

Document of  
**The World Bank**

**FOR OFFICIAL USE ONLY**

**Report No. 5742**

**PROJECT COMPLETION REPORT**

**BRAZIL - VALEFERTIL FERTILIZER PROJECT**

**(LOAN 1411-BR)**

June 28, 1985

Industry Department

**This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not otherwise be disclosed without World Bank authorization.**

WEIGHTS AND MEASURES

1 Metric Ton	=	907 kilogram (kg)
1 Short Ton	=	1,000 kg
1 Pound (lb)	=	0.453 kg
1 Standard Cubic Foot (scf)	=	0.02831 Normal cubic meter (Nm <sup>3</sup> )
1 Kilo Calorie (Kcal)	=	4.19 10 <sup>3</sup> Joule (KJ)
1 British Thermal Unit (BTU)/lb	=	2.326 KJ/kg

ABBREVIATIONS

CVRD = Companhia Vale do Rio Doce  
FOSFERTIL = Fertilizantes Fosfatados S.A.  
PETROBRAS = Petroleo Brasileiro S.A.  
PETROFERTIL = Petrobras Fertilizantes S.A.,  
VALFERTIL = Fertilizantes Vale do Rio Grande S.A. - VALEFERTIL

FISCAL YEAR

January 1 to December 31

Industry Department

**PROJECT COMPLETION REPORT**

**TABLE OF CONTENTS**

	<u>Page No.</u>
Preface .....	i
Key Project Data .....	ii
Highlights.....	iv
I. <u>INTRODUCTION</u> .....	1
II. <u>PROJECT BACKGROUND</u> .....	2
A. Project Preparation, Appraisal, Approval and Credit Effectiveness .....	2
B. Project Description and Objectives .....	3
III. <u>PROJECT IMPLEMENTATION AND MANAGEMENT</u> .....	4
A. Achievement of Project Objectives .....	4
B. Project Scope .....	4
C. Project Management .....	5
D. Employment and Training .....	5
E. Use and Performance of Engineering Contractors and Consultants .....	6
F. Procurement and Performance of Suppliers .....	6
G. Implementation Schedule .....	7
H. Cost, Disbursements and Financing .....	8
I. Project Ownership .....	12
IV. <u>OPERATING PERFORMANCE</u> .....	12
A. Commissioning and Start-Up .....	12
B. Build-up of Production .....	13
C. Market Growth .....	14
V. <u>FINANCIAL PERFORMANCE</u> .....	16
A. Financial Rate of Return .....	16
B. Financial Results .....	16
VI. <u>ECONOMIC PERFORMANCE</u> .....	17
A. Economic Rate of Return .....	17
B. Environmental Aspects .....	18
C. Foreign Exchange Saving .....	18
D. Transfer of Technology .....	18
VII. <u>BANK ROLE</u> .....	18
VIII. <u>CONCLUSIONS AND LESSONS LEARNED</u> .....	19

ANNEXES

1 -	Project Organization Chart .....	20
2 -	VALEFERTIL Industrial Complex Organization Chart .....	21
3 -	Bank-Financed Procurement of Supplies and Services by Country of Origin .....	22
4 -	Implementation Summary .....	23
5 -	Implementation Schedule .....	24
6 -	Project Cost Disbursement Schedule .....	25
7 -	FOSFERTIL Organization Chart.....	26
8 -	Operating Performance .....	27
9 -	Price Assumptions for Financial and Economic Analysis.....	28
10 -	Estimated Production Cost Summary and Output Value.....	29
11 -	Financial Rate of Return.....	30
12 -	Financial Statements.....	31
13 -	Economic Rate of Return.....	34

Industry Department

BRAZIL - VALEFERTIL FERTILIZER PROJECT (LOAN 1411-BR)

PROJECT COMPLETION REPORT

PREFACE

On April 19, 1977 the Bank approved a loan of US\$82.0 million equivalent to Fertilizantes Vale do Rio Grande S.A. (VALEFERTIL) to assist in the financing of the VALEFERTIL Fertilizer Project (Loan 1411-BR). The loan was guaranteed by the Government of Brazil. In January 1979, with the agreement of the Bank, the Project ownership was transferred to Fertilizantes Fosfatados S.A. (FOSFERTIL), an affiliate company of PETROFERTIL. As a consequence of the transfer, the repayment and all other obligations under the Loan Agreement were assumed by FOSFERTIL. At the borrower's request, a total of US\$27.0 million was cancelled as of March 1980, due to an increased share of equipment obtained by procurement limited to Brazilian suppliers.

Following successful project commissioning, IND Staff visited Brazil in August 1981 for the preparation of the Project Completion Report (PCR) and had discussions with the Government, PETROFERTIL and FOSFERTIL, the Project implementing agency. This report reflects the findings of the mission as well as a review of the project files and related documents.

Copies of the PCR were sent to the Borrowers, who had no comments. This project was not audited by the Operations Evaluation Department.

BRAZIL - VALEFERTIL FERTILIZER PROJECT (Loan 1411-BR)

PROJECT COMPLETION REPORT

KEY PROJECT DATA

<u>Item</u>	<u>Appraisal Expectation</u>	<u>Actual Estimate</u>	<u>Variation</u>
<u>Project Cost (US\$Million)</u>			
Installed Cost	244.4	248.0	+ 1%
Working Capital	33.0	42.1	+28%
Interest During Construction	<u>16.6</u>	<u>18.6</u>	+12%
Total Financing Required	294.0	308.6	+ 5%
Foreign Currency Cost	84.2	57.0	(-)32%
Local Currency Cost	209.8	251.6	+20%
<u>Financing (US\$Million)</u>			
Equity	118.0	148.2	+26%
Loans			
Local (BNDE/FINAME)	70.0	82.7	+18%
Foreign Loans <sup>a/</sup>	24.0	22.7	(-) 5%
IBRD	<u>82.0</u>	<u>55.0</u>	(-)33%
Total Financing	294.0	308.6	+ 5%
<u>IBRD Loan Amount (US\$Million)</u>			
Disbursed	82.0	55.0 <sup>b/</sup>	-33%
Cancelled	-	27.0	-
<u>Project Schedule</u>			
Closing Date	05/31/80	05/31/82	24 months
Project Completion	03/79	07/80	16 months
Startup of Operation	08/79	07/80	11 months
Full Production	1982	1983	-
Zero Date to Start-up	41 months	52 months	11 months

a/ Suppliers' credit and commercial banks.

b/ As estimated in March 1982 for project completion

<u>Item</u>	<u>Appraisal Expectation</u>	<u>Actual Estimate</u>	<u>Variation</u>
<b><u>Project Scope</u></b>			
Sulfuric Acid	2,600 tpd	2,600 tpd	-
Phosphoric Acid	940 tpd	940 tpd	-
Monoammonium Phosphate	330,000 tpy	330,000 tpy	-
Triple Superphosphate	340,000 tpy	340,000 tpy	-

**Rate of Return (%)**

Pretax Financial Rate of Return	14	18
Economic Rate of Return	22	17

**OTHER DATA**

	<u>Original Plan</u>	<u>Actual</u>
First mention in Files	06/76	06/76
Appraisal Mission	10/76	10/76
Negotiation	04/77	04/77
Board Approval	04/26/77	04/26/77
Loan Signature Date	04/29/77	04/29/77
Effectiveness Date	07/29/77	07/29/77
Closing Date	05/31/80	05/31/82
Borrower	Valefertil	Fosfertil
Executing Agency	Valefertil	Fosfertil
Fiscal Year of Borrower	01/01 to 12/31	01/01 to 12/31

**MISSION DATA**

<u>Item</u>	<u>Sent By</u>	<u>Mo/Yr</u>	<u>No. of Weeks</u>	<u>No. of Persons</u>	<u>Report Date</u>
Preappraisal	IPD	06/76	2	2	07/14/76
Preappraisal Follow-up	IPD	09/76	1	3	09/27/76
Appraisal	IPD	10/76	2	2	11/04/76
Supervision	IPD	05/77	2	2	05/26/77
Supervision	IPD	07/78	1	2	07/28/78
Supervision	IPD	11/79	1	2	12/07/79
Supervision	IPD	08/80	1	3	09/24/80
Completion	IPD	08/81	1	2	08/31/81

**CURRENCY EXCHANGE RATES**

Appraisal	April 1977	US\$1 = Cr\$ 11.40
Project Completion	July 1980	US\$1 = Cr\$ 53.20
Completion Report	June 1981	US\$1 = Cr\$ 91.40

BRAZIL - VALEFERTIL FERTILIZER PROJECT (LOAN 1411-BR)

PROJECT COMPLETION REPORT

HIGHLIGHTS

1. Brazil's agricultural policy aims to increase agricultural output by expanding the area under cultivation and using intensive agricultural practices supported by extension programs, increased fertilizer application, better credit availability and use of improved seeds. In this context the Government encouraged domestic production of fertilizers and to make increasing use of local phosphate deposits, thus ensuring a reliable supply of phosphate fertilizers less subject to wide price fluctuations of the international market (paras 1.01 - 1.04).

2. The Project comprises processing facilities near Uberaba (Minas Gerais) for the production of 330,000 tpy of monoammonium phosphate (MAP) and 340,000 tpy triple superphosphate (TSP)—built and operated by Fertilizantes Vale do Rio Grande (VALEFERTIL). The Project facilities were started-up in July 1980, 11 months behind the original schedule. Commissioning and start-up of the plant were carried out smoothly and units generally exceeded their rated capacity (paras 1.05 and 3.18).

3. Total Project cost at appraisal was estimated at US\$294.0 million. Although Project completion was delayed by 11 months actual cost was US\$308.6 million - only about 5% above target, since the project sponsor was able to offset most of the cost increases (e.g. site development, Project implementation) through substantially lower cost for delivered equipment and supplies. Of the total Bank loan of US\$82.0 million, only US\$55.0 million were utilized. This was mainly the result of an increase in local procurement of equipment and supplies (70%). The large share of local supplies could have led to a delay in start-up (equipment failures/inadequacies during testing and commissioning) if the project completion was not delayed for other reasons. The performance of the borrower's project management was generally satisfactory. Services provided by consultants largely met the expectations (paras 3.07 - 3.24).

4. In the wake of the Brazilian recession, market constraints limited capacity utilization to 59% and 68% during the two initial operating years. Subsequently, however, operating level rose close to rated capacity (para 4.07).

5. The financial rate of return (FRR) for the Project is now estimated at 23% compared to the appraisal estimate of 14%. The increase in FRR is mainly due to a lower transfer price of rock phosphate. The economic rate of return is now estimated at 17% against 22% at the time of appraisal. The decline is mainly due to variations in the price assumptions for inputs and products between the time of appraisal and now.



The net annual foreign exchange savings from the Project are estimated to be about US\$142 million. In addition, the Project has resulted in substantial technology transfer to Brazilian firms (paras 5.01 - 6.05).

6. The Bank worked closely with VALEFERTIL in formulating and implementing the project financing arrangement which included in addition to the Bank financing, the use of suppliers' credit and commercial bank financing to fund the project foreign exchange requirements. At the suggestion of the Bank, VALEFERTIL used consultant assistance in developing the corporate and works financial systems and in implementing and operating the project. The VALEFERTIL project is a good example of a project in which dedicated work by the project management aided by the Bank support has resulted in a successful project meeting its economic objectives (paras 7.01 - 8.04).

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

(LOAN 1411-BR)

I. INTRODUCTION

1.01 Brazil's agricultural policy aims to increase agricultural output to make Brazil one of the world's foremost producers and exporters of agricultural commodities. Brazil plans to achieve this objective both by expanding the area under cultivation and with increased productivity of the existing areas by using intensive agricultural practices supported by extension programs, increased fertilizer application, better credit availability and use of improved seeds. As part of the above agricultural policy, Brazil has embarked on several fertilizer projects to increase domestic availability of fertilizers. The Bank has participated in three large fertilizer projects in Brazil—the Valefertil fertilizer project near Uberaba (Minas Gerais); the Ammonia-Urea complex in Sergipe (Salvador) and the fuel oil based ammonia-urea project near Araucaria (Parana).

1.02 While the level of fertilizer application showed little growth till 1966, agricultural programs adopted in the mid-sixties stimulated rapid growth averaging 35% annually through 1972. The consumption increase was only modest during 1973 to 1975 due to sharp increase in international prices. Fertilizer nutrient consumption increased on the average annually by about 16 percent during 1975 to 1980. The 1981 estimated fertilizer consumption was about 26% below the previous year's level due to (i) changes in agricultural credit policy (reduced credit availability and higher interest rates), (ii) high opening inventory of fertilizers with the farmers and the retailers, (iii) substantial fertilizer price increases averaging over 96% per annum while prices of major crops such as coffee, soybeans, wheat and maize did not increase to the same level and (iv) effect of unusually cold winter season. In 1982, fertilizer consumption is expected to increase though not fully to the level in 1980. However, as a result of the new agricultural credit policy the domestic consumption of fertilizer nutrients is expected to increase at a somewhat lower rate than earlier estimated.

1.03 Unlike in the other developing countries, phosphate is the dominant nutrient in Brazil's agricultural sector, due to the particular suitability of phosphates to its soil, cropping and agricultural practices. Brazil's annual phosphate consumption of about 1.7 million tons of  $P_2O_5$  in 1979 places it as the world's fifth largest phosphate consuming country - next only to the USSR, the USA, France and China. The phosphate to nitrogen ratio in Brazil has increased from 1.51 in 1970 to 2.20 in 1980 - significantly higher than the world average ratio of 0.6. Brazil's annual phosphate consumption has increased from 0.42 million tons of  $P_2O_5$  in 1970 to 1.95 million tons in 1980 - an annual average growth rate of 16.8%.

1.04 In the initial years of the decade, Brazil's phosphate requirements were mostly met by imports of rock phosphate, phosphoric acid and phosphate fertilizers. With increasing phosphate consumption and rising rock phosphate prices, Brazil has in recent years increased domestic

production and processing of rock phosphate. As a result, the share of domestic rock supply has increased from about 40% of total consumption in 1970 to about 80% in 1980. Even though several large phosphate deposits have been located in Brazil, the rocks are generally of low grade and relatively expensive to beneficiate. However, the sharp increases in world rock prices in the mid-1970s, Brazil's large and increasing consumption of phosphate fertilizers and the impact of substantial imports on Brazil's trade balance have made it economical for Brazil to develop acceptable technologies to beneficiate the available low grade rocks. As a result, rock phosphate production in Brazil has increased from about 55,000 tons of  $P_2O_5$  in 1970 to about 930,000 tons of  $P_2O_5$  in 1980. Major rock phosphate production centers are Jacupiranga, Araxa, Tapira, Onvidor and Patos de Minas. Brazil's rock phosphate production is expected to increase to about 1.60 million tons of  $P_2P_5$  by 1985.

1.05 The VALEFERTIL Fertilizer Project is part of Government of Brazil's recent efforts to maximize domestic phosphatic fertilizer production by processing rock phosphate mined and beneficiated in Brazil. The total program, of which The Project formed the major component, was promoted and implemented by Companhia Vale do Rio Doce (CVRD) and included the following components: (i) rock phosphate mining and beneficiation facilities at Tapira (Minas Gerais) with annual capacity of about one million tons—built and operated by Mineracao Vale do Paranaiba (VALEP); (ii) a 118 km long rock phosphate slurry pipeline from Tapira beneficiation facilities to the Uberaba plant site with capacity of 2 million tpy of rock phosphate; and (iii) processing facilities near Uberaba (Minas Gerais) for the production of 330,000 tpy of monoammonium phosphate (MAP) and 340,000 tpy triple superphosphate (TSP)—built and operated by Fertilizantes Vale do Rio Grande (VALEFERTIL). The products are marketed to other fertilizer manufacturers for the production of various fertilizer grades. All three components have been successfully implemented and commissioned.

## II. PROJECT BACKGROUND

### A. Project Preparation, Appraisal, Approval and Credit Effectiveness

2.01 The project was prepared by VALEFERTIL formed by CVRD in March 1976 as a fully owned subsidiary. The major objective of the project was to process into MAP and TSP rock phosphate mined and beneficiated by VALEP—another CVRD subsidiary, at Tapira. Following a request from VALEFERTIL for Bank participation in financing the Project, a Bank preappraisal mission visited Brazil in July 1976.

2.02 The preappraisal mission generally agreed with the project configuration proposed by Valefertil. The preappraisal mission however, noted (a) the difficult mining conditions and urged caution and use of expert consultants in the selection of mining equipment; (b) the high factors of safety used in sizing the beneficiation facilities and pointed out that improved economies would be possible with better optimization based on more extensive beneficiation studies; and (c) the project depended on rock phosphate supply through a slurry pipeline which, though engineered with caution, introduced risks. Since neither CVRD nor Valefertil had previous experience in phosphatic fertilizers, Valefertil was urged to

engage a technical consultant group for assistance. The mission reviewed with Valefertl further possibilities of optimizing plant capacities. However, since the VALEP rock phosphate will be used for the first time for phosphoric acid production, attempts to improve project economics by a further increase in phosphoric acid plant capacity was not considered desirable. Consequently, VALEP adopted appropriate mining methods and equipment selected in consultation with local and Canadian consultants and also carried out further continuous beneficiation studies to optimize the facilities.

2.03 The appraisal mission visited Brazil in October 1976. Following discussion on the achievable stream efficiency of the phosphoric acid plant especially when using a new rock phosphate the daily capacity of the facility was increased from 900 tpd to 940 tpd. It was also agreed that the phosphoric acid plant will be engineered suitably so that any shortfall in VALEP rock phosphate can be made up with imported rock phosphate.

2.04 The Board approved on April 26, 1977 an IBRD loan to Valefertl of US\$82.0 million for a period of 15 years including 3 years of grace with interest at 8.2% per annum and a guarantee fee of 1.8% per annum to the Government of Brazil.

**B. Project Description and Objectives**

2.05 Valefertl project was planned for the production of 330,000 tpy of MAP and 340,000 tpy of TSP for sale to other fertilizer manufacturers for the production of NPK fertilizers. The project supplements Brazil's phosphatic fertilizer production capacity based on locally occurring rock phosphate. The project includes the following main facilities:

- |                                 |         |                |
|---------------------------------|---------|----------------|
| 1. Sulfuric acid plant          | 2 lines | 1,300 tpd each |
| 2. Phosphoric acid plant        | 2 lines | 470 tpd each   |
| 3. MAP plant                    |         | 1,000 tpd      |
| 4. TSP plant                    |         | 1,100 tpd      |
| 5. Necessary storage facilities |         |                |
| 6. Captive power generation     | - 11 MW |                |

2.06 The main raw materials used in the project are (a) 986,000 tpy of rock phosphate supplied from the VALEP facilities at Tapira through the slurry pipeline, (b) 277,000 tpy of imported sulfur moved by rail cars to the plant site, and (c) 45,500 tpy of ammonia either imported or obtained from one of Brazil's new ammonia plants and transported by ammonia tank cars. Necessary contracting and procurement arrangements for the above are effective.

III. PROJECT IMPLEMENTATION AND MANAGEMENT

A. Achievement of Project Objectives

3.01 The VALEFERTIL project was completed and commissioned in July 1980—about 11 months behind schedule. Even though the project mechanical completion was delayed by 16 months, VALEFERTIL was able to overlap construction and commissioning to reduce the delay by about five months. By December 1981, the facilities had been in operation for 18 months. During the first year of operations and in 1981 the production achieved were as follows:

	<u>First Year</u>		<u>1981</u>	
	<u>Production</u>	<u>Capacity Utilization</u>	<u>Production</u>	<u>Capacity Utilization</u>
Sulfuric acid	537,253 tons	65	585,873 tons	70
Phosphoric acid	186,470 tons	64	209,508 tons	72
MAP	203,261 tons	62	164,190 tons	50
TSP	97,007 tons	29	147,875 tons	43

While the performance of the sulfuric and phosphoric acid plants were better than expected during the first year of operation, the performance of the MAP and TSP plants was less impressive due to several factors. These two plants faced more than normal difficulties during the initial testing and commissioning facilities and had to undergo substantial modifications. In addition, tightening of agricultural credit availability and increased interest rates for farm loans in 1981 resulted in a sharp fall in the sale of MAP and TSP. Faced with excessive MAP and TSP inventory, VALEFERTIL marketed substantial quantities of phosphoric acid. All the process plants and utility facilities have been operated for sustained period at or over their design capacities and the project is capable of reaching and maintaining the planned output levels once the fertilizer market conditions get stabilized. But for the unforeseen market constraints the production achieved could have been significantly higher. Even with these constraints, capacity utilization rates during the first 18 months have been better than assumed during appraisal (para 4.06).

B. Project Scope

3.02 There has been no significant deviation in project scope in regard to the main process units. The scope changes carried out during project implementation were mainly in the areas of offsites and infrastructure. The changes adopted include (i) increase in captive power generation from 7 MW to 11 MW, (ii) deletion of steam condenser in sulfuric acid plant with decision to use the phosphoric acid evaporator for same service, (iii) increase in finished product storage capacity by 50%, (iv) gypsum disposal lagoon capacity reduced for the present to meet the need for five years instead of ten years, (v) additional lagoon with spray system for contaminated water, and (vi) deletion of rock phosphate dryer now located as part of VALEP facilities. The changes in project scope did not significantly affect the project costs, economics and implementation schedule.

C. Project Management

3.03 The project implementation responsibility was initially entrusted to a consortium US and Brazilian companies. VALEFERTIL provided the overall project management from its corporate offices in Belo Horizonte and through technical managers located in the local office of the Brazilian firm in the consortium. VALEFERTIL obtained the process licenses and basic engineering from well known process licensors. The responsibility for detailed engineering, procurement, construction management, project scheduling and cost control rested with the consortium.

3.04 The above arrangement underwent change in December 1977 (Annex 1) when the consortium responsibility was significantly reduced and limited to inspection and expediting outside Brazil and detailed engineering. Rest of the procurement activity was shifted to Belo Horizonte and carried out by a group reporting to the Operations Director. Work at the project site became the responsibility of the Implementation Director. His area of responsibility included project engineering, construction management and project planning. Even though the change in implementation arrangements in the course of the project resulted in completion delays, the new groups carried out their responsibilities professionally and efficiently leading to successful completion of the project. Simultaneously, an industrial group, reporting to the Operations Director, was formed with responsibility to take over the facilities from the construction group at the appropriate time and commission them. This group was also responsible for hiring and training the technical personnel required for the facilities. The industrial group performed well especially during testing and commissioning when the group showed initiative in identifying and implementing the required plant modifications.

D. Employment and Training

3.05 The project manpower requirement was estimated at the time of appraisal, as 450 people mostly skilled and semi-skilled technicians. At present, the project employs 1,022 people consisting of administrative 257, production 388, maintenance 286, technical 76 and others 36 (Annex 2). The large number of administrative people has been the result of the organizational restructuring when VALEFERTIL was merged with Fosfertil. As a result, the VALEFERTIL administrative personnel got shifted to the project site. The present employment is substantially higher than was estimated at the time of appraisal but is still not considered excessive for a complex handling large tonnages of solids.

3.06 VALEFERTIL developed and implemented an effective training program in consultation with its consultants and in cooperation with its process licensors. The operation and maintenance staff proved to be adequately competent in commissioning and operating the facilities without major difficulties.

E. Use and Performance of Engineering Contractors and Consultants

3.07 The consortium performed the responsibilities of the general contractor. Their overall performance was technically adequate and satisfactory. The VALEFERTIL decision in December 1977 to take over the construction management responsibility was due to the availability of a group within CVRD for the above purpose and did not reflect any inadequacies on the part of the consortium.

3.08 VALEFERTIL was satisfied with the services provided by the licensors for the sulfuric acid plant and for the phosphoric acid plant. The cooperation extended by both the consultants was adequate to carry out the detailed engineering and for the Brazilian equipment manufacturers to participate in equipment supplies. The technology and basic designs for the MAP and TSP plants were provided by a third firm, (USA). These two plants contain several solid handling equipment for which detailed designs are normally provided by equipment manufacturers. Several of them were ordered on Brazilian manufacturers who did not have inhouse design capabilities and could not obtain adequate assistance. As a result, the two plants needed substantial modifications during commissioning resulting in loss of production.

3.09 External technical assistance was provided to VALEFERTIL during implementation and commissioning. The specialists were competent and were useful to the project. VALEFERTIL received satisfactory assistance in developing the corporate and works financial systems.

F. Procurement and Performance of Suppliers

3.10 It was anticipated during project appraisal that, of the estimated total cost of equipment and supplies of US\$103 million, 40% of the items would be procured by bidding reserved for Brazilian suppliers, 4% under suppliers' credit/commercial financing and 56% following Bank's procurement guidelines and using the Bank loan. The actual cost of equipment was US\$79 million—23% lower than the appraisal estimates, mainly due to the more favorable prices obtained by VALEFERTIL and the effect of variation between the domestic inflation rates and cruzeiro to dollar exchange rates on domestic equipment prices, expressed in US dollars. The actual share of Bank financed equipment and supplies was only 44% against the appraisal estimate of 56%. Only about 52% of the Bank financed items were procured from suppliers outside Brazil (Annex 3). As a result, about 70% of the project equipment and supplies were procured from Brazilian suppliers. While the large share of local supplies did not significantly delay project completion, it could have if project completion was not delayed by 11 months for other reasons. Difficulties encountered by the local manufacturers in fabricating some of the equipment for the first time were reflected as equipment failures/inadequacies faced by VALEFERTIL during testing and commissioning—especially in the MAP and TSP plants.

3.11 The larger than expected share of local supplies was mainly due to pressures on VALEFERTIL by domestic manufacturers, their associations and Brazilian import regulating agencies. While similar pressures on other

Bank financed fertilizer projects in Brazil resulted in procurement delays, the VALEFERTIL management handled the procurement problems with skill ensuring minimum adverse impact on project completion. While several equipment problems were encountered during commissioning and initial operation, generally there were no major problems in obtaining equipment suppliers' cooperation and assistance in carrying out the required modifications.

#### G. Implementation Schedule

3.12 The mechanical completion and commissioning dates of the various facilities are listed in Annex 4. The project was mechanically completed and commissioned in July 1980, about 11 months behind the appraisal schedule (Annex 5). The above delay was mainly due to the following factors: (i) delay in start of civil works, (ii) change in implementation arrangements decided on in December 1977, (iii) change in VALEFERTIL senior management when FOSFERTIL took over VALEFERTIL, and (iv) delays due to failure of phosphoric acid plant rubber-lining, late availability of sulfuric acid plant converter internals and damage in transit of acid resistant bricks. Even though the start of project activities was delayed, the timing of Bank's involvement in the project was appropriate since it facilitated better definition of project scope and formulation of appropriate implementation arrangements.

3.13 The decision of the Government of Brazil in January 1979 to transfer the ownership of VALEFERTIL from CVRD to FOSFERTIL resulted in a change in senior management. The VALEFERTIL President, Finance Director and Operations Director left the company. Since they formed the core decision making authority for the project, their departure delayed the progress of the project. In addition, problems with obtaining adequate quality rubber-lining in the phosphoric acid plant, the re-ordering of sulfuric acid plant converter internals due to inadequate quality of initial supplies and the damage to acid resistant bricks in transit delayed project completion.

3.14 Another major factor which might have delayed the project was the long time normally taken to obtain import clearances from the Brazilian authorities. The Valefertil, however, handled these clearances at senior management levels and ensured that there were no undue delays in obtaining clearances.

3.15 Sulfuric Acid Plant - The two lines of the sulfuric acid plant were mechanically completed in March and July 1980 respectively and commissioned in April and July 1980 respectively. Both the plants have fulfilled performance guarantee tests and have reached maximum daily production of 1,400 tpd and sulfur conversion and recovery efficiency of over 99.5%. At present, the only factor limiting production has been the difficulties faced with the main air blower turbines. The turbines are being modified to improve performance.

3.16 Phosphoric Acid Plant - The two lines of the phosphoric acid plant were mechanically completed and commissioned in April and June 1980, respectively. Both plants have completed satisfactorily the performance guarantee tests in August and October 1980, respectively. Both lines have



reached over 130% of their daily capacity and have attained P<sub>2</sub>O<sub>5</sub> recovery efficiencies exceeding 90%. Except for somewhat higher than the design reactor temperature and lower fluorine recovery the plants are performing satisfactorily. Necessary modifications to remedy the above are being implemented.

3.17 MAP and TSP Plants - These plants were mechanically completed and commissioned in May/June 1980. The performance tests carried out in March 1981 for granular MAP and in April 1981 for Run of Pile (ROP) TSP did not meet the guarantees. VALEFERTIL, thereafter, decided to take over direct responsibility for these plants. All the required modifications—mainly due to the large share of domestic equipment used in the plants and the inadequacy of the specifications for their manufacture in Brazil, have been carried out. VALEFERTIL has been able to reach 115% of the rated daily powdered MAP capacity and 127% of the rated daily granulated MAP capacity. The maximum ROP TSP and granulated TSP capacities reached are 108% and 109% respectively. VALEFERTIL has not however, been able to achieve the desired stream days of production due to equipment failures and more recently due to market constraints. The VALEFERTIL operating personnel have exhibited considerable initiative in identifying and carrying out substantial plant modifications to improve plant performance.

3.18 Overall, the project was mechanically completed in July 1979—16 months behind the appraisal schedule. However, by overlapping of testing and commissioning with the final stages of the construction activities VALEFERTIL was able to commission the facilities by July 1980—only about 11 months behind schedule, thus reducing the project completion delay by five months. For a grass-root project which faced initial delays in obtaining the project site and underwent major changes in implementation arrangements in the early stages of construction the performance of VALEFERTIL and its consultants was creditable. VALEFERTIL project management and progress reporting systems were professionally organized and performed well. The VALEFERTIL operating team - though overstaffed especially when compared with appraisal estimates, was built up and trained well in time. The team also utilized to best advantage the consultant personnel and their specific capabilities. As a result, the testing and commissioning proceeded smoothly and resulted in a successfully completed project.

#### H. Cost, Disbursements and Financing

3.19 A table summarizing the capital cost estimates at the time of project appraisal and the actual costs is presented below.

Summary of Project Costs  
(US\$millions)

	<u>Appraisal Estimates</u>			<u>Actual</u>			<u>% Change</u>
	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	<u>Local</u>	<u>Foreign</u>	<u>Total</u>	
Equipment/Materials (FOB)	55.8	47.2	103.0	55.2	23.8	79.0	(-) 23
Freight, Insurance and Taxes	15.1	4.8	19.9	5.9	1.2	7.1	(-) 64
Civil Works	28.3	-	28.3	32.2	-	32.2	+ 14
Erection	36.6	-	36.6	35.4	-	35.4	(-) 3
Land & Site Improvements	9.0	-	9.0	22.9	-	22.9	+ 154
Engineering & Other Services	17.0	10.8	27.8	39.6	8.8	48.4	+ 77
Preoperating Expenses Testing & Commissioning	14.5	-	14.5)	23.0		23.0	+ 16
	<u>2.1</u>	<u>3.2</u>	<u>5.3)</u>				
Subtotal	178.4	66.0	244.4	214.2	33.8	248.0	+ 2
Working Capital	26.4	6.6	33.0	34.0	8.1	42.1	+ 28
Interest During Construction	<u>4.9</u>	<u>11.7</u>	<u>16.6</u>	<u>3.4</u>	<u>15.1</u>	<u>18.5</u>	<u>+ 11</u>
	<u>209.7</u>	<u>84.3</u>	<u>294.0</u>	<u>251.6</u>	<u>57.0</u>	<u>308.6</u>	<u>+ 5</u>

3.20 In spite of the eleven months delay in commissioning, the project cost has increased only by 5% in current US dollars. In fact expressed in constant 1981 dollars the actual project cost is US\$332 million against appraisal estimate of US\$376 million. The reduction of project cost in real terms is due to the substantially lower cost of equipment and supplies delivered at the project site. The reduction of about US\$36.8 million (in current terms) in delivered cost of equipment and supplies was mainly due to the better prices at which supplies could be obtained, waiver of import duty and the impact of variation between domestic inflation and cruzeiro exchange rates. On the other hand, there were substantially increases in the cost of engineering and project management services amounting to US\$20.6 million mainly due to the change in project implementation arrangements and project completion delays. The following table summarizes the variations in project cost by different causes.

Cost Variation by Causes

	<u>Amount</u> <u>(US\$million)</u>	<u>%</u>
<u>Reduction</u> in Delivered Cost of Equipment and Supplies	(36.8)	(252)
<u>Increase</u> in Construction Costs	2.7	18
Site Development	13.9	95
Project Implementation	20.6	141
Working Capital	9.1	62
Others	<u>5.1</u>	<u>36</u>
Total	<u>14.6</u>	<u>100</u>

3.21 Of the total Bank loan allocated to the project of US\$82 million, the actual utilization was only US\$55 million. At the request of VALEFERTIL, US\$27 million of the loan was cancelled. The category wise allocation at the time of project appraisal and the actual utilization are summarized below:

	<u>Appraisal</u> <u>Estimate</u>	<u>Actual</u> <u>Utilization</u>
Equipment and Materials)		
Freight and Insurance )	62.3	38.2
Engineering Services	10.7	8.8
Interest During Construction	<u>9.0</u>	<u>8.0</u>
Total	<u>82.0</u>	<u>55.0</u>

3.22 The main factor responsible for the reduced utilization of the Bank loan was the lower cost of equipment and supplies and the increase in share of equipment procured with bidding limited to Brazilian suppliers. These factors alone were responsible for about 90% of the cancelled loan of US\$27.0 million. When VALEFERTIL took over construction management, the responsibility of the external firm and its share in construction management cost was substantially reduced. Since Bank financing covered only the foreign exchange cost of engineering services, less of the allocation for engineering services was actually utilized.

3.23 The disbursement pattern for the Bank loan as estimated at the time of appraisal and the actual pattern are summarized below:

	<u>Bank Loan Disbursement</u>					
	<u>(US\$ millions)</u>					
	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
Appraisal estimate	25.0	48.0	9.0	-	-	-
Actual	5.0	17.7	20.3	8.0	2.0	2.0

The disbursement pattern estimated at the time of appraisal has proved to be optimistic due to several reasons. The loan utilization was only 67% of the original loan amount of US\$82 million. There was considerable delay in the availability of the project site and the start up of project construction. Difficulties with equipment during commissioning, especially of the MAP and TSP plants, delayed final payments to some of the equipment suppliers and required procurement of replacement items during 1981. US\$53.04 million of the loan has been disbursed by the end of December 1981. The loan will be fully disbursed by May 1982. The project disbursement schedule is given in Annex 6.

3.24 The total project cost of US\$308.6 million has been financed with equity provided through FOSFERTIL of US\$148.2 million and borrowings—local of US\$82.7 million and foreign of US\$77.7 million. Details of the project financing plan proposed at the time of appraisal and actually realized are summarized below:

	<u>Project Financing Plan</u>				
	<u>(US\$ million)</u>				
	<u>US\$ millions</u>			<u>Percentage</u>	
	<u>Appraisal</u>	<u>Actual</u>	<u>Difference</u>	<u>Appraisal</u>	<u>Actual</u>
<u>Equity</u>					
Petrofertil, FIBASE, CURD, CAMIG	118.0	148.2	30.2	40	48
<u>Loans</u>					
World Bank	82.0	55.0	(27.0)	28	18
Foreign Loans <sup>a/</sup>	24.0	22.7	( 1.3)	8	7
BNDE	48.0	64.2	16.2	16	21
FINAME	22.0	6.9	(15.1)	8	2
BDMG	-	11.6	11.6	-	4
	-----	-----	-----	-----	-----
Sub Total Loans	<u>176.0</u>	<u>160.4</u>	<u>(15.6)</u>	<u>60</u>	<u>52</u>
Total Financing	<u>294.0</u>	<u>308.6</u>	<u>14.6</u>	<u>100</u>	<u>100</u>

<sup>a/</sup> Suppliers' credit and commercial banks.

The shortfall in borrowings of US\$15.6 million and the project cost overrun of US\$14.6 million have been financed by additional equity of US\$30.2 million. Foreign loans including the World Bank loan form only 25% of the project financing against 36% estimated during project appraisal. The reduction is due to two factors: (i) the share of equipment obtained by procurement limited to Brazilian suppliers has increased and (ii) the project cost overruns have been mainly in local costs of engineering services and site improvements. The final debt/equity ratio of 52:48 is more favorable compared to 60:40 stipulated at the time of appraisal.

#### I. Project Ownership

3.25 At the time of project appraisal Companhia Vale do Rio Doce (CVRD)—a public sector company primarily engaged in the mining and exports of iron ore, was the sole shareholder in both VALEP—the sponsor of the phosphate mining and beneficiation project, and VALEFERTIL—the promoter of the phosphate fertilizer project. Common ownership and cross membership in the administrative councils gave assurance for close coordination between both companies' operations. Such coordination was vital to the success of the two highly interdependent projects executed and operated by two separate corporate entities.

3.26 In January 1979, the Government of Brazil—with the approval of the Bank, transferred the ownership of VALEFERTIL from CVRD to FOSFERTIL, an affiliate company of PETROFERTIL. With the above action, the Government brought all public sector fertilizer production units under the overall coordination of PETROFERTIL. Even though there were resulting changes in the senior management of VALEFERTIL, the construction and operation of the project facilities, while suffering some delays, did not face any other serious difficulties.

3.27 FOSFERTIL had been formed in February, 1977 with responsibility for the production of phosphate materials and was entrusted with the development and operation of the Patos de Minas deposits in August 1977. Following the transfer of VALEFERTIL to FOSFERTIL, the Government of Brazil decided in July 1980 to transfer VALEP from CVRD to FOSFERTIL (Annex 7). The share holding of FOSFERTIL was restructured in December 1980 with the following ownerships: PETROFERTIL (32.6%), FIBASE/BNDE (32.6%, CVRD (34.2%) and CAMIG (0.6%). The above changes in corporate structure have once again brought the VALEP and VALEFERTIL operations under a single company retaining PETROFERTIL's overall coordinating role in the Government-owned fertilizer sector (Annex 1). VALEP and VALEFERTIL are operated and managed as separate profit centers, thus retaining the operating efficiencies of the individual units.

#### IV. OPERATING PERFORMANCE

##### A. Commissioning and Start-up

4.01 As mentioned earlier, the project facilities were mechanically completed in July 1980—about 16 months behind schedule, but the project could recover about five months of the delay by overlapping the final

stages of construction with testing and commissioning. This was possible due to the earlier completion of the utility facilities - water supply and steam generation facility by January 1980 and one line each of the process acid plants by March/April 1980. The commissioning of the plants went smoothly and the production levels achieved (Annex 8) in the first month of operation were sulfuric acid 75% in first line, phosphoric acid 62% in first line and MAP 60%. The TSP plant reached about 36% production only in the fourth month of operation. While the acid plants could increase production soon after the start-up, the MAP and TSP plants underwent substantial modifications before reasonable production levels could be reached.

4.02 During the first year of operation, the sulfuric acid plants produced a total of 537,000 tons of acid which corresponds to about 65% of the annual capacity. Except for some modifications to the air blower turbine, the plants have been stabilized and were capable of achieving and maintaining the rated capacity. Finished product manufacture and marketing were the major constraints.

4.03 The phosphoric acid production during the first year of operation was 186,000 tons of  $P_2O_5$ —corresponding to 64% of the annual rated capacity. All production constraints encountered during initial operation have been resolved and plants can achieve and maintain the rated capacity. Production and sale of MAP and TSP were the major constraints.

4.04 The first year production of MAP—both powder and granular—was about 203,000 tons, corresponding to about 62% of the annual rated capacity. The plant has faced process and equipment problems, several of which have been rectified. Marketing of MAP became a limitation by the latter half of the year and excessive inventory forced production cutback.

4.05 The first year TSP production totalled about 97,000 tons corresponding to only 29% of the annual rated capacity. Even though the plant has reached its daily rated capacity it has not been possible to maintain high production levels due to equipment problems. Several modifications have been carried out but the marketing constraints have not permitted trying out the plant at high capacities.

4.06 The overall performance of the complex—expressed in nutrient terms, was 64% in the first year. This was better than the 50% production level in first year used in appraisal and generally achieved in such plants elsewhere.

#### B. Build-up of Production

4.07 Against about 215,000 tons of  $P_2O_5$  produced and marketed as MAP, TSP and phosphoric acid in 1981, VALEFERTIL plans to produce and market about 289,000 tons in 1982. The continuing market constraints in 1982 is expected to require VALEFERTIL to market about 120,000 tons of  $P_2O_5$  as phosphoric acid. The production levels achieved in 1981 and expected in 1982 of the various products and their rated capacities are summarized below.

<u>Product</u>	<u>Annual Rated Capacity</u>	<u>Production 1981</u>	<u>Capacity Utilization %</u>	<u>Expected 1982</u>	<u>Capacity Utilization %</u>
Sulfuric acid	832,000	585,873	70	750,000	90
Phosphoric acid	291,400	209,508	72	276,000	95
MAP	330,000	164,190	50	175,700	53
TSP	340,200	147,875	43	157,300	46
Total P <sub>2</sub> O <sub>5</sub>	331,400	224,800	68	289,000	87

The marketed products of 194,000 tons of P<sub>2</sub>O<sub>5</sub> in the first year of operation and about 215 thousand tons in 1981 form 59% and 68% respectively of the annual rated capacity. The 1982 expected P<sub>2</sub>O<sub>5</sub> production is 289,000 tons of P<sub>2</sub>O<sub>5</sub> forming about 87% of the rated capacity. The production achieved so far and planned for 1982 is substantially better than the performance assumed in the appraisal of the project and normally achieved in such plants in initial years.

### C. Market Growth

4.08 The apparent plant nutrient consumption in Brazil increased from 2.527 million tons in 1976 to 4.274 million tons in 1980. The actual increase of 1.747 million tons is 46% higher than the increase of 1.194 million tons estimated at the time of appraisal. The higher growth rate achieved was the result of various government measures aimed at promoting fertilizer application in the agricultural sector. The historical and projected fertilizer demands estimated at the time of appraisal and now are summarized below.

#### Historical and Projected Fertilizer Demand in Brazil

<u>Year</u>	<u>Appraisal Estimate</u>				<u>(in '000 nutrient tons)</u> <u>Present Estimate</u>			
	<u>N</u>	<u>P<sub>2</sub>O<sub>5</sub></u>	<u>K<sub>2</sub>O</u>	<u>Total</u>	<u>N</u>	<u>P<sub>2</sub>O<sub>5</sub></u>	<u>K<sub>2</sub>O</u>	<u>Total</u>
1972	412	875	460	1,747	412	875	460	1,747
1974	389	914	521	1,824	389	914	521	1,824
1976	488	1,145	653	2,286	498	1,308	721	2,527
1978	620	1,380	*	*	707	1,442	989	3,138
1980	800	1,680	1,000	3,480	951	2,059	1,264	4,274
1981	*	*	*	*	700	1,450	860	3,010
1982	1,000	1,990	1,200	4,190	884	1,780	1,175	3,839
1985	1,400	2,580	1,700	5,680	1,130	2,230	1,340	4,700

\* Not estimated

4.09 Between 1976-80, the actual fertilizer consumptions was consistently much higher than appraisal estimates. However, as a result of severe economic difficulties faced by Brazil since 1980, the Government has taken unusual measures to control inflation which has adversely affected economic growth. These economic measures and poor weather have also hurt the agricultural sector and as a result 1981 apparent fertilizer consumption is about 30% below the 1980 consumption. Four specific developments are mainly responsible for this drop: (a) as part of its anti-inflationary measures the Government of Brazil has tightened its agricultural credit policy; (b) credit availability to the farmers has been reduced and the interest rate has been increased from zero to 45% in current terms—the newly introduced interest on farm credit encouraged the farmers and retailers to liquidate their inventory which stood at over 2 million tons by the end of 1981; (c) the fertilizer product prices were also deregulated in February 1981, resulting in an average fertilizer price increase of about 96% while the price increases of major agricultural crops like coffee, soya beans, wheat and maize were far lower affecting adversely the benefit/cost ratio of fertilizer application; and (d) the adverse unusually cold and dry winter also affected fertilizer application. Fertilizer consumption should improve during 1982 when the inventory at the farmer and retailer level is depleted, the weather is normal and particularly if the benefit/cost ratios to the farmer improve. FOSFERTIL, expects that the 1982 consumption may still be about 10% below the 1980 consumption.

4.10 The historical and projected domestic production of fertilizers during 1972 to 1980 are summarized below.

Historical and Projected Fertilizer Production in Brazil

Year	Appraisal Estimate		(in '000 tons nutrient) Present Estimate	
	N	P <sub>2</sub> O <sub>5</sub>	N	P <sub>2</sub> O <sub>5</sub>
1972	89	289	89	289
1974	150	387	150	387
1976	160	786	200	875
1978	290	1,097	273	1,110
1980	570	1,555	383	1,717
1982	960	1,827	650	1,870
1985	980	2,026	900	2,230

While the 1980 phosphate fertilizer production exceeded appraisal estimates partly due to the better than expected VALEFERTIL performance, the nitrogen production was lower mainly due to delays in completion of the Araucaria project. By 1985, domestic fertilizer industry will meet Brazil's total phosphatic fertilizer requirement. While the 1985 nitrogen production will be short of expected consumption by about 20%, Brazil could have temporary surplus urea in the earlier years if the Araucaria and Sergipe plants go smoothly into production and if nitrogen consumption, which fell by about 26% in 1981, does not rise rapid enough in the next few years.



V. FINANCIAL PERFORMANCE

A. Financial Rate of Return

5.01 The financial rate of return has been calculated at the 1981 input prices under prevailing contracts with the suppliers (Annex 9). The rock phosphate contract transfer price from VALEP is US\$40 per ton. The costs of imported raw materials—sulfur and ammonia—are based on projected<sup>1/</sup> 1990 import prices adjusted for transport cost to Uberaba. In view of the product price deregulation (para 4.09), the product prices are based on 1990 projected international prices (in 1981 constant dollars) adjusted for transportation differential to the fertilizer market. This assumption will also ensure a more realistic project analysis by providing an appropriate adjustment from the depressed international and local product prices now prevailing. The annual cost of production and sales realization with the facilities operating at 90% are given in Annex 10. Based on these assumptions, the project financial rate of return (FRR) is 23% before taxes (Annex 11)—9% higher than the appraisal estimate of 14% in spite of 11 months delay mainly due to the low transfer price of rock phosphate. If the present rock phosphate price is increased to the equivalent landed cost of imported rock, the FRR comes down to 16%—still about 2% better than the appraisal estimate in spite of the project delay due to the lower capital cost (in constant terms) and better production performance during the first eighteen months.

B. Financial Results

5.02 As was mentioned earlier (para 3.24), the ownership of VALEFERTIL was transferred to FOSFERTIL in January 1979. The past financial data for VALEFERTIL for 1980 and for FOSFERTIL for 1980 and 1981 are presented below. Income Statements and Balance Sheets from 1976 onwards are presented in Annex 12.

Selected Financial Data  
(in Cr\$ millions)

	<u>VALEFERTIL</u>		<u>FOSFERTIL</u>	
	<u>1980</u>		<u>1980</u>	<u>1981</u>
Net Sales	2,258		5,508	20,264
Net Income	(77)		(17)	2,514
Depreciation	346		1,601	3,755
Internal Cash Generation	269		1,584	6,269
Current Assets	4,086		5,443	15,156
Total Assets	18,407		32,954	67,239
Current Liabilities	4,406		6,202	22,117
Long-Term Debt	7,353		14,635	22,965
Equity	6,649		12,117	22,156
<u>Ratios</u>				
Current Ratio	0.93		0.88	0.66
Debt/Equity Ratio	53/47		55/45	51/49
Net Income/Assets (%)	(0.4)		(0.1)	3.7
Return on Equity	(1.1)		(0.1)	11.3
Debt Service Coverage	-		-	1.44

<sup>1/</sup> Raw material and product projections are based on Bank estimates or derived from them.

5.03 Since FOSFERTIL has undergone two restructurings in the last three years, the financial situation of the company has not yet stabilized. Also during the last year, FOSFERTIL has marketed substantial quantities of rock phosphate and phosphoric acid at the government fixed prices lower than international prices due to marketing limitations resulting from the new policies on credit to farmers. With improved market conditions and better production performance in VALEFERTIL after the initial operating problems, FOSFERTIL's financial performance is expected to improve in 1982 and beyond.

5.04 The VALEFERTIL project has been financed with 48% equity—better than the 40% stipulated in the Project Agreement. The equity content of 49% in the financing pattern of FOSFERTIL is also more favorable than the required 40%. The major inadequacy of the FOSFERTIL's financial position is the low current ratio—0.7 in 1981 against 1.2 stipulated in the Project Agreement. The deviation from the financial covenant was discussed with the FOSFERTIL and PETROFERTIL managements who pointed out that the low current ratio is mainly due to the large amount of short term borrowings—Cr\$16.4 billion, used by FOSFERTIL to finance its investments and operation. PETROFERTIL intends to recommend to the FOSFERTIL board, that the shareholders' equity capital be increased by Cr\$4 billion. This measure along with use of internally generated cash to finance part of the inventory and accounts receivable are expected to improve the current ratio to an acceptable level by 1983.

5.05 The present investment plans of FOSFERTIL are limited to (a) possible expansion of VALEP and VALEFERTIL capacities to optimize production capabilities (as stipulated in the Project Agreement) and (b) expansion of Patos de Minas rock phosphate production capacity from 150,000 tpy to 300,000 tpy. With the measures to improve the FOSFERTIL financial status listed in the above paragraph, those investments are appropriate.

## VI. ECONOMIC PERFORMANCE

### A. Economic Rate of Return

6.01 The project economic rate of return (ERR) has been determined using the input and output price assumptions summarized in Annex 9. All traded items have been priced based on projected international prices allowing for transportation and handling costs. All non-tradeable items have been priced at their financial prices after adjusting for duties and taxes. The production cost details for the project are shown in Annex 10 and the economic cost and benefit stream in Annex 13.

6.02 The economic rate of return (ERR) with Cruzeiro exchange rate shadow priced by 25%, is 17% against 22% at the time of appraisal. The decline in spite of the lower capital cost (expressed in constant dollars) and better performance during the first 18 months is due to the variation in the projected price assumptions for inputs and products between the time of appraisal and now. If the inputs and products are priced as at the time of appraisal, the ERR improves to 23%.

## B. Environmental Aspects

6.03 The VALEFERTIL project facilities have been constructed in conformity with environmental regulation norms agreed to during the project appraisal. The measures taken have ensured that the required standards are met during plant operation except for the following: bulk movement of MAP and TSP by truck causes spillages on the plant roads. The spilled products get washed into the plant sewerage system during rains causing pollution. Special efforts are made to reduce spillage and to periodically clean the roads. While fluosilic acid produced in the acidulation of rock phosphate is now recovered and treated before discharge, VALEFERTIL has not yet arranged for its utilization to produce cryolite or aluminum fluoride. VALEFERTIL is attempting to interest private investors in promoting the fluoride utilization project.

## C. Foreign Exchange Saving

6.04 The foreign exchange value of production with the facilities operating at 90% of the rated capacity will be US\$199 million per year. The foreign exchange cost of sulfur, ammonia and maintenance materials will be US\$57 million. The net annual foreign exchange saving for Brazil from this project will be US\$142 million (in 1981 constant dollars) compared to estimated saving of US\$165 million at the time of appraisal.

## D. Transfer of Technology

6.05 The project has been implemented with substantial involvement of Brazilian institutions. Using know-how and basic designs obtained from process licensors, the detailed engineering was carried out by a Brazilian engineering company. Several equipment for the project were also obtained from Brazilian suppliers. The VALEFERTIL and local engineers absorbed very effectively the technology transferred to them and now have significant capabilities.

## VII. BANK ROLE

7.01 During the various phases of the Project, the Bank has worked closely with VALEFERTIL and its consultants. During project appraisal, the Bank not only reviewed the VALEFERTIL project but also the related VALEP project and the rock phosphate slurry pipeline to ensure that the integrated scheme was not only technically sound but also economically optimum. The Bank worked closely with VALEFERTIL in formulating and implementing the project financing arrangement which included in addition to the Bank financing, the use of suppliers' credit and commercial bank financing to fund the project foreign exchange requirements. At the suggestion of the Bank, VALEFERTIL used consultant assistance in developing the corporate and works financial systems and in implementing and operating the project. The VALEFERTIL project is a good example of a project in which dedicated work by the project management aided by the Bank support has resulted in a successful project meeting its economic objectives.

### VIII. CONCLUSIONS AND LESSONS LEARNED

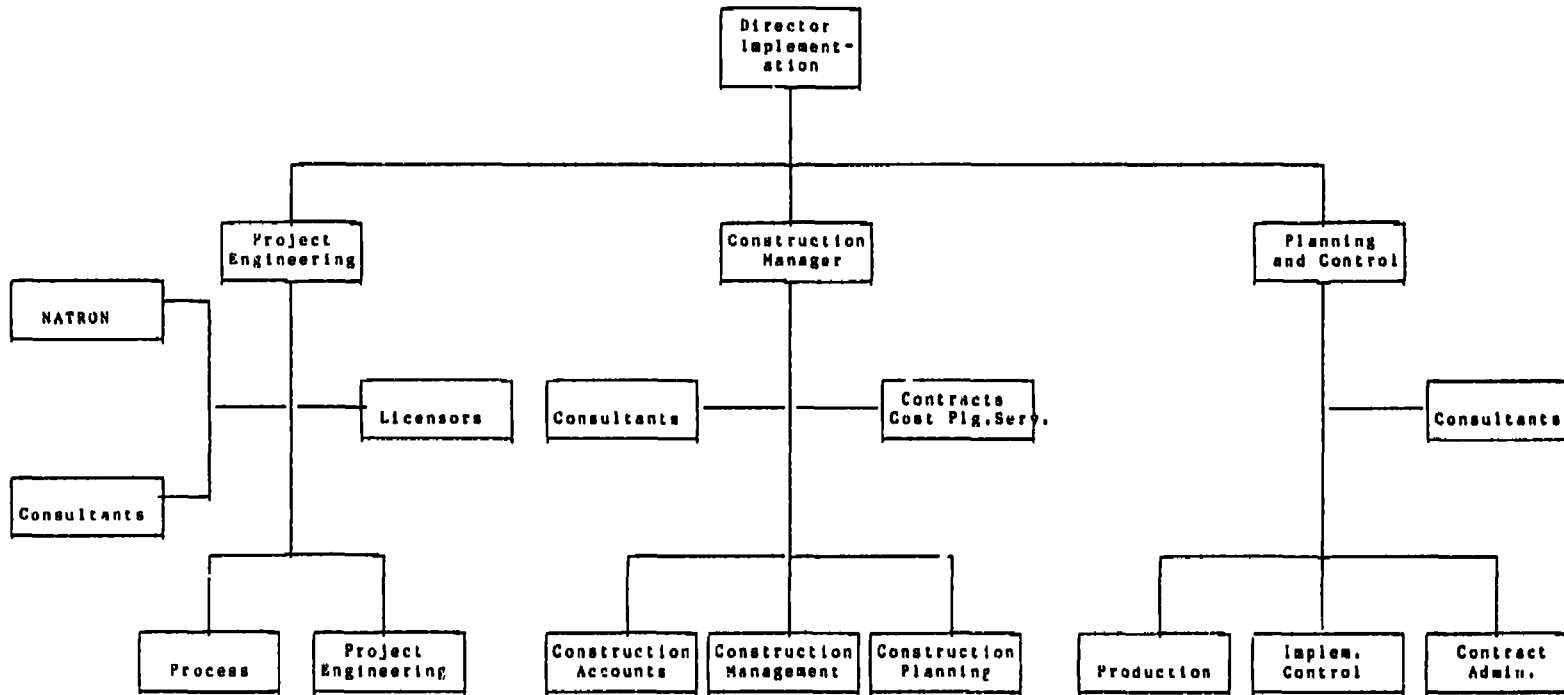
8.01 Except for the delay of about eleven months, the project has been completed successfully at close to initially estimated project cost in current terms and 12% below appraisal estimates in real terms. Even though the project faced some initial commissioning problems, especially in the TSP and MAP plans, the VALEFERTIL engineers worked on the problems, developed solutions and implemented them successfully. As a result, the facilities have achieved about 60% capacity utilization in the first year, compared to 50% assumed during appraisal. The 1982 production is expected to reach close to 90% compared to 75% assumed in appraisal. But for the marketing constraints referred to earlier, VALEFERTIL could have achieved even better levels of production. Due to lower capital costs in real terms and much faster production build-up than assumed during appraisal, the economic rate of return of the project is estimated at 23% compared to 22% at appraisal, if the price and cost assumptions applied in appraisal are used. Even based on more conservative output and input price relationship, the ERR is calculated at a healthy 17%.

8.02 The success of the project has been mainly due to the VALEFERTIL management group which carried out the project with enthusiasm and dedication. VALEFERTIL utilized expatriate consultants to full advantage of the project and there has been smooth and useful transfer of technology.

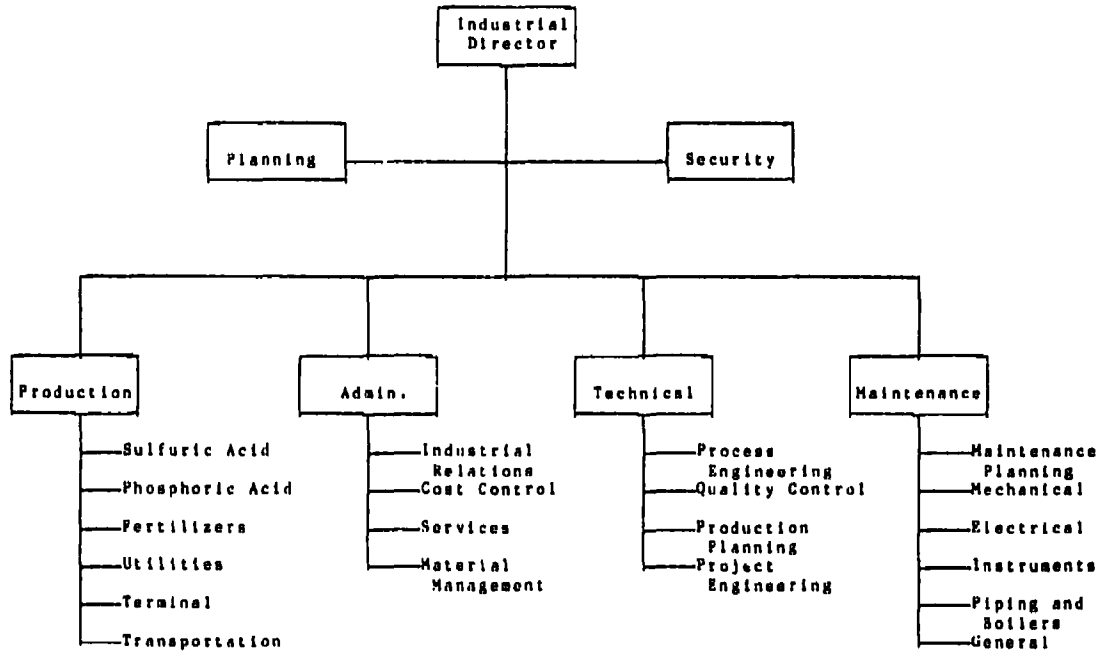
8.03 The project delays were mainly due to (a) initial delays in availability of land; (b) change in implementation arrangement with VALEFERTIL taking over construction management; and (c) change in the management team when VALEFERTIL was taken over by FOSFERTIL. The time needed for obtaining land for locating the project is often underestimated and other phases of the project implemented ahead of needs. However, in spite of this initial delay, the timing of the Bank involvement in the project was appropriate since it facilitated effective Bank participation in formulating project scope and implementation arrangements. This timely participation contributed to the success of the project. The decision to take over construction management and to merge VALEFERTIL with FOSFERTIL had acceptable rationale. However, in both instances the Bank and the Brazilian authorities did not fully recognize the possible impact of the above decision on project schedule. As a result, mechanical completion was delayed by 16 months and it was the alertness of the commissioning staff which enabled about five months of the delay to be recovered.

8.04 On the overall, the VALEFERTIL project has been a success achieved through close coordination of effort between the VALEFERTIL Managers and the Bank staff. The project has fully met its objectives and can be relied upon to continue to be successful industrial enterprise in Brazil.

PROJECT COMPLETION REPORT  
BRAZIL - VALEFERTIL FERTILIZER PROJECT  
 PROJECT ORGANIZATION CHART



PROJECT COMPLETION REPORT  
BRAZIL - VALEFERTIL FERTILIZER PROJECT  
VALEFERTIL INDUSTRIAL COMPLEX ORGANIZATION CHART



Industry Department  
 March 1982

PROJECT COMPLETION REPORT  
BRAZIL - VALEFERTIL FERTILIZER PROJECT  
BANK-FINANCED PROCUREMENT OF SUPPLIES AND SERVICES  
BY COUNTRY OF ORIGIN

	<u>Amount</u> (\$ millions)	<u>Percentage</u>
<u>Equipment, Materials and Spares</u>	35.1	100.0
Brazil	16.7	47.5
Japan	5.5	15.7
Germany (FRG)	3.6	10.2
USA	3.7	10.6
France	3.0	8.5
Italy	0.8	2.4
UK	0.1	0.3
Others	1.7	4.8
<u>Engineering and Other Services</u>	8.8	100.0
Germany (FRG)	1.7	19.3
France	2.7	30.7
USA	4.4	50.0

Industry Department  
March 1982

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

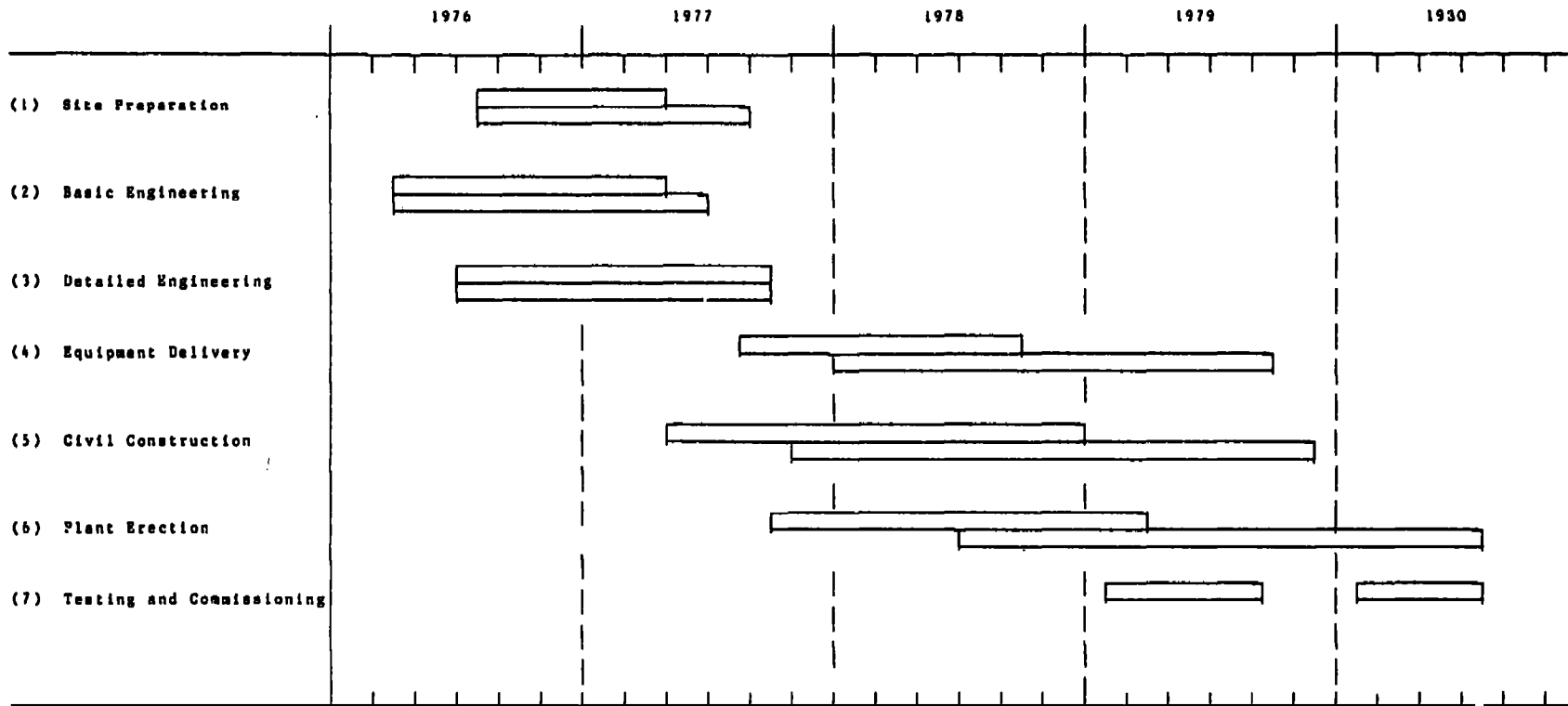
IMPLEMENTATION SUMMARY

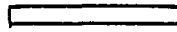
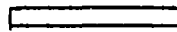
<u>Facility</u>	<u>Mechanical Completion</u>	<u>Start-up Date</u>	<u>Start of Operation</u>
Sulphuric Acid I	27/03/80	April/80	April/80
II	12/07/80	July/ 80	July/ 80
Phosphoric Acid I	22/04/80	April/80	April/80
II	25/06/80	June/ 80	June/ 80
MAP	18/05/80	May/ 80	May/ 80
TSP	13/06/80	June/ 80	June/ 80
Steam Generation	29/12/80	Jan/ 80	Jan/ 80
Power Generation	30/11/79	March/80	March/80
Raw Material Storage	20/11/79	Jan/ 80	Jan/ 80
Product Storage	16/05/80	May/ 80	May/ 80
Appraisal Estimate (Total Project)	March/79	-	August/79

Industry Department  
March 1982



**PROJECT COMPLETION REPORT**  
**BRAZIL - VALEFERTIL FERTILIZER PROJECT**  
**IMPLEMENTATION SCHEDULE**



 As per Appraisal Report  
 Actual

Industry Department  
 March 1982

PROJECT COMPLETION REPORT  
BRAZIL - VALEFERTIL FERTILIZER PROJECT

PROJECT COST DISBURSEMENT SCHEDULE

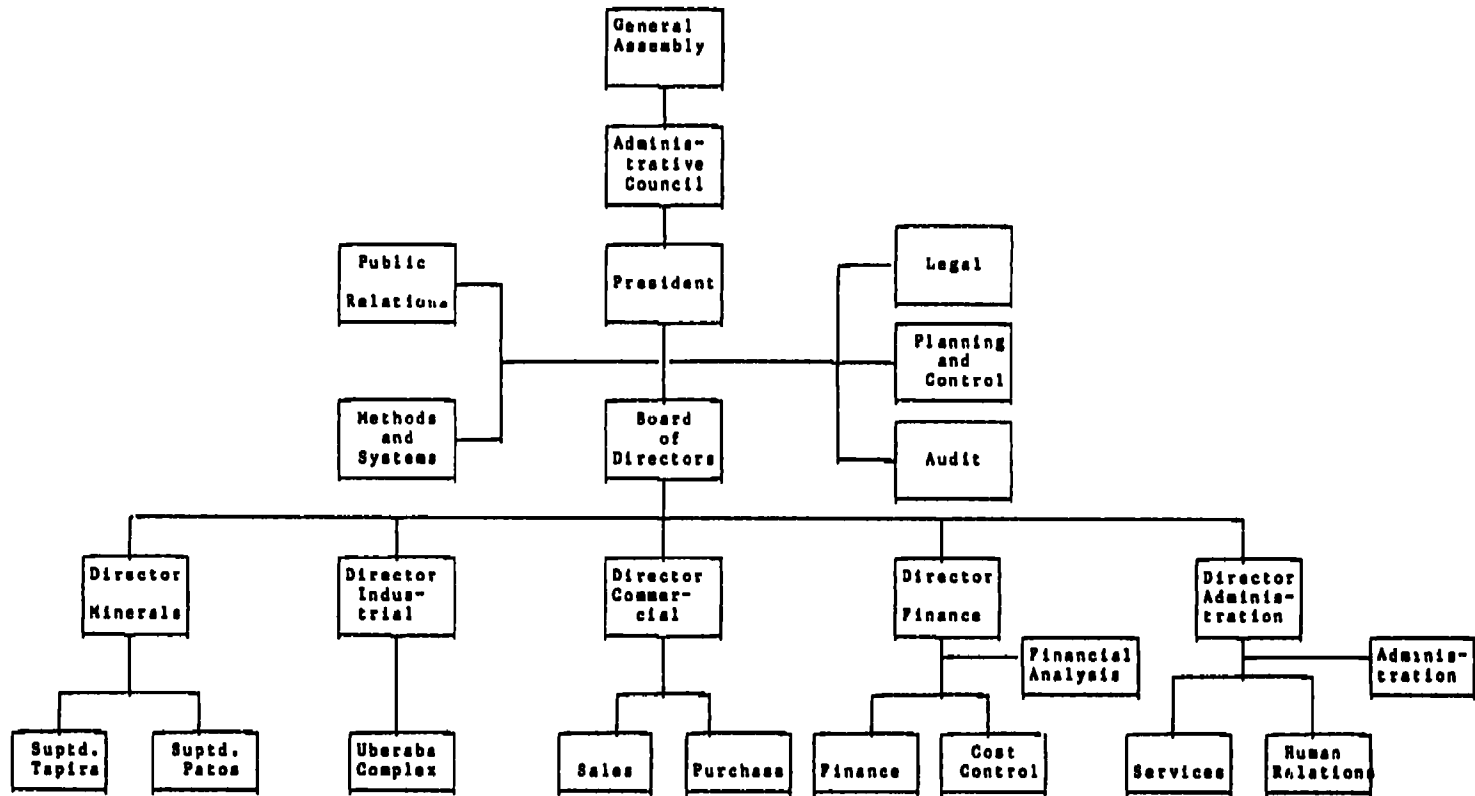
(in US\$ millions)

<u>Year</u>		<u>Appraisal Estimate a/</u>	<u>Actual</u>
1977	1	-	
	2	96.3	33.6
1978	1	-	35.1
	2	128.3	52.6
1979	1	-	68.6
	2	69.4	53.3
1980	1	-	34.8
	2	-	15.1
1981	1	-	13.1
	2	-	2.4
	<b>Total</b>	<u>294.0</u>	<u>308.6</u>

---

a/ For total calendar year

**PROJECT COMPLETION REPORT**  
**BRAZIL - VALEFERTIL FERTILIZER PROJECT**  
**FOSEFERTIL ORGANIZATION CHART**



Industry Department  
March 1962

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

OPERATING PERFORMANCE

<u>Year/Month</u>	<u>Sulfuric Acid</u>	<u>Phosphoric Acid</u>	<u>TSP</u>		
			<u>MAP Granular</u>	<u>ROP Granular</u>	
Monthly Capacity	69,333	24,283	27,500	28,417	28,417
<u>1980</u>					
July	35,629	12,675	18,579	1,555	400
August	47,069	15,626	26,287	5,105	2,257
September	54,333	12,401	24,175	11,885	8,250
October	38,753	11,271	15,650	14,040	5,345
November	47,232	15,962	14,586	14,600	5,535
December	56,697	18,890	18,379	7,900	8,070
Total 1980	279,713	86,825	117,656	55,085	29,857
<u>1981</u>					
January	40,308	17,242	15,260	8,180	12,500
February	44,247	16,024	17,385	13,035	9,690
March	56,013	20,404	11,820	8,685	13,430
April	42,170	18,646	18,175	10,475	14,285
May	28,389	12,423	11,290	12,105	11,960
June	46,413	14,907	11,675	9,470	5,285
July	51,295	17,747	10	17,990	19,700
August	52,346	18,517	290	17,400	16,550
September	69,476	20,283	20,115	11,655	8,230
October	67,518	20,339	22,935	18,525	15,595
November	42,836	14,186	16,750	10,460	11,940
December	44,862	18,790	18,485	10,770	8,710
Total 1981	585,873	209,508	164,190	148,750	147,875
<u>1982</u>					
January	54,517	18,980	19,015	16,690	9,615

Industry Department  
March 1982

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

PRICE ASSUMPTIONS FOR FINANCIAL AND ECONOMIC ANALYSIS

	<u>MAP</u>	<u>TSP</u>	<u>Sulfur</u>	<u>Ammonia</u>	<u>Phosphate Rock</u>
FOB Price	355 <sup>a/</sup>	220	115	215	51
Freight and Insurance	40	40	30	30	30
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
CIF Price	395	260	145	245	81
Port Taxes (10%)	40	26	17	25	8
Port Handling and Storage	15	15	10	2	5
Inland Transport	-	-	23	35	25
Inland Freight Differential	25	25	-	-	-
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
Total	475	326	195	307	119
Financial Price	475	326	195	307	40 <sup>b/</sup>
Economic Price					
1. At Official Exchange Rate	435	300	180	282	75 <sup>c/</sup>
2. At Shadow Exchange Rate	427	292	173	275	75

a/ Calculated from projected DAP and ammonia prices.

b/ Contracted transfer price from VALEP to VALEFERTIL.

c/ CIF price plus transportation cost Santos/Sao Paulo less drying cost and transportation from Uberaba to Sao Paulo and adjusted for the rock BPL.

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

ESTIMATED PRODUCTION COST SUMMARY AND OUTPUT VALUE

(at 19% Production Level)

	<u>Annual Quantities (Tons)</u>	<u>In Millions of Constant 1981 US Dollars</u>			
		<u>Financial Costs</u>	<u>Economic Costs</u>		
			<u>At Official Exchange Rate</u>	<u>% Foreign Exchange</u>	<u>At Shadow Exchange Rate</u>
<b>1. <u>Variable Costs</u></b>					
Rock Phosphate	988,600	39.5	74.1	100	74.1
Sulfur	259,500	50.6	46.7	85	44.9
Ammonia	39,600	12.2	11.2	88	10.9
Others		<u>8.9</u>	<u>8.0</u>	25	<u>6.8</u>
Total Variable Cost		111.2	140.0		136.7
<b>2. <u>Fixed Costs</u></b>					
Labor		8.5	8.5		6.8
Maintenance		0.6	0.5	40	0.4
Administrative and Marketing		8.8	8.8		7.0
Others		<u>1.0</u>	<u>1.0</u>		<u>0.8</u>
Total Fixed Cost		18.9	18.8		15.0
<b>3. <u>Value of Output</u></b>					
MAP	297,000	141.1	129.2	94	126.8
TSP	306,180	<u>99.8</u>	<u>91.9</u>	89	<u>89.4</u>
Total Output		<u>240.9</u>	<u>221.1</u>		<u>216.2</u>

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

FINANCIAL RATE OF RETURN

(in Millions 1981 US Dollars)

<u>Year</u>	<u>Project Cost</u>	<u>Working Capital</u>	<u>Fixed Cost</u>	<u>Variable Cost</u>	<u>Revenues</u>	<u>Net Cash Flow</u>
1977	47.8	-	-	-	-	(47.8)
1978	107.1	-	-	-	-	(107.1)
1979	124.5	-	-	-	-	(124.5)
1980	10.3	30.6	9.4	37.5	83.6	(4.2)
1981	1.8	10.0	18.9	82.5	177.0	63.8
1982	-	-	18.9	84.5	228.3	107.1
1983	-	-	18.9	111.2	240.9	110.8
1984	-	-	18.9	111.2	240.9	110.8
1985	-	-	18.9	111.2	240.9	110.8
1986	-	-	18.9	111.2	240.9	110.8
1987	-	-	18.9	111.2	240.9	110.8
1988	-	-	18.9	111.2	240.9	110.8
1989	-	-	18.9	111.2	240.9	110.8
1990	-	-	18.9	111.2	240.9	110.8
1991	-	-	18.9	111.2	240.9	110.8
1992	(29.2)	(40.6)	18.9	111.2	240.9	180.6

Financial Rate of Return (Base case) 22.9%

FRR with Rock Phosphate at US\$75/ton 15.8%

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

FINANCIAL STATEMENTS

BALANCE SHEET

CR\$ Million

Item	VALEFERTIL					FOSFERTIL	
	1976	1977	1978	1979	1980	1980	1981
<u>Assets</u>							
Cash and Banks	4.9	17.7	190.6	199.1	229.7	312.4	2,594.4
Accounts Receivable	-	11.4	-	43.7	791.5	1,198.7	5,393.6
Inventory	-	-	-	269.7	2,895.3	3,717.0	6,899.5
Other Receivables	-	1.5	27.0	23.6	169.2	215.1	268.4
Total Receivables	4.9	30.6	217.6	536.1	4,085.7	5,443.0	15,155.9
Long-Term Receivables	-	5.5	36.1	58.0	39.0	304.8	610.9
Fixed Assets	12.2	133.5	2,499.9	6,356.8	10,056.7	21,120.4	44,439.4
Depreciation	-	(0.2)	(3.1)	(14.5)	(300.9)	(1,181.4)	(5,607.3)
Net Fixed Assets	12.2	133.3	2,496.8	6,342.3	9,755.8	19,939.0	38,832.1
Deferred Charges	6.7	25.7	329.4	2,072.3	4,526.4	7,267.6	12,639.9
<b>TOTAL ASSETS</b>	<b>23.8</b>	<b>195.1</b>	<b>3,079.9</b>	<b>9,008.7</b>	<b>18,406.9</b>	<b>32,954.4</b>	<b>67,238.8</b>
<u>Liabilities and Equity</u>							
Accounts Payable	4.7	13.1	302.9	293.9	848.2	538.4	627.3
Short-term Portion of Long-term Debt	-	-	16.3	450.3	1,007.8	1,007.8	4,340.2
Short-term Debt	-	-	-	65.8	2,376.1	4,330.6	16,358.3
Other Accounts Payable	9.0	5.4	37.8	103.6	173.5	325.6	791.6
Total Current Liabilities	13.7	18.5	357.0	913.6	4,405.6	6,202.4	22,117.4
Long-term Debt	-	-	1,775.3	4,879.1	7,352.6	14,550.6	22,965.1
Other Long-term Payables	0.1	3.4	13.7	-	-	84.0	-
Total Long-Term Debt (2)	0.1	3.4	1,789.0	4,879.1	7,352.6	14,634.6	22,965.1
Share Capital	10.0	172.9	770.1	2,463.2	4,756.9	8,454.5	12,061.8
Reserves	-	0.3	163.8	752.8	1,968.5	3,662.9	12,608.4
Retained Earnings	-	-	-	-	(76.7)	-	(2,513.9)
Total Equity (3)	10.0	173.2	933.9	3,216.0	6,648.7	12,117.4	22,156.3
<b>TOTAL LIABILITIES AND EQUITY</b>	<b>23.8</b>	<b>195.1</b>	<b>3,079.9</b>	<b>9,008.7</b>	<b>18,406.9</b>	<b>32,954.4</b>	<b>67,238.8</b>



PROJECT COMPLETION REPORT

ANNEX 12

Page 2

BRAZIL-VALEFERTIL FERTILIZER PROJECT

STATEMENT OF INCOME

<u>Item</u>	<u>VALEFERTIL</u>	<u>FOSFERTIL</u>	
	<u>12/31/80</u>	<u>12/31/80</u>	<u>12/31/80</u>
Gross Revenue			
(+) Sales	2,310.3	5,560.0	20,417.3
(-) Deduction and Taxes on Sales	<u>52.3</u>	<u>52.3</u>	<u>153.1</u>
(=) Net Sales	2,258.0	5,507.7	20,264.2
(-) Cost of Products Sold	<u>1,411.8</u>	<u>3,373.5</u>	<u>11,603.5</u>
(=) Gross Profit	<u>846.2</u>	<u>2,134.2</u>	<u>8,660.7</u>
(-) Operating Expenses	<u>2,324.2</u>	<u>6,285.4</u>	<u>10,535.4</u>
Selling Expenses	2,147.4	5,791.2	8,787.6
General and Administrative Expenses	84.5	180.8	685.9
Depreciation and Amortization of Pre-operating Expenses	<u>85.6</u>	<u>263.3</u>	<u>986.1</u>
(=) Operating Loss	<u>1,478.0</u>	<u>4,151.2</u>	<u>1,874.7</u>
Nonoperating Income	<u>5.8</u>	<u>11.0</u>	<u>-</u>
(-) Monetary Variation on long Term Loans and Financing	-	3,549.8	14,022.5
Monetary Correction	<u>1,394.8</u>	<u>7,672.9</u>	<u>13,383.3</u>
On Permanente Assets	<u>2,520.5</u>	<u>10,042.2</u>	<u>24,274.3</u>
(-) Of Shareholders Equity	<u>1,125.7</u>	<u>2,369.3</u>	<u>10,891.0</u>
(=) Net Loss For The Year	<u>77.4</u>	<u>17.1</u>	<u>2,513.9</u>

PROJECT COMPLETION REPORTBRAZIL - VALEFERTIL FERTILIZER PROJECTSTATEMENTS OF SOURCE AND APPLICATION OF FUNDS

	<u>VAJEFERTIL</u>	<u>FOSFERTIL</u>	
	<u>1980</u>	<u>1980</u>	<u>1981*</u>
<u>SOURCES</u>			
Net loss for the year	(77.4)		(2,513.9)
From capital increase - capital paid up	1,617.2	7,248.9	-
Long-term debt increase	(239.3)	14,633.8	-
Monetary variation on long-term loans and financing	1,462.4	3,549.8	14,022.5
Monetary restatement of permanent assets and shareholders equity	(1,394.8)	-	(13,383.5)
Depreciation and amortization	345.9	1,601.0	3,755.3
Decrease in long-term assets	19.0	-	-
TOTAL SOURCES	<u>1,733.0</u>	<u>27,033.5</u>	<u>1,880.4</u>
<u>APPLICATIONS</u>			
Addition to property	518.0	20,788.1	9,016.4
Pre-operation and Pre-industrial expenses	1,157.4	6,984.5	-
Long-term assets increase	-	86.9	306.1
TOTAL APPLICATIONS	<u>1,675.4</u>	<u>27,859.5</u>	<u>9,322.5</u>
Increase (decrease) in working capital	57.6	(826.0)	(7,442.1)

\* Projected

PROJECT COMPLETION REPORT

BRAZIL - VALEFERTIL FERTILIZER PROJECT

ECONOMIC RATE OF RETURN

(in Million US Dollars)

<u>Year</u>	<u>Project Cost</u>	<u>Working Capital</u>	<u>Fixed Cost</u>	<u>Variable Cost</u>	<u>Revenues</u>	<u>Net Cash Flow</u>
1977	39.0	-	-	-	-	(39.0)
1978	87.5	-	-	-	-	(87.5)
1979	101.7	-	-	-	-	(101.7)
1980	8.0	25.0	7.5	44.8	75.0	(10.3)
1981	1.5	8.2	15.0	100.5	158.9	33.7
1982	-	-	15.0	126.5	204.9	63.4
1983	-	-	15.0	136.7	216.2	64.5
1984	-	-	15.0	136.7	216.2	64.5
1985	-	-	15.0	136.7	216.2	64.5
1986	-	-	15.0	136.7	216.2	64.5
1987	-	-	15.0	136.7	216.2	64.5
1988	-	-	15.0	136.7	216.2	64.5
1989	-	-	15.0	136.7	216.2	64.5
1990	-	-	15.0	136.7	216.2	64.5
1991	-	-	15.0	136.7	216.2	64.5
1992	(28.8)	(33.2)	15.0	136.7	216.2	126.5

Economic Rate of Return (Base case) 16.6%

ERR with Appraisal Report Price Assumptions 22.8%

