & Surplus	254.9	290.0	441.7	535.4	614.6	703.0
Equity	374.9	410.0	561.7	655.4	734.6	823.0
Total Liabilities	788.1	784.3	921.4	983.2	1,045.4	1,098.5
Ratios						
Return on Invested Capital, % e/	19.7	10.7	23.4	25.0	22.7	20.9
Debt Service Coverage Ratio	4.0	1.9	3.4	3.6	3.2	3.2
Current Ratio	3.3	1.8	2.7	2.9	3.2	3.3
Debt/Debt + Equity, %	48	41	28	23	19	14

a/ No income tax liabilities up to 1975 due to development tax rebate.
b/ New debt represents the FX portion of the 3 proposed projects (Purge Gas Recovery, Fluorine Recovery and Phosphoric Acid Plant Upgrading).
c/ Includes working capital of Rs 17.5 million.
d/ GSFC plans to invest in a new company (another fertilizer plant). During FY 1976-FY 1978, GSFC can invest a total of Rs 130 million for this new venture.
e/ The return is calculated as the ratio: (net profit + depreciation + interest)/(debt + equity) at end of year.

Industrial Projects Department
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INDIA: FERTILIZER INDUSTRY CREDIT

GSFC - CAPITAL COST ESTIMATES

A. Capital Cost Estimates - Purge Gas Recovery Project

	in Rs Million			in US$ Million		
	Foreign Exchange 1/	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment & Spares (delivered)	18.8	9.7	28.5	2.4	1.2	3.6
Duties and Taxes	-	10.0	10.0	-	1.3	1.3
Licenses and Engineering	3.5	0.5	4.0	0.4	0.1	0.5
Civil Works, Erection & Commissioning	4.7	12.9	17.6	0.6	1.7	2.3
Base Cost Estimate (BCE)	27.0	33.1	60.1	3.4	4.3	7.7
Physical Contingencies (10%)	2.7	3.3	6.0	0.4	0.4	0.8
Price Escalation (18%)	5.4	6.6	12.0	0.7	0.8	1.5
Installed Cost	35.1	43.0	78.1	4.5	5.5	10.0
Working Capital	-	6.0	6.0	-	0.8	0.8
Interest during Construction	-	4.0	4.0	-	0.5	0.5
Project Cost	35.1	53.0	88.1	4.5	6.8	11.3

1/ Includes Rs 2.4 (US$0.3) million in indirect foreign exchange.

B. Capital Cost Estimates - Fluorine Recovery/Cryolite Project

	in Rs Million			in US$ Million		
	Foreign Exchange 2/	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment & Spares (delivered)	5.0	4.8	9.8	0.6	0.7	1.3
Duties and Taxes	-	1.6	1.6	-	0.2	0.2
Licenses and Engineering	1.1	0.5	1.6	0.1	0.1	0.2
Civil Works, Erection & Commissioning	0.3	2.1	2.4	0.1	0.2	0.3
Base Cost Estimate (BCE)	6.4	9.0	15.4	0.8	1.2	2.0
Physical Contingencies (10%)	0.6	0.9	1.5	0.1	0.1	0.2
Price Escalation (18%)	1.2	1.8	3.0	0.1	0.2	0.3
Installed Cost	8.2	11.7	19.9	1.0	1.5	2.5
Working Capital	-	1.0	1.0	-	0.1	0.1
Interest during Construction	-	1.1	1.1	-	0.1	0.1
Project Cost	8.2	13.8	22.0	1.0	1.7	2.7

2/ Includes Rs 1.2 (US$0.2) million in indirect foreign exchange.

C. Capital Cost Estimate - Phosphoric Acid Upgrading Project

	in Rs Million			in US$ Million		
	Foreign Exchange 3/	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment & Spares (delivered)	9.5	8.0	17.5	1.3	1.0	2.3
Duties and Taxes	-	3.2	3.2	-	0.5	0.5
Licenses and Engineering	1.5	1.9	3.4	0.2	0.2	0.4
Civil Works, Erection, & Commissioning	2.4	3.4	5.8	0.2	0.5	0.7
Base Cost Estimate (BCE)	13.4	16.5	29.9	1.7	2.2	3.9
Physical Contingencies (10%)	1.3	1.6	2.9	0.2	0.2	0.4
Price Escalation (18%)	2.7	3.4	6.1	0.3	0.5	0.8
Installed Cost	17.4	21.5	38.9	2.2	2.9	4.1
Working Capital 4/	-	10.5	10.5	-	1.3	1.3
Interest during Construction	-	2.0	2.0	-	0.2	0.2
Project Cost	17.4	34.0	51.4	2.2	4.4	6.6

3/ Includes Rs 2.0 (US$0.2) million in indirect foreign exchange
4/ Additional raw material stock, mostly sulfur and phosphate rock.

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INDIA FERTILIZER INDUSTRY CREDIT

GSFC - Purge Gas Recovery Project Production

Cost Estimate (in constant 1975 rupees)

A. Variable Cost Rs per 1000 NM^3 of Purge Gas Processed a/

Items	Unit 1000 NM^3 of Gas	Financial Cost	Economic Cost Foreign Exchange	Local Currency
Purge Gas	1000 NM^3	37.5	-	37.5
Power	0.23 MWH	41.4	20.7	20.7
Steam	0.06 tons	3.6	2.5	1.1
Chemicals and other variable costs		62.5	31.3	31.2
Total variable costs, Rs/1000 NM^3 of gas		145.0	54.5	90.5

B. Fixed Costs, Rs million per year

Items	Financial Cost	Economic Cost Foreign Exchange	Local Currency
Salaries and overhead	0.5	-	0.5
Maintenance materials (3% of capital cost)	2.5	1.0	1.0
Depreciation (1/12 of capital cost)	6.8	-	-
Other fixed costs	1.7	-	1.7
Total fixed costs, Rs million/year	11.5	1.0	3.2

C. Average Production Cost (at 90% capacity utilization) b/

	Financial Cost	Economic Cost Foreign Exchange	Local Currency
Rs/1000 NM^3 of Purge Gas	322.3	69.9	139.8
Rs million per year	20.9	4.5	9.1

D. Annual Output (at 90% utilization and 90% recovery factor)

Synthesis Gas ($3H_2$:N_2)	49.04 million NM^3
Methane	5.84 million NM^3
Argon	2.34 million NM^3

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a/ Unit costs of value used

b/ At 90% capacity utilization 64.865 million NM^3 of purge gas is processed per year.

E. Value of annual Output, Rs million

	Financial	Economic Foreign Exchange	Local Currency
Synthesis Gas ($3H_2$: N_2)	9.81	-	9.81
Methane	0.58	-	0.58
Argon	35.10	17.55	17.55
	45.49	17.55	27.94

	Financial	Economic
Purge gas (as fuel)	Rs 37.5/1000 NM^3	Rs 37.5/1000 NM^3
Power	Rs 180/MWH	Rs 180/MWH
Steam	Rs 60/ton	Rs 60/ton
Synthesis gas ($3H_2$: N_2	Rs 0.2/NM^3	Rs 0.2/NM^3
Methane	Rs 0.1/NM^3	Rs 0.1/NM^3
Argon	Rs 15/NM^3	Rs 15/NM^3

Note: i) Synthesis gas ($3H_2$::N_2) value is set equal to the present cost of generating synthesis gas in the plant.

ii) Methane price is equal to cost of natural gas purchased from O.N.G.C.

iii) The argon ex-factory price is assumed as Rs 15/NM^3 and 50% of the output is assumed to be exported.

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INDIA - FERTILIZER INDUSTRY CREDIT
GSFC-Fluorine Recovery/Cryolite Project Production Cost Estimates

A. **Annual Production at 90% Capacity Utilization**

1,400 TPY of cryolite (Na_3AlF_6) and 420 TPY of active silica

B. **Production Costs (in constant 1975 rupees)**

1. **Variable Costs, Rs/ton of cryolite**[1/]

Item	Units/ton of Cryolite	Financial Cost	Economic Cost: Foreign Exchange	Economic Cost: Local Currency
Aluminum Hydroxide (95%)	0.42 tons	504.0	327.6	32.8
Caustic Soda (98%)	0.40 tons	440.0	280.8	31.2
Soda Ash (98%)	0.27 tons	297.0	189.5	21.1
Fuel Oil	0.30 tons	264.0	150.5	15.8
Power	0.35 MWH	63.0	-	63.0
Bags	20 pieces	90.0	22.5	54.0
Other Variable Costs		400.0	-	360.0
Less: (i) Credit for Active Silica	0.30 tons	(300.0)	-	(270.0)
(ii) Reduction in Treatment Cost	-	(70.0)	-	(63.0)
Total Variable Costs, Rs/ton Cryolite		1,708.0	970.9	244.9

2. **Fixed Costs, Rs Million/Year**

	Financial	Economic: Foreign Exchange	Economic: Local Currency
Salaries and Overhead	0.2	-	0.2
Maintenance Materials (3% of installed cost)	0.6	0.3	0.2
Depreciation (1/12 of capital cost)	1.8	-	-
Other Fixed Costs	0.1	-	0.1
	2.7	0.3	0.5

C. **Average Production Cost (at 90% output)**

	Financial	Economic: Foreign Exchange	Economic: Local Currency
Rs/ton of cryolite	3,636.6	1,185.2	602.0
Rs million per year	5.1	1.7	0.8

1/ Unit prices (constant 1975 rupees) are assumed as follows:

	Financial	Economic: Foreign Exchange	Economic: Local Currency
Aluminum Hydroxide, Rs/ton	1,200	780.0	78.0
Soda Ash, Rs/ton	1,100	702.0	78.0
Caustic Soda, Rs/ton	1,100	702.0	78.0
Fuel Oil, Rs/ton	880	430.0	45.0
Bags, Rs/piece	4.5	1.1	2.7
Power, Rs/MWH	180.0	-	180.0
Active Silica, Rs/ton	1,000.0	-	900.0
Cryolite, Rs/ton	8,000.0	5,150	80.0

The raw material input requirements have been estimated by the appraisal mission from the technical literature on cryolite manufacture from hydrofluosilic acid recovered from phosphate fertilizer production. The raw material requirements vary with the specific processes/equipment used and alternate raw materials, such as aluminum sulphate instead of aluminum hydroxide are possible.

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INDIA -- FERTILIZER INDUSTRY CREDIT

GSFC-Phosphate Plant Upgrading Project Production Cost Estimates

A. Annual Production of 100% P_2O_5

	Without Project	With Project
1. Phosphoric Acid Plant Capacity Utilization	55%	85%
2. Output, tons P_2O_5	31,760	49,090

B. Production Costs in Constant 1975 Rupees

1. Variable Costs, Rs/ton of P_2O_5 1/

	Units/ton P_2O_5	Financial	Economic	
			Foreign Exchange	Local Currency
Phosphate Rock	3.3 tons	2,062.5	1,801.8	260.7
Sulphur	1.3 tons	780.0	679.9	100.1
Fuel Oil	0.15 tons	132.0	64.5	6.8
Other Variable Costs	-	75.0	33.8	33.7
Less: Credit for Calcium Sulphate		(195.0)	(170.0)	(25.0)
		2,854.5	2,410.0	376.3

2. Incremental Fixed Costs, Millions Rs/Year

	Financial	Economic	
		Foreign Exchange	Local Currency
Salaries and Overhead	0.2		0.2
Maintenance Materials (3% of capital costs)	1.2	0.5	0.5
Depreciation (1/12 of capital costs)	3.2	-	-
Others	0.3	-	0.3
Total fixed costs, Rs Millions/year	4.9	0.5	1.0

3. Average Production Costs (based on incremental output of 17,330 TPY P_2O_5)

	Financial	Economic	
		Foreign Exchange	Local Currency
Rs/ton of P_2O_5	3,137.2	2,438.8	434.0
Incremental Rs Million/year	54.4	42.3	7.5

4. Value of Incremental Output (17,330 TPY P_2O_5)

	Financial	Economic	
		Foreign Exchange	Local Currency
Rs Million per Year	65.8	52.9	2.9

5. Value of Raw Material Savings for Existing Output of 31,760 TPY P_2O_5, Rs Million/Year.

	Financial	Economic	
		Foreign Exchange	Local Currency
Phosphate Rock Savings	9.9	8.7	1.2
Sulphur Savings	5.7	5.0	0.7
Total savings	15.6	13.7	1.9

1/ Price assumptions are as follows:

	Financial	Economic	
		Foreign Exchange	Local Currency
Phosphate Rock, Rs/ton	625	546	79
Sulphur, Rs/ton	600	523	77
Fuel Oil (for fuel), Rs/ton	880	430	45
Phosphoric Acid (100% P_2O_5; price for 1978 and onwards), Rs/ton	3,800	3,052	170

Phosphate rock economic price is based on f.o.b. price of $40 per ton plus $30 per ton for ocean freight and $10/ton for local charges.

Sulphur economic price is based on f.o.b. price of $37/ton plus $30/ton for ocean freight and $10/ton for local charges.

P_2O_5 economic price is derived from a TSP (46% P_2O_5) f.o.b. price of $150/ton of TSP plus $30/ton for ocean freight and $10/ton for local charges.

Calcium sulphate is utilized to manufacture ammonium sulphate and has been valued at one fourth of the cost of the sulphur used in the P_2O_5 manufacture with the FX component based on the same proportion as the sulphur FX cost.

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INDIA - FERTILIZER INDUSTRY CREDIT

GSFC-Purge Gas Recovery Project Cost and Benefit Streams
(in millions of constant 1975 rupees)

Calendar Year		Financial Cost/Benefit Streams: Capital Cost[a]	Financial: Operating Cost	Financial: Financial Value of Output	Financial: Net Cost/ Benefit	Economic Cost/Benefit Streams: Capital Cost[a]	Economic: Operating Costs	Economic: Economic Value of Output	Economic: Net Cost/ Benefit
1	(1975)	7.0	-	-	(7.0)	7.0	-	-	(7.0)
2		39.7	-	-	(39.7)	28.0	-	-	(28.0)
3	(1977)[b]	27.4	2.8	5.7	(24.5)	27.4	2.2	5.7	(23.9)
4		-	14.1	45.5	31.4	-	13.6	45.5	31.9
5		-	14.1	45.5	31.4	-	13.6	45.5	31.9
6		-	14.1	45.5	31.4	-	13.6	45.5	31.9
7		-	14.1	45.5	31.4	-	13.6	45.5	31.9
8		-	14.1	45.5	31.4	-	13.6	45.5	31.9
9		-	14.1	45.5	31.4	-	13.6	45.5	31.9
10		-	14.1	45.5	31.4	-	13.6	45.5	31.9
11		-	14.1	45.5	31.4	-	13.6	45.5	31.9
12		-	14.1	45.5	31.4	-	13.6	45.5	31.9
13		-	14.1	45.5	31.4	-	13.6	45.5	31.9
14		-	14.1	45.5	31.4	-	13.6	45.5	31.9
15		(5.0)[c]	14.1	45.5	36.4	(5.0)[c]	13.6	45.5	36.9

Financial Rate of Return = 33%　　　Economic Rate of Return = 41%

a/ Based on a disbursement schedule of (in millions of current rupees) of Rs 7, Rs 44.1 (including Rs 13.0 for duties), and Rs 37 (including Rs 4 for interest) during 1975, 1976 and 1977 respectively, converted to constant 1975 rupees with interest excluded for the financial cost and both interest and duties excluded for the economic costs.
b/ Production starts September 1977 at 50% capacity and reaching 90% by January 1978.
c/ The recovered working capital of Rs 6 million (1977 rupees) deflated to constant 1975 terms.

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INDIA - FERTILIZER INDUSTRY CREDIT

GSFC-Fluorine Recovery/Cryolite Plant Cost and Benefit Streams
(in millions of constant 1975 rupees)

Calendar Year		Financial Costs and Benefit Streams: Capital Costs a/	Operating Cost	Financial Value of Output	Net Cost/Benefit	Economic Cost and Benefit Streams: Capital Costs a/	Operating Costs	Economic Value of Output	Net Cost/Benefit
1	(1975)	1.0	-	-	(1.0)	1.0	-	-	(1.0)
2		9.0	-	-	(9.0)	7.1	-	-	(7.1)
3		6.6	-	-	(6.6)	6.6	-	-	(6.6)
4	(1978) b/	1.5	2.0	5.0	1.5	1.5	1.4	3.3	0.4
5		-	3.3	11.2	7.9	-	2.5	7.3	4.8
6		-	3.3	11.2	7.9	-	2.5	7.3	4.8
7		-	3.3	11.2	7.9	-	2.5	7.3	4.8
8		-	3.3	11.2	7.9	-	2.5	7.3	4.8
9		-	3.3	11.2	7.9	-	2.5	7.3	4.8
10		-	3.3	11.2	7.9	-	2.5	7.3	4.8
11		-	3.3	11.2	7.9	-	2.5	7.3	4.8
12		-	3.3	11.2	7.9	-	2.5	7.3	4.8
13		-	3.3	11.2	7.9	-	2.5	7.3	4.8
14		-	3.3	11.2	7.9	-	2.5	7.3	4.8
15		(0.8) c/	3.3	11.2	8.7	(0.8) c/	2.5	7.3	5.6

Financial Rate of Return = 30%

Economic Rate of Return = 21%

a/ Based on a disbursement schedule (in millions of current rupees) of Rs 1.0, Rs 10.0 (including Rs 2.1 for duties), Rs 9.0 (including Rs 1.1 for interest) and Rs 2.0 million during 1975, 1976, 1977 and 1978 respectively. Interest is excluded from the financial costs and both interest and duties are excluded from the economic costs. The costs have been deflated to constant 1975 rupee.

b/ Production is assured to start April 1978 at an average 60% utilization for the year and 90% from 1979 onwards.

c/ Recovered working capital deflated to constant 1975 terms.

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

GSFC-Phosphate Plant Upgrading Project Cost and Benefit Streams

Calendar Year	Financial Costs and Benefits Streams: Capital Costs[a]	Operating Costs	Value of Incremental Output	Value of Raw Material Savings	Net Cost/ Benefit	Economic Costs and Benefits Streams: Capital Costs[a]	Operating Costs	Value of Incremental Output	Value of Raw Material Savings	Net Cost/ Benefit
1 (1975)	3.5	-	-	-	(3.5)	3.5	-	-	-	(3.5)
2	20.6	-	-	-	(20.6)	17.2	-	-	-	(17.2)
3	19.1	-	-	-	(19.1)	19.1	-	-	-	(19.1)
4 (1978)[b]	-	27.8	32.9	15.6	20.7	-	25.6	27.9	15.6	17.9
5	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
6	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
7	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
8	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
9	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
10	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
11	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
12	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
13	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
14	-	51.2	65.8	15.6	30.2	-	49.8	55.8	15.6	21.6
15	(8.7)[c]	51.2	65.8	15.6	38.9	(8.7)[c]	49.8	55.8	15.6	30.3

Financial Rate of Return = 47%

Economic Rate of Return = 40%

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a/ Based on a disbursement schedule (in millions of current rupees) of Rs 3.5, Rs 22.9 (including Rs 3.8 for duties), and Rs 25.0 (including Rs 2.0 for interest) during 1975, 1976 and 1977 respectively. Interests are excluded from financial costs and both interests and duties are excluded from economic costs. Capital costs have been deflated to constant 1975 rupees.

b/ Incremental production is estimated to start January 1978. During 1978 incremental output is 8,660 TPY P_2O_5 (70% total capacity utilization). During 1979 and subsequent years, incremental output is 17,330 TPY of P_2O_5 (85% total capacity utilization).

c/ Recovered working capital deflated to 1975 constant rupees.

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

SPIC - PROJECT DESCRIPTION AND ANALYSIS

I. Fluorine Recovery and Cryolite Project

1. This project is identical to the GSFC fluorine recovery/cryolite project. The only difference is that GSFC has a 175 TPD (57,750 TPY) 100% P_2O_5 plant which is assumed to operate at 85% stream efficiency thereby producing some 49,100 TPY of P_2O_5 while SPIC has a 165 TPD (54,450 TPY) 100% P_2O_5 plant which is assumed to operate at 90% stream efficiency, also producing some 49,000 TPY of 100% P_2O_5. Hence the quantity of effluents to be treated and hydrofluosilicic acid (H_2SiF_6) to be recovered are about the same. The capital costs capacities, operating results and rates of return for the GSFC fluorine recovery and cryolite projects are thus more or less applicable and are assumed to be identical to the proposed SPIC project.

II. Soda Ash/Ammonium Chloride Project

A. Capital Cost Estimate (including 30% for physical and price contingencies)

		$ Million	Rs Million
i)	Foreign exchange	9.9	76.9
ii)	Local currency:		
	- duties and taxes	3.4	26.3
	- working capital	1.4	11.2
	- interest during construction	3.3	25.7
	- others	25.5	199.4
	Total:	43.5	339.5

Note: The soda ash sub-project will be owned by a new company Tuticurin Alkali Chemicals (TAC) which will be capitalized with 40% equity (10.4% general public and financial institutions) and 60% long-term loans from the financial institutions. The foreign exchange will be included in the proposed IDA credit and on-lent to TAC through IDBI as part of the long-term loans.

B. Benefits

2. Production, at 90% output of 65,340 TPY of Soda Ash and 65,340 TPY of ammonium chloride (fertilizer grade) or a total of 130,680 TPY of product.

C. Rated Capacity

3. Product--440 TPD of product, equally divided into 220 TPD of soda ash and 220 TPD of fertilizer grade ammonium chloride (25% N). At 90% capacity utilization, production will be 130,680 TPY of product or 65,340 TPY each of soda ash and ammonium chloride.

D. Raw Material Requirements

4. Ammonia--0.16 tons per ton of product about 70 TPD. At 90% output, ammonia requirements will be about 20,910 TPY.

5. Carbon dioxide (CO_2)--164 NM^3 per ton of product or about 72,000 NM^3 per day.

6. Common salt (NaCl)--0.75 tons per ton of product or about 330 TPD.

E. Implementation Period

7. The project will take some 30 months to complete but implementation will likely start January 1976 since financial support from the local financial institutions is dependent on SPIC attaining sustained urea production. The project is expected to be completed by June 1978.

Industrial Projects Department
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

SPIC-Capital Cost Estimate of Soda Ash/Ammonium Chloride Project[1/]

	in Rs million			in US$ Million			%
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total	
1. Equipment, Supplies & Spares[2/]	45.2	56.2	101.4	5.8	7.2	13.0	43.6
2. Offsites	2.3	67.1	69.4	0.3	8.6	8.9	29.9
3. Duties and Taxes[3/]	-	20.3	20.3	-	2.6	2.6	8.7
4. Licenses & Engineering	11.7	7.8	19.5	1.5	1.0	2.5	8.4
5. Civil Works & Erection	-	19.5	19.5	-	2.5	2.5	8.4
6. Pre-Operating Expenses	-	2.3	2.3	-	0.3	0.3	1.0
Base Cost Estimate (BCE)	59.2	173.2	232.4	7.6	22.2	29.8	100
Physical Contingencies (10%	6.0	17.4	23.4	0.8	2.2	3.0	10
Price Escalation (18%)[4/]	11.7	35.1	46.8	1.5	4.5	6.0	20
Installed Cost	76.9	225.7	302.6	9.9	28.9	38.8	130
Working Capital[5/]	-	11.2	11.2	-	1.4	1.4	
Project Cost	76.9	236.9	313.8	9.9	30.3	40.2	
Interest During Construction[6/]	-	25.7	25.7	-	3.3	3.3	
Total Financing Required	76.9	262.6	339.5	9.9	33.6	43.5	

1/ The breakdown of this cost estimate was prepared by the appraisal mission based on SPIC's project cost estimate of US$ 36 million including $7 million in direct imports. A higher price escalation and working capital is provided above.

2/ Imported equipment is on a CIF basis while the local currency cost includes local delivery charges for both imported and local equipment. Directly imported equipment is Rs 31.2 (US$4.6) million. Indirect foreign exchange is Rs 14.0 (US$1.8) million.

3/ Duties are 40% of FX equipment and offsite costs while taxes are 5% of local currency costs for equipment and offsites.

4/ 18% of BCE plus physical contingency

5/ Taken as equivalent to 1 month's sales value.

6/ Based on an interest rate of 11% and a long term debt of $26 (Rs 203) million representing 60% of the financing required.

ANNEX 5-6
Table 1

INDIA - FERTILIZER INDUSTRY CREDIT

SPIC - SODA ASH/AMMONIUM CHLORIDE PRODUCTION COST ESTIMATES

A. Annual Production at 90% Capacity Utilization

65,340 TPY each of soda ash and ammonium chloride (130,680 TPY of product).

B. Production Costs (in constant 1975 rupees)

1. Variable Costs, Rs/ton of product[1/]

Item	Units/ton of Product	Financial Cost	Economic Cost FX	Economic Cost LC
Ammonia	0.16 tons	110.4	124.8	-
Carbon Dioxide	164 NM^3	-	-	-
Common Salt	0.75 tons	90.0	-	81.0
Fuel Oil	0.17 tons	151.3	73.1	7.6
Power	0.18 MWH	32.4	-	32.4
Packaging Materials	-			
Others	-	50.0	-	45.0
Total Variable, Rs/ton of Product		434.1	197.9	202.0

2. Fixed Costs, Rs Millions/Year

Item	Financial Cost	Economic Cost FX	Economic Cost LC
Salaries and Overhead	1.0	-	1.0
Maintenance Materials (3% of installed cost)	9.3	3.7	3.7
Depreciation (1/12 of capital cost)	27.4	-	-
Other Fixed Costs	0.5	-	0.5
Total Fixed Costs	38.2	3.7	5.2

C. Average Production Cost at 90% Capacity Utilization

	Financial Cost	Economic Cost FX	Economic Cost LC
Rs/ton of Product	726.4	226.2	241.8
Rs Million per Year	94.9	29.6	31.6

D. Value of Output at 90% Capacity Utilization,[1/] Rs Million/Year

	Financial Cost	Economic Cost FX	Economic Cost LC
Soda Ash	65.3	45.9	5.1
Ammonium Chloride	68.6	-	68.6
Total Value of Production	133.9	45.9	73.7

1/ Unit prices (constant 1975 rupees) are assumed as follows:

	Financial	Economic FX	Economic LC
1. Ammonia, Rs/ton	690	780	-
2. Carbon Dioxide, Rs/NM^3	-	-	-
3. Common Salt, Rs/ton	120	-	108
4. Fuel Oil, Rs/ton	890	430	45
5. Power, Rs/MWH	180	-	180
6. Soda Ash, Rs/ton	1,000	702	78
7. Ammonium Chloride	1,050	-	1,050

Note: The ammonia financial price is taken as 60% of the urea ex-factory price (Rs 1,150/ton)--or about Rs 690 per ton of ammonia. The economic price is taken as 50% of the urea CIF price (US$185/ton)--or about $100 per ton of ammonia.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

SPIC - SODA ASH/AMMONIUM CHLORIDE PRODUCTION COST AND BENEFIT STREAMS
(in million constant 1975 Rs)

		Financial Costs and Benefit Streams				Economic Costs and Benefit Streams			
		Capital Costs[a]	Operating Costs	Value of Output	Net Cost/ Benefits	Capital Costs[a]	Operating Costs	Value of Output	Net Cost/ Benefits
1	(1975)	-	-	-	-	-	-	-	-
2		99.0	-	-	(99.0)	99.0	-	-	(99.0)
3		107.9	-	-	(107.9)	86.1	-	-	(86.1)
4	(1978)[b]	56.1	28.8	44.6	(40.3)	56.1	30.1	39.9	(46.3)
5		-	67.5	133.9	66.4	-	61.2	119.6	58.4
6		-	67.5	133.9	66.4	-	61.2	119.6	58.4
7		-	67.5	133.9	66.4	-	61.2	119.6	58.4
8		-	67.5	133.9	66.4	-	61.2	119.6	58.4
9		-	67.5	133.9	66.4	-	61.2	119.6	58.4
10		-	67.5	133.9	66.4	-	61.2	119.6	58.4
11		-	67.5	133.9	66.4	-	61.2	119.6	58.4
12		-	67.5	133.9	66.4	-	61.2	119.6	58.4
13		-	67.5	133.9	66.4	-	61.2	119.6	58.4
14		-	67.5	133.9	66.4	-	61.2	119.6	58.4
15		-	67.5	133.9	66.4	-	61.2	119.6	58.4
16		(8.5)[c]	67.5	133.9	73.9	(8.5)[c]	61.2	119.6	66.9

Financial Rate of Return = 19% Economic Rate of Return = 18%

a/ Based on a disbursement schedule (in millions of current rupees) of Rs 110, Rs 130 (including Rs 26.3 for duties & taxes) and Rs 99.5 (including interest of Rs 25.7) million during 1976, 1977 and 1978 respectively. Capital costs are deflated to constant 1975 rupees with interest excluded from the financial costs and both interest and duties excluded from the economic costs.

b/ Production is estimated to start July 1978 at 60% capacity utilization and reaching 90% by 1979 and subsequent years.

c/ Recovered working capital of Rs 11.2 million deflated to constant 1975 terms.

Industrial Projects Department
July 1975

INDIA - FERTILIZER INDUSTRY CREDIT

HPCL - PROJECT DESCRIPTION AND ANALYSIS

A. Introduction

1. Hindustan Petroleum Corporation (HPCL - formerly Esso Eastern Inc.) started operation in India at the beginning of the 20 th century as a marketing organization. The first refinery was on stream in 1954 to produce fuel products and specialities. In 1969 the company successfully commissioned a lube oil plant. While the fuel refinery and the marketing organization -- Esso Standard Refining Company of India Ltd. -- was wholly owned by Esso Eastern Inc., the lube refinery -- Lube India Ltd. -- was a joint venture of Esso Eastern and the Government of India. The capacity of the refinery was gradually increased to the present level of 3.5 million TPY of crude.

2. In March 1974 the Government of India acquired 74% equity shareholdings in both Esso Standard Refining Company of India Ltd. and Lube India Ltd., therefore becoming the majority shareholder of the refinery operation. Subsequently, Esso Eastern was merged into Esso Standard Refining Company. Further in July 1974 Lube India Ltd. was merged with Esso Standard Refining Company of India Ltd. into a new company with the name of HINDUSTAN PETROLEUM CORPORATION LIMITED (HPCL).

B. Operating Results

3. The consolidated income statement of the three functions, i.e., Marketing, Fuel Refinery and Lube Refinery, is presented below. Net profits have been of the order of Rs 50 to Rs 70 million between 1970 and 1972. Profit levels, however, declined in 1973 due to the imposition of various duties on petroleum products. Profitability in the petroleum industry is largely determined by the pricing policies of the Government. In the past few years, the pricing mechanism allowed the petroleum industry a return of 12% on capital employed on a pre-tax basis. HPCL results show that the returns have always exceeded this level and in 1973 the pre-tax return was 29%. Recently, due to the steep cost escalations experienced by the petroleum industry, the Government had set up a committee to review the pricing structure of the industry. It is expected that a pre-tax return of 15% on capital employed will be recommended.

HINDUSTAN PETROLEUM CORPORATION LTD.
Income Statement for the Years 1970-1973
(Rs Millions)

	1970	1971	1972	1973
Income before Depreciation, Interest and Tax	137	176	170	160
Depreciation	(27)	(28)	(28)	(28)
Interest	(23)	(22)	(17)	(09)
Tax	(36)	(50)	(75)	(82)
	51	76	50	41

Note: Before March 13, 1974, Hindustan Petroleum Corporation Limited existed as three different corporate entities, namely: (a) Esso Eastern Inc., (b) Esso Standard Refining Company India Ltd. (both being wholly owned by Esso Eastern Inc.) and (c) Lube India Ltd. which was jointly owned by Esso Eastern Inc. and the Government of India. The above numbers have been approximated by consolidating their financial statements.

4. The following table summarizes the balance sheet of HPCL. Investment in fixed assets was of the order of Rs 340 to 380 million during the year 1970-73, while working capital investment was of the order of Rs 160 to 260 million in 1973. The capital employed decreased from Rs 630 million in 1970 to Rs 500 million in 1973 due to a reduction in the working capital. The surplus funds in 1970-1973 were used to reduce debt. Long term borrowings are mostly from Manufacturers Hanover Trust and from USAID, totalling Rs 460 million at the end of 1974. These loans were used to finance the construction of the Lube Refinery and will be repaid by 1979.

HINDUSTAN PETROLEUM CORPORATION LTD.
Balance Sheet as of Dec. 31 for the years 1970-73
(Rs Millions)

	1970	1971	1972	1973
Fixed Assets	377	368	356	337
Working Capital:				
Current Assets:				
Cash	79	149	99	86
Sundry Debtors	70	67	36	45
Stock	197	239	194	224
Other Current Assets	114	77	52	55
Less Current Liabilities	(211)	(272)	(190)	(250)
Working Capital	249	260	191	160
Capital Employed	626	628	547	497
Financed by:				
Share Capital	78	78	78	78
Reserves and Surpluses	226	215	219	235
Others	34	65	60	65
Borrowings: Long Term	154	139	104	62
Short Term	130	125	80	51
Long Term Deposit	04	06	06	06
Capital Employed	626	628	547	497
Debt to Equity Ratio	47:53	44:56	33:69	23:77

5. In 1974, the Government of India set up a fund called Petroleum Industry Development Fund to provide financial assistance to projects in the petroleum industry. However, for the proposed refinery debottlenecking project, the company will borrow[1] the entire fund requirement (US$25.9 million) from a consortium of financial institutions to be headed by IDBI. IDA has been requested by GOI to assist in the foreign exchange financing of the project (US$4 million excluding working capital).

C. Proposed Project

6. The debottlenecking project will expand the capacity of the refinery in Bombay. The naphtha production would be increased from 245,000 to 487,000 TPY and the additional output (242,000 TPY) will be adequate to provide naphtha feedstock to a large (1,000 TPD ammonia) ammonia plant. The additional fuel oil (962,000 TPY) will be sufficient to provide feedstock to almost four such ammonia plants.

HINDUSTAN PETROLEUM CORPORATION LTD.
REFINERY PRODUCTS OUTPUT, '000 Ton/y

	Base Case Present Capacity		After Debottle-necking		Incremental Output	
		%		%		%
Light Distillates	336	9.6	364	6.1	28	1.1
Naphtha[1]	245	7.0	487	8.1	242	9.7
Middle Distillates	1,504	43.0	2,772	46.2	1,268	50.7
Fuel Oil and Heavy Ends	1,162	33.2	2,076	34.6	914	36.5
Refinery Fuel & Losses	253	7.2	301	5.0	48	2.0
Total	3,500	100.0%	6,000	100.0%	2,500	100.0%

1/ 157,000 TPY of naphtha production is presently earmarked for chemical usage (including ammonia feedstock). The remaining 88,000 TPY are sold on a "spot" basis.

SOURCE: data supplied by Hindustan Petroleum

7. HPCL's refinery debottlenecking will take full advantage of existing facilities and infrastructure. In this way the installed cost (excluding interest and working capital) will be kept low at Rs 140 (US$18) million. Given the additional refining capacity of 2.5 million TPY, the average installed cost is about Rs 56 (US$7.2) per ton of crude oil refining capacity.

1/ The debt equity ratio of HPCL will still remain at about 50:50 even if the entire project cost is borrowed.

This level of investment is low when compared to the investment of about Rs 150 to Rs 250 (US$20 to 30) per ton of crude capacity, depending on the size and complexity, needed for a new refinery. The factors reducing the level of investment are:

a) availability of spare capacity in the secondary and the conversion process units;
b) reactivation of an old pipestill to increase the fractionation capacity from 3.5 to 6.0 million TPY;
c) availability of a second flare system which can be separated from the existing blowdown system and tied in to the new fractionation unit; and
d) availability of infrastructures, such as warehouses, drainage system, cooling water system, oil movement and storage facilities, workshops and office buildings.

D. Raw Material Requirements and Operating Costs

8. 2.5 million TPY of additional crude oil (imported -- 80% Arabian Light and 20% Arabian heavy crude or domestic crude from Bombay High) will be processed by HPCL, raising the total crude oil requirement to 6.0 million TPY.

9. The incremental operating cost (excluding crude oil, depreciation and interest charges) is estimated at Rs 10.8 million annually as shown below:

Incremental Operating Cost
(In millions of constant 1975 rupees)

Item	In Rs Million/Year	
	Financial Cost	Economic Cost
Salaries, Wages & Overhead	0.3	0.3
Chemicals & Catalysts	0.5	0.4
Purchased Utilities	2.6	2.3
Insurance (0.3% of total project cost)	0.6	0.6
Maintenance Expenses (3% of installed plant cost)	4.2	3.4
Crude Receiving/Wharfage/BPT Charges	2.6	2.6
Total Operating Cost	10.8	9.6

E. Implementation Period

10. The project will be implemented in about 36 months including some 4 months for testing and trial production. Commercial production is expected by October 1978.

F. Petroleum Price Assumptions

11. The petroleum prices assumed in the project analysis are as follows:

Assumed Average Petroleum Prices in 1979 & Onwards
(In constant 1975 Rupees)

Product	Ex-Refinery Price Rs/ton	International (CIF) Price Rs/ton	International (CIF) Price US$/ton
Crude Oil (raw material)	-	610	78
Naphtha	610	700	90
Other Light Distillates	920	1055	135
Middle Distillates	740	780	100
Heavy Fuel Oil, etc.	580	430	55

G. Project Recurrent Costs and Benefits

12. The recurrent costs and benefits at the full incremental output are shown below:

a. Recurrent Benefits

Product	Quantity (1000 TPY)	Value of Incremental Output in Rs Million/Year: Financial Value	Economic Value
Naphtha	242	147.6	169.4
Other Light Distillates	28	25.8	29.5
Middle Distillates	1268	938.3	989.0
Heavy Fuel Oil, etc.	914	530.1	393.0
Refinery Fuel & Losses	48	-	-
Total	2500	1641.8	1580.9

b. Recurrent Costs

Item	Quantity (1000 TPY)	Cost in Rs Million/Year: Financial Cost	Economic Value
Crude Oil	2500	1525.0	1525.0
Operating Costs	-	10.8	9.6
Total		1535.8	1534.6

c. Net Recurrent Benefits

	In Rs Million/Year: Financial	Economic
Cashflow before Interest and Income Taxes	106.0	46.3
Cashflow before Interest but after Income Taxes 1/	60.2	46.3

1/ The income tax is approximated on the basis of 12 years straight line depreciation of Rs 13.8 million/year (working capital is not depreciated), an average of Rs 10 million for interest annually and an income tax rate of 57.75%.

Industrial Projects Depament
July 1975

ANNEX 5-7
Table 1

INDIA - FERTILIZER INDUSTRY CREDIT

HPCL - CAPITAL COST ESTIMATE

	--- in Rs Million ---			---- in US $ Million ----		
	Foreign[1/] Exchange	Local Currency	Total	Foreign[1/] Exchange	Local Currency	Total
Equipment & Spares (delivered)	19.9	74.6	94.5	2.6	9.5	12.1
Duties and Taxes	-	6.5	6.5	-	0.8	0.8
Licenses and Engineering	0.5	0.6	1.1	0.1	0.1	0.2
Civil Works, Erection,& Commissioning	-	5.9	5.9	-	0.8	0.8
Base Cost Estimate (BCE)	20.4	87.6	108.0	2.7	11.2	13.9
Physical Contingencies (10%)	2.0	8.8	10.8	0.2	1.2	1.4
Price Escalation (18%)	4.0	17.4	21.4	0.5	2.2	2.7
Installed Cost	26.4	113.8	140.2	3.4	14.6	18.0
Working Capital	30.0	7.0	37.0	3.8	0.9	4.7
Interest during Construction[2/]	-	25.0	25.0	-	3.2	3.2
Project Cost	56.4	145.8	202.2	7.2	18.7	25.9

1/ Includes Rs 4 (US$0.5) million in indirect foreign exchange.
2/ The entire project cost will be financed with long-term debt.

Industrial Projects Department
July 1975

INDIA - FERTILIZER INDUSTRY CREDIT

HPCL - COST AND BENEFIT STREAMS FOR RATE OF RETURN CALCULATION
(in million constant 1975 Rs)

Year	Financial Cost/Benefit Streams[a/] (in Rs millions)				Economic Cost/Benefit Streams (in Rs millions)			
	Capital Costs [b/]	Crude & Other Costs	Value of Output	Net Benefit	Capital Costs [b/]	Crude & Other Costs	Value of Output	Net Benefit
1 (1975)	13.0	-	-	(13.0)	13.0	-	-	(13.0)
2	32.4	-	-	(32.4)	32.4	-	-	(32.4)
3	46.5	-	-	(46.5)	41.1	-	-	(41.1)
4 (1978)[c/]	54.8	384.0	410.4	(28.5)	54.8	383.6	395.2	(43.2)
5	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
6	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
7	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
8	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
9	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
10	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
11	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
12	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
13	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
14	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
15	-	1,535.8	1,641.8	106.0	-	1,534.6	1,580.9	46.3
16	(28.1)[d/]	1,535.8	1,641.8	134.1	(28.1)[d/]	1,534.6	1,580.9	74.4

Financial Rate of Return = 49 %   Economic Rate of Return = 26 %

/ Financial rate of return before income taxes.
b/ Capital costs exclude interest charges (also exclude duties in economic costs) and are based on a disbursement (in Rs million and current terms) scheduled of:

	Financial	Economic
Year 1 (1975)	13.0	13.0
Year 2	36.0	36.0
Year 3	56.0	49.5
Year 4	72.2	72.2
Total	177.2	170.7

c/ Production starts October 1978.
d/ Working capital acquired in 1978 (Rs 37 million) deflated to 1975 rupees.

Industrial Projects Department
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

COROMANDEL - PROJECT DESCRIPTION AND ANALYSIS

A. Introduction

1. Coromandel was issued an industrial license in March 1961 for the manufacture of various grades of Ammonium Phosphate and prilled urea, and for this purpose it acquired about 40 acres of land at Visakhapatnam on a 50-year lease from the Visakhapatnam Port Trust. This site, on which the plant is now located, is adjacent to the Caltex Oil Refinery and about 2-1/2 miles from Visakhapatnam harbor.

2. Coromandel Fertilizers Limited was incorporated as a private company on October 16, 1961 by the promoters, Chevron Chemical Company (USA), International Minerals and Chemical Corporation (USA), and EID Parry Limited (India); the latter company was formed by the merger of East India Distilleries and Parry & Company, who originally were involved in the selling of fertilizers and chemicals. The company went public on April 10, 1964. Approximately 55% of the share capital is presently owned by the original three promoters (Chevron 26%, IMCC 23%, and EID Parry 6%) with the balance being held by the public and Indian financial institutions. Total funds employed in the company as at the end of 1973 were Rs 366.8 million made up of:

	(in Rs million)
Issued and subscribed share capital	95.8
Reserves and surplus	25.0
Long-term loans	246.0

Debt to equity ratio as at the end of 1973 was 72:28. Long-term loans (outstanding) came from the Export-Import Bank of the USA, US AID, and the Industrial Development Bank of India.

3. The Lumus Company of USA together with Lumus (India) was the prime contractor for construction of the works with five major subcontractors, namely: M. W. Kellogg Company (USA) acting as subcontractor for the design of the ammonia unit; Vulcan-Cincinnati Inc. (USA) for the design of the urea unit; Chemical Construction Company (USA) for the design of the sulfuric acid unit; Dorr-Oliver Inc. (USA) for the design of the phosphoric acid unit; and Wellman-Lord Inc. (USA) for the design of the complex plant. Construction was started in the first quarter of 1965 and was completed in December 1967. First production of ammonia commenced in December 1967 with urea following soon afterwards; manufacture of complex (28-28-0) started in February 1968. During commissioning of the plant, the Company had the assistance of about 35-40 operators provided by Chevron and IMCC and was further assisted by its own local supervisors having had experience in similar companies in India. Plant production reached 85% of design capacity within 7 months of commissioning and progressively improved to 92% by 1972 in spite of intermittent interruptions in the supply of power and water.

B. Production

4. Coromandel presently has a capacity of 400 TPD urea and 325 TPD ammonia but an expansion program will raise the ammonia capacity to 357 TPD. The phosphoric acid plant is also being expanded from 225 TPD P_2O_5 to 400 TPD P_2O_5. Similarly, the sulfuric acid plant capacity is being raised from 600 TPD to 900 TPD. The expansion program will be completed by the end of 1975. The principal products are two high analysis NPK fertilizers (28-28-0 and 14-35-14) with all urea being used in the NPK mixes by 1976. NPK capacity is equivalent to 1,040 TPD of 28-28-0. The expansion program will cost Rs 90 (US$12) million including Rs 25 (US$3) million in foreign exchange.

5. The plant has a present annual demand (on a design basis) for 88,000 MT per year naphtha, 73,000 MT per year sulfur, and 235,000 MT per year phosphate rock. Naphtha requirements are supplied from the adjacent Caltex refinery while sulfur and phosphate rock are imported and delivered to the works by railwagons allocated by the Port Authority. Fresh water requirements are drawn from the Municipal Supply System which is fed from a catchment about 35 miles to the west. To minimize periodic fresh water shortages the company constructed a 10 million gallon storage tank during 1970/71. Most cooling in the works however is done by salt water supplied via an open channel from the harbor about 1-3/4 miles in length which is owned and maintained by Coromandel.

6. Power is supplied by the Andhra Pradesh Electricity Board (APEB) which operates both thermal and hydro stations having a total capacity of about 660 MW to which one additional generating unit has recently been added. When it first started, the Coromandel fertilizer works experienced severe problems from power supply interruptions and dips in the supply voltage but the problem was largely alleviated when the APEB brought in its Upper Sileru hydroplant in 1969. Power is now delivered at 220 KV and stepped down to 11 KV at the works. In January 1973 there were political disturbances in the State of Andhra Pradesh and severe power cuts were experienced during the year. At one time the works was without power for a period of 50 days and power was cut by about 25-40% during peak periods throughout most of the year. Overall in 1973, lost output due to power supply problems represented about 25% of potential production. The company is normally subject to power cuts only during the summer months but voltage dips are still experienced throughout the year. The total contractual power consumption of the works is 23 MW but actual usage at full load is about 21-22 MW. Tata Consultants (India) were appointed by the company to make a stabilization study of the APEB system to determine how a constant supply could be achieved. The consultant's report of this study which was conducted with the full cooperation of the APEB was submitted about September 1974. Its recommendations which basically apply to the APEB are still under review.

7. Coromandel's production performance since start-up taking into account these difficulties has been commendable and annual outputs are shown below:

Year	Amonium Phosphates All Grades (MT)	Prilled Urea (MT)	Capacity Utilization in Terms of Nutrients (%)
1968 (10 months)	121,586	27,735	57
1969	184,874	14,347	70
1970	217,055	3,256	76
1971	246,382	722	85
1972	255,188	6,678	91
1973	180,676	1,891	65
1974	177,950	3,852	64
1975 (estimate)	248,400	28,000	90

8. While the drop in output in 1973 was mainly attributable to reduced power supplies, the poor result for 1974 was caused primarily by mechanical problems in the primary steam reformer and the Syngas/BFW exchanger of the ammonia plant caused by thermal shock resulting from numerous crash shutdowns mainly as a consequence of fluctuations in power voltage. This necessitated a complete retubing of the primary reformer in September 1974 which took 72 days. During this operation, however, it was found that the hot gas transfer line between primary and secondary reformers had to be replaced and this took a further 20 days. All replacement tubes for the primary reformer had to be air freighted because the decision to effect the replacement was delayed and delivery of the tube order was as well delayed due to the UK (from where the tubes were supplied) being on a 3-day work week at that time due to a prolonged strike in the coal industry. The company has ordered a new Syngas/BFW exchanger for delivery towards the end of 1975. In general the company says it has usually been able to obtain its essential requirements of foreign exchange even though this requires submission of a great deal of supporting evidence and considerable persuasion. In 1970 when the company suffered damage to its reforming catalyst it was able to obtain the foreign exchange to secure a replacement immediately.

9. At present the company employs a total of about 1,016 persons including those located at its head office in Hyderabad, and therefore has a far more efficient labor utilization than similar public sector undertakings. Its staff has only marginally increased since start-up in 1968 and presently is distributed approximately 20% managerial and supervisory, 11% clerical, 54% skilled and semi-skilled, and 15% unskilled.

C. Problems and Proposed Projects

10. The company regards unreliability of power supply as its major problem in achieving continuing high production rates in the future. The only existing emergency power generation plant on the works is a 200 KW set supplying the plant instruments and critical equipment in the phosphoric acid plant. Some additional protection is also afforded in the ammonia plant which is equipped with steam driven reformer pumps and fans, supplied from

self generating boilers thus enabling the naphtha reformer to be kept running in the event of a power blackout. Most of the large electric motors are, however, supplied from the grid and being of synchronous type trip out when voltage and frequency fluctuations in the power supply become excessive. In 1974 the works suffered 6 or 7 such motor trippings which although causing disruption to production was an improvement on previous years. If the duration of the tripping is only about one minute, the works is able to get back to full production within 3 hours. While the stability of the power supply has shown considerable improvement the company is doubtful that the supply authority will be able to supply its full requirements in the future, in view of past rationing and the dependency of the hydroplants on good rains in the summer months. The company was exempted from power cuts in 1974 but believes it may have been so favored because its power consumption overall was low due to extended production shutdowns thus qualifying it to draw its full requirements when actually on line.

11. In March 1975 Coromandel was notified that the APEB has imposed a power cut of 20% on the supply to the factory. In fact power cuts as high as 30% have been experienced since then. A study of the power supply/demand situation in the State has been undertaken by the company and the management is convinced that power cuts of 25-30%, at least during the four summer months should be expected up to the mid or late 1980s. The company has therefore requested, and received permission from the State Electricity Board to install a 5 MW power generator provided the unit is used only when power is not available from the grid. In view of the urgent need to restore the power supply in the shortest time the company is proceeding with plans for installing a new 45 TPH coal fired boiler and a 5 MW condensing turbo alternator and has requested IDA assistance for this project. The coal-fired boiler will operate throughout the year, providing processed steam during 8 months and steam for power during the four summer months. This will reduce the fuel oil consumption of the company as the existing boilers are all fuel-oil fired. The estimated cost of the power unit is Rs 24 (US$3.0) million including Rs 6 (US$0.8) million in foreign exchange.

12. This investment has already been approved by the company's board and the State, and Central Government approval is expected shortly. The Central Government is also encouraging the company to proceed with the company's plans for recovery of fluorine produced in phosphoric acid manufacture as an anti-pollution measure and to produce aluminum fluoride. The company has recently decided to proceed with the project and has also requested IDA assistance to meet the foreign exchange cost of the undertaking. The fluorine recovery unit will be similar to the unit planned by FCI's Sindri Division, with a capacity of 3,835 TPY of aluminum fluoride. The estimated capital cost of the fluorine recovery project is Rs 42 (US$5.5) million including Rs 18 (US$2.4) million in foreign exchange.

13. The company has adequate resources to finance both the captive power project and the fluorine recovery project with internally generated funds.

However, it will need foreign exchange allocation to meet the foreign exchange costs of the two projects. About US$4 million is included in the proposed IDA Fertilizer Industry Credit for these two projects and will be made available by the Government to the company on a purchase basis. However, as a condition of disbursement of the foreign exchange, the company will enter into an agreement with the Government to utilize the funds according to IDA procurement procedures.

14. The economic rate of return of the captive power project is 70% and that of the fluorine recovery/aluminum fluoride project 28%. Sensitivity tests indicate the returns would still be at least 15% even under moderately adverse conditions--such as a simultaneous 20% increase in capital costs and a 20% decrease in project benefits.

D. Project Costs and Other Data

I. Captive Power (5 MW) Unit with 45 TPH Coal-Fired Boiler

a) Capital Cost Estimate (including 30% for physical and price contingencies):

	$ Million	Rs Million
i) Foreign exchange	0.8	6.2
ii) Local currency: - duties	0.3	2.3
- others	1.9	15.2
	3.0	23.7

b) Gross Benefits

i) 25 days' production (about 29,500 tons of NPK product) which would otherwise be lost during the four summer months due to a projected 25-30% power cut.

ii) Reduction in fuel oil consumption from 0.41 tons per ton of N to 0.29 tons per ton of N or a net reduction of about 7,800 TPY of fuel oil even with the higher production of 86,400 TPY of N with the captive power unit compared to 79,200 TPY of N without the captive power unit.

c) Rated Capacities of the Production Units

	as end of 1974	as end of 1975
-ammonia unit	325 TPD NH_3	357 TPD NH_3 (96,000 TPY N)
-phosphoric acid unit	225 TPD P_2O_5	400 TPD P_2O_5 (132,000 TPY P_2O_5)
-sulfuric acid unit	600 TPD	900 TPD
-urea unit	400 TPD	400 TPD
-complex fertilizer unit (28-28-0 equivalent)	1,040 TPD	1,040 TPD

d) Projected Production 1978 and Onwards

	Without Captive Power Unit			With Captive Power Unit		
	Product	N	P_2O_5	Product	N	P_2O_5
i) complex fertilizers:						
- 28-28-0	240.4	67.3	67.3	262.1	73.4	73.4
- 14-35-14	85.0	11.9	29.8	92.8	13.0	32.5
Total:	325.4	79.2	97.1	354.9	86.4	105.9
ii) % of nutrient capacity		82%	74%		90%	80%

	Without Captive Power Unit	With Captive Power Unit
iii) stream days per year	272	297
iv) average product composition (NPK)	24-30-4	24-30-4
v) average ex-factory price in current Rs per ton of NPK product 1/	2,690	2,690

e) Raw Material Consumption (average over one year)

	Without Captive Power Unit	With Captive Power Unit
i) naphtha, tons/ton of N in final product	1.1	1.1
ii) sulfur, tons/ton of P_2O_5 in final product	1.0	1.0
iii) phosphate rock, tons/ton of P_2O_5 in final product	3.2	3.2
iv) fuel oil, tons/ton of N in final product:		
-for dryers	0.05	0.05
-for process steam	0.36	0.24
v) coal, tons/ton of N in final product:		
-for power (per ton of incremental N)	-	2.54
-for process steam	-	0.37
vi) power, MWH/ton of N in final product:		
-purchased power, MWH/year	158,400	158,400
-generated power, MWH/year	-	14,400
vii) production by nutrient (1000 TPY):		
-N	79.2	86.4
-P_2O_5	97.1	105.9

f) Implementation Period

The project will be implemented in about 27 months and be ready by the end of 1977.

1/ Actual 1974 and 1975 prices (in current terms) are Rs 2,316 and Rs 2,690 per ton respectively. It is assumed that prices will remain the same in current terms up to 1978.

II. Fluorine Recovery Project

a) Capital Cost Estimate (including 30% for physical and price contingencies):

	$ Million	Rs Million
i) foreign exchange	2.4	17.6
ii) local currency: - duties	0.6	4.3
- others 1/	2.5	20.4
Total:	5.5	42.3

b) Benefits

Recovery from the effluents of the phosphoric acid manufacture of hydrofluosilicic acid (H_2SiF_6) which will be converted into aluminum fluoride, AlF_3 (or alternatively into cryolite). At present, these effluents are treated by lime and chalk to fix the fluorine into insoluble calcium fluoride. Since chemical treatment of these effluents are mandatory, it would be economically advantageous to combine this treatment with the recovery of commercially valuable fluorine compounds such as aluminum fluoride and/or cryolite.

c) Proposed Plant Capacity

i) 3,835 TPY of 96% aluminum fluoride (equivalent to a recovery of 4,280 TPY of 100% H_2SiF_6). Production at 90% output is 3,450 TPY AlF_3 (3,850 TPY of 100% H_2SiF_6).

ii) 1,290 TPY of by-product active silica (at 90% output).

d) Raw Material Requirements (at 90% output)

i) aluminum hydroxide, 1.17 tons/ton of AlF_3 or 4,040 TPY;
ii) line, 0.07 tons/ton of AlF_3 or 240 TPY.

e) Implementation Period

The project will be implemented in about 30 months and will be completed about April 1978.

1/ Including Rs 1.0 million for working capital.

INDIA - FERTILIZER INDUSTRY CREDIT

Coromandel Fertilizer Limited--Income Statement and Balance Sheet 1974-76

(in millions of Rupees)

	1974 Actual	1975 Budget	1976 Forecast
I. Income Statement for Year Ending Dec. 31			
Gross Sales	428.6	703.6	932.1
Less: Excise duties, commissions, transport and handling expenses	78.6	132.9	183.1
Net Ex-Factory Realization	350.0	570.7	749.0
Manufacturing Costs			
Variable Costs	124.3	289.9	422.0
Fixed Costs			
Depreciation	46.3	49.4	53.4
Other Fixed Costs	65.4	81.8	90.2
	236.0	421.1	565.6
Inventory Adjustments	0.4	(6.5)	-
Cost of Goods Sold	236.4	414.6	565.6
Selling & Administrative Costs	10.1	15.0	17.3
Interest Expenses			
Interest on Long-Term Loans	17.7	16.0	13.9
Other Interest Expenses	0.6	3.5	2.5
Total Interest	18.3	19.5	16.4
Operating Profit	85.2	121.6	149.7
Non-Operating Income (Expenses)	4.7	1.2	1.3
Profit Before Taxes	89.9	122.8	151.0
Income Taxes 1/	-	-	123.3
Profit After Taxes	89.9	122.8	27.7

	1974 Actual	1975 Budget	1976 Forecast
II. Balance Sheet as of Dec. 31			
Assets			
Current Assets	276.0	375.4	409.0
Gross Fixed Assets in Operation	491.0	555.6	555.6
Less: Accum. Depreciation	318.5	367.9	421.3
Net Fixed Assets in Operation	172.5	187.7	134.3
Capital Works in Progress 2/	33.0	0.4	0.4
Total Assets	481.5	563.5	543.7
Liabilities			
Current Liabilities			
Current Portion of L.T. Debt	26.3	40.4	40.4
Other Current Liabilities 3/	53.2	50.8	54.7
Total Current Liabilities	79.5	91.2	95.1
Long-Term Loans	210.4	170.0	129.6
Equity			
Share Capital	95.8	95.8	95.8
Reserves	95.8	206.5	223.2
Total Equity	191.6	302.3	319.0
Total Liabilities	481.5	563.5	543.7
Current Ratio	3.5	4.1	4.3
Debt Equity Ratio	52:48	36:64	29:71
Debt Service Coverage Ratio	3.5	3.3	1.7

1/ No tax liabilities during 1974 and 1975 due to development rebate.
2/ Excluding the proposed two projects (power and fluorine recovery).
3/ Includes dividends payable of Rs 11.5 million for each year.

Industrial Projects Department
July 1975

ANNEX 5-8
Table 2

INDIA: FERTILIZER INDUSTRY CREDIT

COROMANDEL - CAPITAL COST ESTIMATES

A. Capital Cost Estimates - Captive Power Project

	----- in Rs Millions -----			---- in US$ Million -----		
	Foreign Exchange 1/	Local Currency	Total	Foreign Exchange 1/	Local Currency	Total
Equipment & Spares (delivered)	6.2	7.8	14.0	0.8	1.0	1.8
Duties and Taxes	-	2.3	2.3	-	0.3	0.3
Licenses and Engineering	-	0.5	0.5	-	0.1	0.1
Civil Works, Erection & Commissioning	-	3.0	3.0	-	0.3	0.3
Base Cost Estimate (BCE)	6.2	13.6	19.8	0.8	1.7	2.5
Physical Contingencies (10%)	-	1.6	1.6	-	0.2	0.2
Price Escalation (18%)	-	2.3	2.3	-	0.3	0.3
Installed Cost	6.2	17.5	23.7	0.8	2.2	3.0
Additional Working Capital	-	-	-	-	-	-
Project Cost	6.2	17.5	23.7	0.8	2.2	3.0

1/ Includes Rs 1.5 (US$0.2) million in indirect foreign exchange.

B. Capital Cost Estimates - Fluorine Recovery/Aluminum Fluoride Project

	----- in Rs Millions -----			---- in US$ Million -----		
	Foreign Exchange 2/	Local Currency	Total	Foreign Exchange 2/	Local Currency	Total
Equipment & Spares (delivered)	10.4	10.0	20.4	1.4	1.3	2.7
Duties and Taxes	-	3.3	3.3	-	0.4	0.4
Licenses and Engineering	2.4	1.0	3.4	0.3	0.1	0.4
Civil Works, Erection & Commissioning	0.7	4.0	4.7	0.1	0.6	0.7
Base Cost Estimate (BCE)	13.5	18.3	31.8	1.8	2.4	4.2
Physical Contingencies (10%)	1.4	1.8	3.2	0.2	0.2	0.4
Price Escalation (18%)	2.7	3.6	6.3	0.4	0.4	0.8
Installed Cost	17.6	23.7	41.3	2.4	3.0	5.4
Additional Working Capital	-	1.0	1.0	-	0.1	0.1
Project Cost	17.6	24.7	42.3	2.4	3.1	5.5

2/ Includes Rs 2.5 (US$0.3) million in indirect foreign exchange.

Industrial Projects Department
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

Coromandel Fertilizers Limited--Production Cost Estimates
(in constant 1975 Rupees)

I. 1978 Incremental Production Cost Estimates - Captive Power Project

A. Incremental Output
NPK (24-30-4) 29,500 TPY

B. NPK (average 24-30-4) Production Cost Estimate in Constant 1975 Rupees

1. Incremental Variable Production Costs[a/]	Financial Costs (Rs/ton NPK)	Economic Costs (Rs/ton NPK)	
		Foreign Exchange	Local Currency
a. Raw Materials			
Naphtha	221.8	185.3	20.6
Phosphate Rock	600.0	524.2	75.8
Sulphur	180.0	156.8	23.2
Muriate of Potash (60% K_2O)	52.0	46.8	5.2
Sub-Total, Raw Materials	1,053.8	913.1	124.8
b. Fuel Oil (for steam and drying)	61.2	29.9	3.1
c. Coal (for steam and power)	62.9	-	59.8
d. Bags	90.0	22.5	54.0
e. Chemicals	22.1	13.3	6.6
f. Other Variable Expenses[b/]	10.0	-	5.2
Total Variable Costs (Rs/ton NPK)	1,300.0	978.8	253.5

2. Incremental Fixed Costs	Financial Costs Rs million/year	Economic Costs Rs million/year	
		For. Exchange	Local Currency
a. Salaries, Wages and Overhead	0.3	-	0.3
b. Insurance and Taxes (0.5% of cost)	0.3	-	0.2
c. Maintenance Expense (2% of cost)	1.2	0.5	0.5
d. Depreciation (1/12 of cost)	2.0	-	-
Total Fixed Costs (Rs Million/year)	3.8	0.5	1.0

3. Average Production Cost	Financial	Economic	
		For. Exchange	Local Currency
a. Rs/ton of NPK	1,428.8	995.7	287.4
b. Rs Million/year	42.1	29.4	8.5

II. 1978 Production Cost Estimates - Fluorine Recovery Project

A. Annual Production at 90% Capacity Utilization
3,450 TPY AlF_3 and 1,290 TPY active silica

B. Production Costs (in constant 1975 Rupees)

1. Variable Costs	Units/ton AlF_3	Financial Costs Rs/Unit	Financial Costs Rs/ton AlF_3	Economic Costs, Rs/ton AlF_3 Foreign Exchange	Economic Costs, Rs/ton AlF_3 Local Currency
a. Aluminum Hydroxide[c/]	1.17 tons	1,200	1,404.0	912.6	91.4
b. Lime	0.07 tons	150	10.5	-	9.4
c. Power	0.33 MWH	150	49.5	25.0	22.0
d. Fuel Oil (fuel)	0.11 tons	880	96.8	47.3	5.0
e. Bags	20 pieces	4.5	90.0	22.5	54.0
f. Other Variable Costs	-	-	127.0	-	114.3
g. Less: i. Credit for by-product silica	0.37 tons	1,000.0	(370.0)	-	(333.0)
ii. Reduction in effluent treatment cost	-	-	(100.0)	-	(90.0)
Total Variable Cost			1,307.8	1,007.4	(126.9)

2. Fixed Costs	Rs million per year Financial Costs	Economic Costs Foreign Exchange	Economic Costs Local Currency
a. Salaries, Wages and Overhead	0.7	-	0.7
b. Insurance and Taxes (0.5% of Capital Cost)	0.2	-	0.2
c. Maintenance Expenses (3% of Capital Cost)	1.3	0.5	0.6
d. Depreciation (1/12 of Capital Cost)	3.6	-	-
Total Fixed Cost	5.8	0.5	1.5

3. Average Production Costs	Financial Costs	Economic Costs For. Exchange	Economic Costs Local Currency
a. Rs/ton of AlF_3	2,989.0	1,152.3	307.9
b. Rs million/year	10.3	4.0	1.0

C. Ex-Factory Prices, Rs/ton AlF_3	Financial Costs	Economic Costs[d/]
	7,000	5,000

a/ Assumed costs (in 1975 constant Rupees)

	Financial	Economic For. Exchange	Economic Local Currency
1. Naphtha, Rs/ton	840	702	78
2. Phosphate Rock, Rs/ton	625	546	79

	Financial	Economic For. Exchange	Economic Local Currency
3. Sulphur, Rs/ton	600	523	77
4. Muriate of Potash (60% K_2O), Rs/ton	780	702	78
5. Fuel Oil (for fuel), Rs/ton	880	430	45

b/ Including duty on self-generated power of Rs 10/MWH or Rs 4.8/ton of NPK.
c/ Aluminum hydroxide CIF cost is estimated at $100/ton and local charges are $10/ton (economic price of say Rs 1004/ton).
d/ Aluminum Fluoride CIF cost is estimated at $630/ton plus $10/ton for local charges (economic price of say Rs 5,000/ton).

Industrial Projects Department
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

COROMANDEL FERTILIZER LIMITED - FINANCIAL COST AND BENEFIT STREAMS OF CAPTIVE POWER PROJECT
(in million constant 1975 Rs)

Calendar Year	A. Costs/Benefits of Incremental Production (29,500 TPY of NPK) Capital Costs a/	Naphtha & Fuel Oil Costs	Other Raw Material Costs	Coal Costs	Other Costs b/	Sales Value of Output c/	Net Benefits (A)	B. Incremental Cost/Benefits for Base Production (325,400 TPY NPK) Coal Costs	Fuel Oil Savings	Net Benefits (B)	Net Cost/Benefits (A+B)
1 (1975)	(3.0)	-	-	-	-	-	(3.0)	-	-	-	(3.0)
2	(15.1)	-	-	-	-	-	(15.1)	-	-	-	(15.1)
3	(3.0)	-	-	-	-	-	(3.0)	-	-	-	(3.0)
4 (1978) d/	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
5	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
6	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
7	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
8	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
9	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
10	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
11	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
12	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
13	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
14	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8
15	-	8.4	24.5	1.9	5.4	66.4	26.2	2.6	8.2	5.6	31.8

Financial Rate of Return before Taxes = 80%

a/ Based on disbursements (in millions of current rupees) of Rs 3, 17 and 3.7 million during 1975, 1976 and 1977 respectively, deflated to constant 1975 rupees.
b/ Excluding depreciation.
c/ At an average ex-factory price of Rs 2250 in constant 1975 rupees (Rs 2690 in current terms).
d/ Project benefits start in 1978.

ANNEX 5-8
Table 4

Industrial Projects Department
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

Coromandel Fertilizer Limited-Economic Cost and Benefit Streams of Captive Power Project

(in Millions of Constant 1975 Rupees)

Calendar Year	A. Costs/Benefits of Incremental Production (29,500 TPY of NPK)							B. Incremental Cost/Benefits for Base Production (325,400 TPY NPK)			
	Capital Costs a/	Naphtha & Fuel Oil Costs	Other Raw Material Costs	Coal Costs	Other Costs	Economic Value of Output b/	Net Benefits (A)	Coal Costs	Fuel Oil Savings	Net Benefits (B)	Net Cost/Benefits (A+B)
1 (1975)	(3.0)	-	-	-	-	-	(3.0)	-	-		(3.0)
2	(13.1)	-	-	-	-	-	(13.1)	-	-		(13.1)
3	(3.0)	-	-	-	-	-	(3.0)	-	-		(3.0)
4 (1978) c/	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
5	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
6	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
7	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
8	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
9	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
10	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
11	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
12	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
13	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
14	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9
15	-	7.0	24.5	1.8	4.5	59.8	22.0	2.5	4.4	1.9	23.9

Economic Rate of Return = 70%

a/ Based on disbursements (in millions of current rupees) of Rs 3, 14.7 (excluding duties of Rs 2.3) and 3.7 million during 1975, 1976 and 1977 respectively, deflated to constant 1975 rupees.

b/ Based on a CIF price of $250/ton of NPK equivalent to 24-30-4 plus $10/ton for local handling.

c/ Project is completed end of 1977 and full benefits start 1978.

Industrial Projects Department
November 1975

ANNEX 5-8
Table 5

INDIA - FERTILIZER INDUSTRY CREDIT

Coromandel Fertilizer Limited - Financial Cost and Benefit Streams of Fluorine Recovery Project
(in Millions of Constant 1975 Rupees)

	Financial Cost Streams (before taxes)			Financial Benefit Streams		
Calendar Year	Capital Costs a/	Aluminum Hydroxide Costs	Other Production Costs b/	Credit for Silica & Reduction in Treatment Cost	Ex-Factory Sales of Output	Net Benefit Stream
1 (1975)	(4.0)	-	-	-	-	(4.0)
2	(6.7)	-	-	-	-	(6.7)
3	(22.0)	-	-	-	-	(22.0)
4 (1978) c/	(3.0)	2.4	1.8	0.8	12.1	5.7
5	-	4.8	3.5	1.6	24.2	17.5
6	-	4.8	3.5	1.6	24.2	17.5
7	-	4.8	3.5	1.6	24.2	17.5
8	-	4.8	3.5	1.6	24.2	17.5
9	-	4.8	3.5	1.6	24.2	17.5
10	-	4.8	3.5	1.6	24.2	17.5
11	-	4.8	3.5	1.6	24.2	17.5
12	-	4.8	3.5	1.6	24.2	17.5
13	-	4.8	3.5	1.6	24.2	17.5
14	-	4.8	3.5	1.6	24.2	17.5
15	0.8 d/	4.8	3.5	1.6	24.2	17.5

Financial Rate of Return before taxes = 36%

a/ Based on disbursements (in millions of current rupees) of Rs 4.0, 7.5, 26.8 and 4.0 millions during 1975, 1976, 1977 and 1978 respectively which are deflated to constant 1975 rupees.
b/ Excluding depreciation
c/ Production is assumed to start April 1978 at 60% capacity utilization and 90% during subsequent years.
d/ Recovered working capital of Rs 1.0 million (disbursed in 1978) deflated to constant 1975 rupees.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

Coromandel Fertilizer Limited-Economic Cost and Benefit Streams of Fluorine Recovery Project

(in Millions of Constant 1975 Rupees)

Calendar Year	Economic Cost Streams: Capital Costs a/	Aluminum Hydroxide Costs	Other Production Costs	Economic Benefit Streams: Credit for Silica & Reduction in Treatment Cost	Economic Value of Output	Net Benefit Stream
1 (1975)	(4.0)					(4.0)
2	(6.7)					(6.7)
3	(18.5)					(18.5)
4 (1978) b/	(3.0)	1.8	1.5	0.8	8.6	3.1
5	-	3.5	3.0	1.5	17.2	12.2
6	-	3.5	3.0	1.5	17.2	12.2
7	-	3.5	3.0	1.5	17.2	12.2
8	-	3.5	3.0	1.5	17.2	12.2
9	-	3.5	3.0	1.5	17.2	12.2
10	-	3.5	3.0	1.5	17.2	12.2
11	-	3.5	3.0	1.5	17.2	12.2
12	-	3.5	3.0	1.5	17.2	12.2
13	-	3.5	3.0	1.5	17.2	12.2
14	-	3.5	3.0	1.5	17.2	12.2
15	0.8 c/	3.5	3.0	1.5	17.2	12.2

Economic Rate of Return = 28%

a/ The disbursement (in millions of current rupees) are assumed to be as follows: Rs. 4.0, 7.5, 26.8 (including 4.3 for duties) and 4.0 millions respectively during 1975, 1976, 1977 and 1978 which are deflated to constant 1975 rupees.

b/ Production starts April 1978 at 60% output and 90% during subsequent years.

c/ Recovered working capital of Rs. 1.0 million (disbursed in 1978) deflated to constant 1975 rupees.

Industrial Projects Department
August 1975

INDIA - FERTILIZER INDUSTRY CREDIT

ZUARI - PROJECT DESCRIPTION AND ANALYSIS

I. Urea Anti-Pollution Project

1. The project is designed to reduce the nitrogenous (dilute ammonia and urea) contaminants to less than 50 PPM in the effluents of the urea plant. The procedure will involve recycling the effluents to a recovery unit before discharge. The present level of pollutants violate both local (State) as well as national standards and must be rectified. The project is justified as the least cost solution to the pollution problem. The technical scope of the anti-pollution project has yet to be precisely defined and the project cost estimate below is a preliminary estimate by the appraisal mission.

Capital Cost Estimate

	----- in Rs Million -----			---- in US$ Million ----		
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment and Spares (CIF)	8.6	0.8	9.4	1.1	0.1	1.2
Duties	-	2.3	2.3	-	0.3	0.3
Licenses and Engineering	1.6	-	1.6	0.2	-	0.2
Civil Works, Erection, Supervision and Commissioning	1.6	0.8	2.4	0.2	0.1	0.3
Base Cost Estimate (BCE)	11.8	3.9	15.7	1.5	0.5	2.0
Physical Contingency (10%)	1.6	0.8	2.4	0.2	0.1	0.3
Price Contingency (18%)	2.3	0.8	3.1	0.3	0.1	0.4
Total Project Cost	15.7	5.5	21.2	2.0	0.7	2.7
Interest during Construction	-	2.3	2.3	-	0.3	0.3
Total Financing Required	15.7 1/	7.8	23.5	2.0 1/	1.0	3.0

1/ Contains US$0.4 (Rs 3.1) million in indirect foreign exchange.

II. Ammonia Plant Debottlenecking Project

A. Capital Cost Estimate

2. Toyo (Japan), the ammonia plant engineering contractor, is studying the technical scope of the debottlenecking project. Zuari and the appraisal mission has prepared a cost estimate for the project as follows:

AMMONIA DEBOTTLENECKING PROJECT

Capital Cost Estimates

	In Rs. Million			In Rs. Million		
	Foreign Currency	Local Currency	Total	Foreign Exchange	Local Currency	Total
Equipment & Spares (CIF)	21.1	3.9	25.0	2.7	0.5	3.2
Duties	-	8.6	8.6	-	1.1	1.1
Licenses & Engineering	1.6	-	1.6	0.2	-	0.2
Civil Works, Erection, Supervision	1.6	3.1	4.7	0.2	0.4	0.6
Base Cost Estimate	24.3	15.6	39.9	3.1	2.0	5.1
Physical Contingency (10%)	2.3	1.6	3.9	0.3	0.2	0.5
Price Contingency (18%)	4.7	3.1	7.8	0.6	0.4	1.0
Installed Cost	31.3	20.3	51.6	4.0	2.6	6.6
Interest during Construction	-	4.7	4.7	-	0.6	0.6
Project Cost	31.3	25.0	56.3	4.0[a/]	3.2	7.2

a/ Includes US$0.5 (Rs.3.9) million in indirect foreign exchange.

B. Benefits

3. The ammonia plant capacity is 630 TPD of ammonia (171,000 TPY of N). At 90% capacity utilization, annual output is 153,900 TPY of N. The proposed project will increase production by about 10%, or 15,400 TPY of N, and satisfy the ammonia requirements of the NPK facilities. The NPK plant has been idle for about one year due to a shortage of phosphoric acid but is now being brought on stream as phosphoric acid is becoming available. The analysis of the project will assume that the ammonia will be converted into 33,500 TPY of urea (that is, without the project, the NPK facility will receive all the ammonia it needs but the urea unit will not). Thus, the cost/benefits will be evaluated in terms of the additional urea production.

C. Raw Material Requirements

4. Urea production at Zuari consumes about 0.6 tons of naphtha per ton of urea. The incremental output of 15,400 TPY N (33,500 TPY urea) will require 20,100 TPY of naphtha.

5. Fuel oil consumption for fuel is about 0.25 tons fuel oil/ton of urea, or about 8,400 TPY of fuel oil.

D. Implementation Period

6. The project's technical scope will be defined by January 1976 and implementation will take another 24 months. The project is expected to be completed by January 1978.

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

Zuari - Production Cost Estimates
(in constant 1975 rupees)

I. Incremental Output (Starting 1978) 33,500 TPY urea

II. Production Cost Estimates

A. Variable Costs

Item	Units/ton of Urea	Rs/ton of Urea: Financial Costs	Economic Costs: Foreign Exchange	Economic Costs: Local Currency
Naphtha	0.6	507	420	27
Fuel Oil (fuel)	0.25	220	108	11
Bags	4.5 pieces	90	22	55
Catalysts & Chemicals	-	20	10	8
Utilities & Other Expenses	-	30	15	12
Total variable costs, Rs/ton		867	575	113

B. Incremental Fixed Costs

	Rs Million/Year: Financial Cost	Economic: Foreign Exchange	Economic: Local Currency
Insurance & Taxes (0.5% of capital costs)	0.1	-	0.10
Depreciation (1/12 of capital costs)	4.7	-	-
Maintenance Expenses (2% of capital costs)	0.5	0.2	0.2
Others	0.1	-	0.1
Total Fixed Costs, Rs Million/year	5.4	0.2	0.4

C. Average Production Costs

	Financial	Foreign Exchange	Local Currency
a. Rs/ton of urea	1028	581	125
b. Rs million/year	34.4	19.5	4.2

III. Value of Incremental Output[a/]

	Financial	Foreign Exchange	Local Currency
a. Rs/ton of urea	1150	1445	75
b. Rs million/year	38.5	48.4	2.5

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a/ The following prices are used:

	Financial Cost	Economic Cost: Foreign Exchange	Economic Cost: Local Currency
Naphtha, Rs/ton (delivered)	845	700	45
Fuel oil, Rs/ton (delivered)	880	430	45
Urea, Rs/ton	1150	1445	75

NOTE: Urea economic price is based on a CIF price of US$185/ton plus about US$10/ton for local handling.

Industrial Projects Department
November 1975

ANNEX 5-9
Table 2

INDIA - FERTILIZER INDUSTRY CREDIT

ZUARI AGRO - COST AND BENEFIT STREAMS FOR RATE OF RETURN CALCULATION
(In Million Constant 1975 Rs)

Year	Financial Cost and Benefit Streams a/				Economic Costs and Benefit Streams			
	Capital Costs b/	Operating Costs c/	Value of Output	Net Benefit	Capital Costs b/	Operating Costs c/	Value of Output	Net Benefit
1 (1975)	3.0	-	-	(3.0)	3.0	-	-	(3.0)
2	28.7	-	-	(28.7)	21.1	-	-	(21.1)
3	13.4	-	-	(13.4)	13.4	-	-	(13.4)
4 (1978)	-	29.7	38.5	8.8	-	23.7	50.9	27.2
5	-	29.7	38.5	8.8	-	23.7	50.9	27.2
6	-	29.7	38.5	8.8	-	23.7	50.9	27.2
7	-	29.7	38.5	8.8	-	23.7	50.9	27.2
8	-	29.7	38.5	8.8	-	23.7	50.9	27.2
9	-	29.7	38.5	8.8	-	23.7	50.9	27.2
10	-	29.7	38.5	8.8	-	23.7	50.9	27.2
11	-	29.7	38.5	8.8	-	23.7	50.9	27.2
12	-	29.7	38.5	8.8	-	23.7	50.9	27.2
13	-	29.7	38.5	8.8	-	23.7	50.9	27.2
14	-	29.7	38.5	8.8	-	23.7	50.9	27.2
15	-	29.7	38.5	8.8	-	23.7	50.9	27.2

Financial Rate of Return = 14%   Economic Rate of Return = 52%

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a/ Before income taxes.
b/ Based on a disbursement schedule (in millions of current rupees including interest and duties) of Rs.3.0 in 1975, Rs. 34 in 1976 and Rs.19.3 in 1977, deflated to constant rupies. Duties and interest have been excluded from the economic cost.
c/ Excluding depreciation changes.

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INDIA - FERTILIZER INDUSTRY CREDIT

Cost Estimates by Company/Sub-Project
(US$ Millions)

Company	Sub-Project	Costs: Foreign Exchange	Costs: Local Currency	Costs: Total
I. Public Sector				
A. FCI	Boiler/Power(25MW) Set at Gorakhpur	10.8	12.7	23.5
	Boiler/Power(12MW) Set at Durgapur	8.7	12.0	20.7
	170 TPH Boiler at Trombay	9.5	3.4	12.9
	Ammonia Tankwagons/Storage	9.1	11.4	20.5
	Pollution Control & Testing Equipment	1.4	-	1.4
	FCI Sub-Total	39.5	39.5	79.0
B. Neyveli Lignite Corp.	Neyveli Feedstock Conversion	7.5	12.0	19.5
C. Hindustan Steel Corp.	Rourkela Feedstock Conversion	9.0	17.1	26.1
	Public-Sector: Sub-Total	56.0	68.6	124.6
II. Joint Sector				
D. GSFC	Purge Gas Recovery	4.5	6.8	11.3
	Fluorine Recovery/Cryolite Plant	1.0	1.7	2.7
	Phosphoric Acid Plant Debottlenecking	2.2	4.4	6.6
	GSFC Sub-Total	7.7	12.9	20.6
E. HPCL	Refinery Debottlenecking	7.2	18.7	25.9
F. Madras (MFL)	Urea Plant Debottlenecking	0.7	0.5	1.2
	Ammonia Process Control Computer	0.2	0.3	0.5
	MFL Sub-Total	0.9	0.8	1.7
G. SPIC	Fluorine Recovery/Cryolite Plant	1.0	1.7	2.7
	Soda Ash/Ammonium Chloride Plant	9.9	33.6	43.5
	SPIC Sub-Total	10.9	35.3	46.2
	Joint Sector: Sub-Total	26.7	67.7	94.4
III. Private Sector				
H. Coromandel	Boiler/Power(5MW) Set	0.8	2.2	3.0
	Fluorine Recovery/Aluminum Fluoride Plant	2.4	3.1	5.5
	Coromandel Sub-Total	3.2	5.3	8.5
I. Zuari Agro	Ammonia Plant Debottlenecking	4.0	3.2	7.2
	Urea Plant Pollution Control	2.0	1.0	3.0
	Zuari Sub-Total	6.0	4.2	10.2
	Private Sector: Sub-Total	9.2	9.5	18.7
Total for Sub-Projects		91.9	145.8	237.7
	Technical Assistance	0.5	0.5	1.0
Total Project Cost		92.4	146.3	238.7

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

CAPITAL COST ESTIMATE BY TYPE OF SUB-PROJECT

	in Rs Million			in US$ Million			
	Foreign Exchange	Local Currency	Total	Foreign Exchange	Local Currency	Total	%
1. Capacity Expansion & Process Efficiency Improvement (10)	368	697	1065	47.1	89.3	136.4	57
2. Internal Power Generation & Utilities (4)	232	236	468	29.8	30.3	60.1	25
3. Anti-Pollution (4)	50	58	108	6.4	7.5	13.9	6
4. Refinery Expansion (1)	56	146	202	7.2	18.7	25.9	11
5. Miscellaneous (3)[a]	15	4	19	1.9	0.5	2.4	1
Total Project Cost	721[b]	1141	1862	92.4[b]	146.3	238.7	100

a/ Includes technical assistance (US$1.0 million).

b/ Includes Rs 148 (US$19) million of indirect foreign exchange.

Industrial Projects Department
November 1975

INDIA - FERTILIZER INDUSTRY CREDIT

CALCULATION OF PRICE ESCALATION FACTOR 1/

A. Annual Price Inflation (from Annex 7-1)

Calendar Year	International Prices	Domestic Prices
1975	12%	15%
1976	10	10
1977	8	8
1978	8	8

B. Average Commitment as Percent of Project Cost

	% Committed	
Calendar Year	Foreign Exchange	Local Currency
1975	5	10
1976	35	35
1977	40	35
1978	20	20
Total	100%	100%

C. Calculation of Price Escalation

	Foreign Exchange			Local Currency		
Year	Compounded % Inflation Factor 2/	Fraction Committed	Weighted Escalation %	Compounded % Inflation Factor 2/	Fraction Committed	Weighted Escalation
1975	0	0.05	0	0	0.10	0
1976	11	0.35	3.8	12	0.35	4.2
1977	21	0.40	8.4	22	0.35	7.7
1978	31	0.20	6.2	32	0.20	6.4
Total		1.00	18.4%		1.00	18.3%
Say:			18%			18%

1/ The price inflation factor calculated here is used in all project components unless estimated otherwise for a specific project. The factor of 18% is applied to both the base cost estimate (BCE) and the physical contingencies.

2/ From mid-1975 to mid-year.

Industrial Projects Department
July 1975

INDIA: FERTILIZER INDUSTRY CREDIT

INDUSTRIAL DEVELOPMENT BANK OF INDIA (IDBI)1/

1. The Industrial Development Bank of India (IDBI) was established in 1964 as a subsidiary of the Reserve Bank of India (RBI), the Central Bank. However, as part of a Bill passed by Parliament in August 1975, the ownership of IDBI will be transferred from RBI to GOI probably at the beginning of 1976. IDBI is now the largest single institutional source of industrial finance, accounting for approximately 5% of the annual total industrial investment in India. It acts as the apex institution for all other financial intermediaries and is a strong institution in its own right. It has its head office in Bombay and its three regional offices are located at New Delhi, Calcutta and Madras.

Trends in Operation

2. IDBI's activities include granting direct loans, rediscounting commercial bills, the refinancing of loans made by the State Finance Corporations (SFCs) and commercial banks, providing export finance, underwriting, equity investment and guarantee operations. As of June 30, 1975, the total effective financial assistance sanctioned by IDBI excluding guarantees was Rs 13.08 billion (US$1.68 billion), of which Rs 6.96 billion (US$0.89 billion) -- approximately 53% of the total -- was in the form of refinancing of industrial loans and discounting of bills. Thus, refinancing of industrial loans and discounting of bills constitute a major part of IDBI's operations.

3. The IDBI operation has expanded rapidly in recent years, with the total annual assistance sanctioned reaching Rs 3,514 million (US$450.4 million) in 1974/75 compared to Rs 1,331 million (US$171 million) in 1970/71. Direct loans accounted for Rs 672 million (US$86.6 million), i.e. about 19% of the total assistance approved in 1974/75 as shown below:

1/ Detailed analysis of IDBI is in Annex 6 of the appraisal report: "India Appraisal of the Industrial Credit and Investment Corporation of India Ltd." (Report No 637a-IN), March 14, 1975. Further, IDBI was recently appraised by the South Asia Projects Department.

IBDI Assistance Approved in 1974/75

		Rs Million	US$ Million	% of Total
1.	Direct Loans	672.0	86.6	19.1
2.	Underwriting & Direct Subscription to Shares	179.0	23.0	5.0
3.	Foreign Lines of Credit (to Bangladesh)	80.0	10.3	2.2
4.	Refinancing of Loans and Discounting of Bills	2,201.0	283.3	62.6
5.	Export Credits	382.0	49.2	10.9
	Total	3,514.0	450.4	100

4. IDBI's total assets as of June 30, 1974 were Rs 4.8 billion, its debt/equity ratio 4.8:1, and its profitability 1.74% on average total assets. Its financial position has been projected to remain satisfactory by the recent appraisal mission.

Board of Directors

5. IDBI's 18-member Board of Directors, which is identical with RBI's[1/] continues to be breadly representative of business, professional and Government circles. Nine directors including the Chairman and the Vice-Chairman constitute the Executive Committee which is the highest decision-making body for IDBI's day-to-day operations, including all investment decisions (except for loans of smaller amounts which are approved at the management level).

Management and Staff

6. Mr. Chari continues to be the Vice-Chairman of IDBI and he is scheduled to retire in November. Under him are Messrs. C.S. Venkat Rao and Y.S. Kedare, the General Manager and the Joint General Manager, respectively. Mr. Venkat Rao has been in the post since September 1972. The total staff strength has increased significantly in recent years. The new staff is mostly recruited from private-sector institutions. IDBI continues to be active in training its staff in programs organized by various domestic and foreign institutions, including the Bankers' Training College, Bombay, and the UN Asian Institute for Economic Development and Planning, Bangkok.

1/ This will, however, change as a result of the recent passage of a Bill by Parliament.

Lending Policies and Practices

7. Interest rates: Following an increase in the Bank Rate in July 1974 (from 7% to 9% per annum), IDBI's lending rates were revised upward. The new rates are shown in Table 1.

8. Assistance to backward areas: IDBI has since 1970 been providing its direct and indirect assistance to projects located in the backward districts on concessionary terms. Some modifications in IDBI's lending policies to these projects took place during 1972/73. With respect to its direct assistance, the previous limit on the total cost of projects (up to Rs 30 million) which qualify for concessionary assistance was removed, and a new limit was set on the aggregate amount of assistance provided by all national term-lending institutions (up to Rs 20 million for loans and Rs 10 million for underwritings), irrespective of the project cost. Likewise, with respect to refinance, the eligibility criterion changed from the project cost to the loan amount. Now, loans up to Rs 3 million each can benefit from IDBI's concessionary refinance, provided the net worth of the enterprise does not exceed Rs 10 million.

Characteristics of Portfolio

9. Industrial distribution: IDBI's direct assistance has been allocated mainly to modern types of large industries, including fertilizers, iron and steel, petro- and heavy-chemicals, and paper and paper products. More than one-third of India's total capacity for fertilizer production was created with IDBI assistance, and so was about 40% of its special steels and steel rolls production capacity. The distribution of IDBI refinance shows a relatively heavy concentration on traditional lines of industries such as light chemicals, food manufacturing, textiles, and road transport, but some new types of industries, including machine manufacturing and metal products are also taking on an increasing importance. The machinery sold under the IDBI rediscounting scheme went mostly to the textile and machine manufacturing industries.

10. Geographical distribution: Reflecting the imbalances of industrialization among States, IDBI's assistance has been generally concentrated on several relatively industrialized States such as Gujarat, Maharashtra, Tamil Nadu and West Bengal. However, the proportion of direct assistance given to projects in the industrially backward districts (including those in the relatively advanced States) has somewhat increased recently.

11. Size of assistance and projects: A breakdown by size of direct loans and investments shows that about 70% by amount of total approvals were for Rs 10 million or more each, whereas about 2% were far below Rs 1 million each. Sector-wise, about four-fifths by amount of total approvals went to the large-scale sector, and the rest to the medium-scale sector. This is a logical consequence of IDBI's primary emphasis on modern and relatively capital intensive projects. By contrast, its refinancing loans have mainly financed smaller projects.

12. Loan maturity: Of total direct loan approvals, the largest number had maturities between nine and 12 years. The maturity pattern of IDBI refinance shows that three-fourths of loans (by number) had repayment periods below 10 years.

13. Nature of projects: Both IDBI's direct assistance and refinance loans have financed mainly new projects as opposed to expansion or modernization of existing projects.

14. Type of clients: An overwhelming majority of the loan recipients belong either to the private sector or the joint sector; public sector accounts for less than 10% of the total loans. IDBI's refinance has all been given to private sector companies. The modest size of IDBI's public-sector financing does not reflect its reluctance to provide such financing, but rather indicates the small demand to-date from public-sector enterprises though this is expected to change significantly over the next few years.

Promotional Activities

15. IDBI's promotional activities have been intensified since 1970 when IDBI started taking the initiative in conducting a series of industrial surveys of less developed States and Union Territories, coordinating the activities of State-level financial institutions, and strengthening the mechanisms of technical assistance. IDBI has recently further stepped up its activities in these areas.

16. Industrial surveys: Surveys covering almost all States and Union Territories classified by the Government as industrially backward were completed, and reports were published. These surveys were carried out by joint-institutional study teams comprising officials of IDBI, RBI, Industrial Finance Corporation of India (IFCI) and Industrial Credit and Investment Corporation of India (ICICI) to identify industrial potentials and specific project ideas in these States. In addition, IDBI has extended assistance to similar surveys of backward areas in the relatively developed States, such as Kerala, Karnataka and West Bengal, by having its officials participate in such surveys or by bearing the survey cost.

17. Inter-Institutional Groups (IIGs) at State level: Since July 1972, eight more IIGs have been formed, bringing the total number of such groups to 14. Consisting of representatives of SFCs, State Industrial Development Corporation (SIDCs), lead banks, State Governments, and the All-India term-lending institutions, IIGs have met periodically to discuss issues arising from project identification and implementation. Some of the topics discussed at recent IIG meetings in various States include: (a) organizing an entrepreneurial training program (Kerala, Andhra Pradesh, Assam, Bihar); (b) disseminating information on identified projects to attract prospective entrepreneurs (Madhya Pradesh, Bihar, Orissa); and (c) following up on industrial licenses issued by the Government (Karnataka, Andhra Pradesh).

18. Technical assistance: In view of the difficulty for every State-level institution to be equipped with adequate technical capabilities, IDBI has been encouraging the establishment of jointly-sponsored Technical Consultancy Service Centers (TCSCs) which conduct technical appraisals for financial institutions as well as prepare project feasibility reports for prospective entrepreneurs. To-date, three Centers have been established in Assam, Kerala and Bihar.

Involvement In Fertilizer Industry

19. Since its inception in 1964, IDBI has sanctioned financial assistance of about Rs 860 million to 11 fertilizer projects, involving a total cost of Rs 4.9 billion to increase installed capacity in India by 1.4 million nutrient tons to 4.8 million nutrient tons (Tables 2 and 3). All the major fertilizer projects set up in the private sector since the inception of IDBI have been financed by it. IDBI acts as the lead financial institution when appraising fertilizer projects.

20. Fertilizer projects financed by IDBI are appraised by IDBI's Projects Department which is staffed with 41 professionals. The staff is generally of good quality and over the years has acquired the expertise for appraising the technical and financial aspects of fertilizer projects. Some of the senior officers have also acquired management-level experience as nominees of IDBI on the Boards of assisted fertilizer companies. Project supervision is undertaken by IDBI's Follow-Up Department, which is staffed with 22 professionals, who are also assisted by engineers in the Projects Department and by staff in the Regional Offices. Of the 11 fertilizer projects financed by IDBI, eight were completed within the original schedule, and the rest were completed with less than one-year delay. Data for five of these companies, which were in operation during 1974, showed for that year an average return on total capital employed 1/ of 16% and a net return of after tax of 14% on net worth. Only two of the 11 companies were in arrears with IDBI for an amount of Rs 5.9 million. In terms of its experience and past performance, IDBI appears qualified to administer part of the proposed credit.

1/ Earnings before interest and tax/net worth plus long-term debt.

Industrial Projects Department
August 1975.

INDIA: FERTILIZER INDUSTRY CREDITS

IDBI : Interest Rate Structure

	Rates prevailing before 27th July 1974		Revised Rates effective from 27th July 1974	
1. Direct assistance to industrial concerns (other than for exports)	% p.a.		% p.a.	
(a) Normal rate: for Rupee loans	9.00		10.25	
- for foreign exchange loans	9.25		10.50	
(b) - to units in the specified backward districts	7.50		8.50	
2. Refinance				
(a) Normal rate	7.00	- Ceiling on the rate to be charged by the financial institutions at 10.50 per cent.	8.50	- Ceiling on the rate to be charged by the financial institutions at 12 per cent.
(b) Special rate for small-scale industrial units covered under the CGS	5.00	- For assistance up to Rs 25,000 - Provided the financial institution does not charge more than 8.50 per cent.)	7.00	- Ceiling on the rate to be charged by the financial institution at 10.50 per cent.
	5.50	- On the assistance in excess of Rs 25,000 - provided the financial institution does not charge more than 9 per cent.)		
(c) Special rate for units in the specified backward districts	4.00	- Provided the financial institution does not charge more than 9 per cent	5.50	- Ceiling on the rate to be charged by the financial institution at 9.00 per cent.
Under IDA line of credit (Foreign currency component)				
(a) To small-scale industries covered under GGS, technician entrepreneur scheme and units in specified backward districts	6.50	- Provided the financial institution does not charge more than 9 per cent	8.00	- Provided the financial institution does not charge more than 10.50 per cent.

Industrial Projects Department
August 1975

INDIA: FERTILIZER INDUSTRY CREDIT

Statement showing details of assistance sanctioned to fertilizer projects

(Position as of November 30, 1974) (Rs in millions)

		Loans				Debentures				Equity					Preference				
Sr. No.	Name of the Company	Sanctioned	Disbursed	Repaid	Outstanding	Sanctioned	Subscribed	Repaid	Outstanding	Sanctioned	Devolved	Paid-up	Sales	Outstanding	Sanctioned	Devolved	Paid-up	Sales	Outstanding
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1.	West India Chemicals	1.5 (60)	-	-	-	-	-	-	-	0.4 (13.3)	0.4	0.4	-	0.4	0.8 (53.3)	0.7	0.7	-	0.7
2.	GSFC	180.0 (72)	180.0	108.8	71.2	-	-	-	-	19.7 (21.7)	19.3	19.3	4.6	14.7	7.1 (23.7)	6.2	6.2	6.2	-
3.	E.I.D. Parry	12.0 (100)	12.0	6.8	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	Coromandel Fertilizers	70.0 (17.7)	70.0	13.1	56.9	-	-	-	-	2.5 (3)	-	-	-	-	-	-	-	-	-
5.	Indian Explosives Ltd.	46.5 (24.5)	46.5	4.8	41.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	D.C.M.	12.5 (41.6)	12.5	12.4	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	Orissa Fertilisers	3.0 (62.5)	2.9	-	2.9	-	-	-	-	0.9 (39.1)	0.9	0.9	-	0.9	-	-	-	-	-
8.	Zuary Agro	-	-	-	-	-	-	-	-	5.0 (4)	0.3	0.3	-	0.3	24.2 (58.7)	22.1	22.1	22.1	2.1
9.	IFFCO	110.0 (17)	105.0	-	105.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	SPIC	150.0 (23.9)	125.2	-	113.7	-	-	-	-	42.4 (20.8)	11.4	11.2	-	11.2	1.2	1.1	1.1	-	1.1
11.	Mangalore Chemicals	135.8 (29.0)	53.5	-	53.5	-	-	-	-	33.8 (22.5)	20.9	20.9	-	20.9	-	-	-	-	-
	Total	721.3	607.6	145.9	450.2	-	-	-	-	104.7	53.2	53.2	4.6	48.4	33.3	30.1	30.1	28.3	23.3

Note: Figures in brackets in col. (3) indicate percentage of IDBI's loan assistance to the total loan amount in the projects. Similarly for cols. (11) and (16).

Source: IDBI

Industrial Projects Department
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ANNEX 6-4
Table 3

INDIA - FERTILIZER INDUSTRY CREDIT

IDBI - STATEMENT SHOWING DETAILS OF FERTILIZER PROJECTS ASSISTED
(Position as on November 30, 1974)

	Company Name	Product	Production capacity in millions	Project cost	Means of financing: Equity	Preference	Debenture	Loan	Deposits	Deferred credits
				(Rs. in million)						
1.	West India Chemicals Ltd.	Sulphuric phosphate	0.1 (installed)	13.8	3.0	1.5	-	8.7	0.6	-
2.	Gujarat State Fertilisers Co. Ltd.	Ammonia	0.3	410.2	90.0	30.0	-	250.0	10.2	30.0
		A. Sulphate	0.1	(236.3)						
		P. Phosphate	0.1							
		Urea Fertilizer	0.4							
3.	E.I.D. Parry Ltd.	Ammonium Phosphate		43.8	12.0	-	-	12.0	0.8	19.0
		Ammonium Sulphate		(23.2)						
4.	Coromancel Fertilisers Ltd.	Ammonium Phosphate		509.8	95.8	-	-	395.4	18.6	-
		Urea		(325.4)						
5.	Indian Explosives Ltd.	Ammonium Phosphate	0.3	558.4	166.8	-	-	240.4	77.7	-
		Urea	0.5	(241.8)						
6.	Delhi Cloth Mills Co. Ltd.	Ammonia	0.1	270.0	22.0	8.0	-	30.0	49.6	160.4
7.	Orissa Fertilisers & Chemicals Ltd.	NPK		7.3	2.3	0.2	-	4.8	-	-
8.	Zuari Agro Chemicals Ltd.	Ammonia	0.2	477.1	124.3	41.2	-	400.0	-	11.6
				(80.6)						
9.	Indian Farmers Fertiliser Co-op. Ltd.	Ammonia	0.3	938.9	277.4	-	-	661.5	-	-
		Urea	0.4	(280.3)						
10.	Southern Petro-chemical Industries Corp.	Ammonia	0.4	896.8	204.0	20.0	-	626.8	46.0	-
		Urea	0.5	(342.9)						
		NPK	0.2							
11.	Mangalore Chemicals & Fertilisers Ltd.	Ammonia	0.2	676.2	150.0	35.0	6.8	468.4	-	16.0
		Urea	0.3	(208.4)						
				4902.3						
				(1899.3)						

Note: Figures within bracket indicate foreign exchange component.

Source: IDBI

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

ESTIMATED DISBURSEMENT OF IDA CREDIT

Calendar Year/Quarter		Disbursed during Period (US $ Million)	Cumulative Disbursement US $ Million	%
1976	I 1/	10.5	10.5	10
	II	3.1	13.6	13
	III	3.2	16.8	16
	IV	4.2	21.0	20
1977	I	6.3	27.3	26
	II	7.3	34.6	33
	III	11.6	46.2	44
	IV	11.6	57.8	55
1978	I	13.6	71.4	68
	II	12.6	84.0	80
	III	10.5	94.5	90
	IV	10.5	105.0	100
	TOTAL	105.0		

1/ Including retroactive financing.

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INDIA - FERTILIZER INDUSTRY CREDIT
INFLATION AND PRICE ASSUMPTIONS

I. INFLATION RATES

Calendar Year	Domestic General Price Inflation: Annual Rate, %	Compounded Rate, Mid 1975 to Mid-Year, %	Price Deflator to Constant 1975 Rupees	International Price and Domestic Equipment Price Inflation: Annual Rate, %	Compounded Rate, Mid-1975 to Mid-Year, %	Price Deflator to Constant 1975 Rupees or US Dollars
1975	15	---	1.0	12	---	1.00
1976	10	12.5	0.89	10	11%	0.90
1977	8	22.6	0.82	8	21%	0.83
1978	8	32.4	0.76	8	31%	0.76
1979	8	43.0	0.70	8	41%	0.71

II. FERTILIZER PRICES

	Domestic Ex-factory Prices, Rs/ton				International CIF Prices, $/ton			
	Urea (Bagged)		P_2O_5 a/		Urea (Bagged)		P_2O_5 b/	
Calendar Year	In Current Rupees	In Constant 1975 Rupees	In Current Rupees	In Constant 1975 Rupees	Current Dollars	Constant 1975 Dollars	Current Dollars	Constant 1975 Dollars
1975	1100	1100	4,800	4,800	325	325	610	610
1976	1240	1105	4,800	4,270	315	285	485	435
1977	1355	1110	4,800	3,935	290	240	490	405
1978	1510	1150	5,000	3,800	245	185	515	390
1979	1645	1150	5,430	3,800	260	185	550	390

III. FEEDSTOCK PRICES

	Ave. Domestic Ex-Storage Prices (Including Excise Duties and Sales Taxes), Rs/ton				International CIF Prices, $/ton			
	Naphtha c/		Fuel Oil d/		Naphtha e/		Fuel Oil f/	
Calendar Year	In Current Rupees	In Constant 1975 Rupees	In Current Rupees	In Constant 1975 Rupees	Current Dollars	Constant 1975 Dollars	Current Dollars	Constant 1975 Dollars
1975	575	575	555	555	90	90	55	55
1976	645	575	625	555	100	90	60	55
1977	1020	835	675	555	110	90	65	55
1978	1100	835	730	555	120	90	70	55
1979	1195	835	795	555	130	90	80	55

a/ Average P_2O_5 price equivalent of phosphate content of SSP and TSP estimated as Rs 4,800/ton of P_2O_5 in 1975. Prices in current terms are assumed to remain the same through 1977 and from 1978 onwards, stay at Rs 3800/ton in constant terms.

b/ Based on TSP (46% P_2O_5) fob prices plus $30/ton of TSP for ocean freight. Local charges of $10/ton of TSP are added to the CIF price to get the economic price.

c/ Prices after 1977 (in real terms) are increased to 1.5 times the fuel oil price (on a weight basis) to equalize the production costs of the new fuel oil and the older Naphtha based plants.

d/ As fuel, fuel oil price is Rs 875/ton (in 1975 rupees).

e/ Taken as 115% of crude oil CIF price on a weight basis.

f/ Taken as 70% of crude oil CIF price on a weight basis.

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INDIA - FERTILIZER INDUSTRY CREDIT

INCREASE IN FERTILIZER OUTPUT DUE TO PROJECT
(in 000 TPY of Nutrients)

Project Firms	Installed Capacity as of Dec. 1975		Increase in Output from Proposed Credit	
	N	P_2O_5	N	P_2O_5
Coromandel 1/	96	132	7.2	8.8
FCI: - Durgapur 2/	152	-	9.2	-
- Gorakhpur 2/	80	-	13.8	-
- Trombay 2/	81	36	9.6	4.8
- Ammonia Transport and Storage	-	-	39.3	-
GSFC	257	57	15.3	17.3
Madras	203	85	15.2	-
Neyveli	75	-	40.7	-
Rourkela	115	-	40.3	-
SPIC 3/	297	54	16.3	-
Zuari	171	42	15.4	-
Sub-total:	1,527	406	222.3	30.9

1/ Includes expansion to be completed by end of 1975 (8,000 TPY of N).
2/ Included in POIP component of Trombay IV Credit.
3/ New factory commissioned in 1975.

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INDIA - FERTILIZER INDUSTRY CREDIT

SUMMARY FINANCIAL COSTS AND BENEFITS

Type and Number of Sub-Projects	Annual Physical Benefits TPY	In Millions of Constant 1975 Rupees: Annual Net Operating Costs[a/]	Annual Gross Value of Benefits	Net Annual Benefit	%
1. Capacity Expansion & Process Efficiency Improvement (10)					
(a) Additional Fertilizer Nutrient Output	199,800[b/]	295	562	288	
(b) Reduction in Raw Material Usage	32,210[c/]		21		
(c) Soda Ash	65,300				
Sub-Total		295	583	288	52
2. Internal Power Generation & Utilities (4)					
Additional Fertilizer Nutrient Output	53,400[d/]	104	229	125	23
3. Anti-Pollution (3)					
Recovered Industrial Chemicals	8,300[e/]	13	47	34	6
4. Refinery Expansion (1)					
Additional Crude Oil Refining Capacity	2.5 million	1,536	1,642	106	19
Total		1,948	2,501	553	100

a/ Excludes depreciation and interest charges. The value of by-products or co-products (soda ash) have been deducted from operating costs to arrive at the net cost.
b/ 182,500 TPY N and 17,300 TPY P_2O_5.
c/ 15,880 TPY phosphate rock, 9,530 TPY sulphur and 5,800 TPY naphtha.
d/ 39,800 TPY N and 13,600 TPY P_2O_5.
e/ 2800 TPY cryolite, 3400 TPY aluminum fluoride and 2100 TPY silica.

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

SUMMARY OF FINANCIAL AND ECONOMIC RATES OF RETURN

Company/Sub-Project		Rate of Return % Financial 1/	Rate of Return % Economic
I. Public Sector			
A. FCI	Boiler/Power Set-Gorakhpur	15	22
	Boiler/Power Set-Durgapur	19	26
	Boiler-Trombay	15	26
	Ammonia Tankwagons/Storage	21	37
	Pollution Control & Testing Equipment	NA 2/	NA
B. Neyveli Lignite Corporation	Feedstock Conversion	27	41
C. Hindustan Steel Corp.(Rourkela)	Feedstock Conversion	15	33
II. Joint Sector			
D. GSFC	Purge Gas Recovery	34	41
	Fluorine Recovery/Cryolite Plant	30	21
	Phosphoric Acid Plant Upgrading	47	40
E. HPCL	Refinery Expansion	49	26
F. Madras Fertilizer	Urea Plant Debottlenecking	Exceeds 60%	Exceeds 60%
	Ammonia Process Control Computer	Exceeds 60%	Exceeds 60%
G. SPIC	Fluorine Recovery/Cryolite Plant	30	21
	Soda Ash/Ammonium Chloride Plant	19	18
III. Private Sector			
H. Coromandel	Boiler/Power Set	Exceeds 60%	Exceeds 60%
	Fluorine Recovery/Aluminum Fluoride Plant	36	28
I. Zuari Agro	Ammonia Plant Debottlenecking	14	52
	Urea Plant Pollution Control	NA	NA
IV. Miscellaneous	Technical Assistance	NA	NA
Composite Return for 17 Projects with quantifiable benefits		26	32

1/ Financial rate of return before income taxes.
2/ NA - not applicable. The benefits have not been quantified.

Industrial Projects Department
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INDIA - FERTILIZER INDUSTRY CREDIT

SUMMARY ECONOMIC COSTS AND BENEFITS

Type and Number of Sub-Projects	Annual Physical Benefits TPY	In Millions of Constant 1975 Rupees: Annual Net Operating Costs[a/]	Annual Gross Value of Benefits	Net Annual Benefit	%
1. Capacity Expansion & Process Efficiency Improvement (10)					
(a) Additional Fertilizer Nutrient Output	199,800[b/]	260	674	434	
(b) Reduction in Raw Material Usage	31,210[c/]		20		
(c) Soda Ash	65,300				
Sub-Total		260	694	434	66
2. Internal Power Generation & Utilities (4) Additional Fertilizer Nutrient Output	53,400[d/]	89	240	151	23
3. Anti-Pollution (3) Recovered Industrial Chemicals	8,300[e/] TPY	10	32	22	3
4. Refinery Expansion (1) Additional Crude Oil Refining Capacity	2.5 million TPY	1,535	1,581	46	8
Total		1,894	2,547	653	100

a/ Excludes depreciation and interest charges. The value of by-products or co-products have been deducted from operating costs to arrive at the net cost.
b/ 182,500 TPY N and 17,300 TPY P_2O_5.
c/ 15,880 TPY phosphate rock, 9,530 TPY sulphur and 5,800 TPY naphtha.
d/ 39,800 TPY N and 13,600 TPY P_2O_5.
e/ 2,800 TPY cryolite, 3,400 TPY aluminum fluoride and 2,100 TPY silica.

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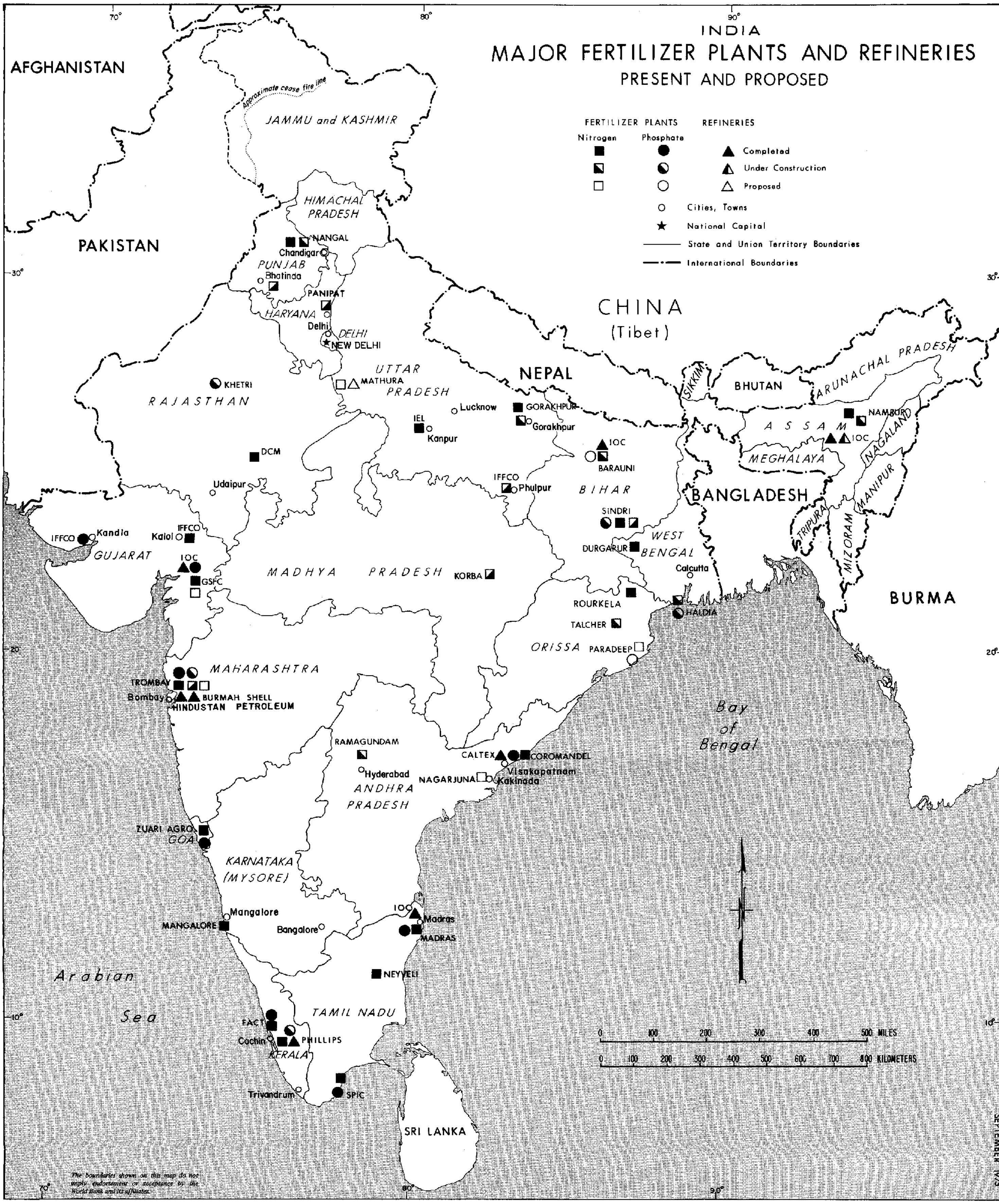
INDIA
MAJOR FERTILIZER PLANTS AND REFINERIES
PRESENT AND PROPOSED
FERTILIZER PLANTS
Nitrogen
Phosphate
REFINERIES
Completed
Under Construction
Proposed
Cities, Towns
National Capital
State and Union Territory Boundaries
International Boundaries
AFGHANISTAN
PAKISTAN
CHINA
(Tibet)
NEPAL
BHUTAN
SIKKIM
BANGLADESH
BURMA
SRI LANKA
Approximate cease fire line
JAMMU and KASHMIR
HIMACHAL PRADESH
PUNJAB
HARYANA
DELHI
UTTAR PRADESH
RAJASTHAN
GUJARAT
MADHYA PRADESH
BIHAR
WEST BENGAL
ORISSA
MAHARASHTRA
ANDHRA PRADESH
KARNATAKA (MYSORE)
GOA
TAMIL NADU
KERALA
ASSAM
MEGHALAYA
ARUNACHAL PRADESH
NAGALAND
MANIPUR
MIZORAM
TRIPURA
NANGAL
Chandigarh
Bhatinda
PANIPAT
Delhi
NEW DELHI
MATHURA
KHETRI
Lucknow
GORAKHPUR
Gorakhpur
IEL
Kanpur
DCM
Udaipur
IFFCO
Phulpur
IOC
BARAUNI
SINDRI
DURGAPUR
Calcutta
KORBA
IFFCO
Kandla
IFFCO
Kalol
IOC
GSFC
ROURKELA
TALCHER
HALDIA
PARADEEP
NAMRUP
IOC
TROMBAY
Bombay
BURMAH SHELL
HINDUSTAN PETROLEUM
RAMAGUNDAM
Hyderabad
CALTEX
COROMANDEL
Visakapatnam
NAGARJUNA
Kakinada
ZUARI AGRO
Mangalore
MANGALORE
Bangalore
IOC
Madras
MADRAS
NEYVELI
FACT
Cochin
PHILLIPS
Trivandrum
SPIC
Arabian Sea
Bay of Bengal
70°
80°
90°
30°
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10°
0 100 200 300 400 500 MILES
0 100 200 300 400 500 600 700 800 KILOMETERS
The boundaries shown on this map do not imply endorsement or acceptance by the World Bank and its affiliates.
IBRD 10453R2
SEPTEMBER 1975