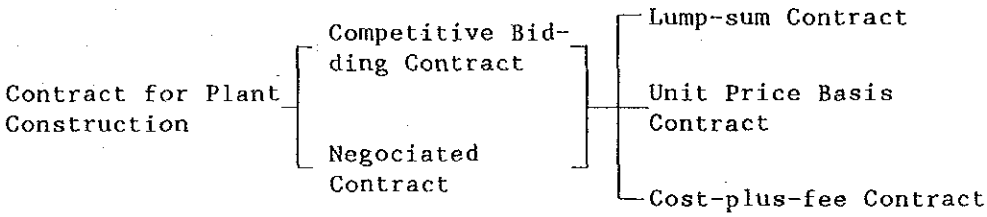
CHAPTER VIII PLANT CONSTRUCTION COST

8.1 Plant Construction

8.1.1 Contract for Plant Construction

There are various typical ways of establishing contracts for plant construction. Diagrammed below are some examples which can be considered applicable for the Paraguayan fertilizer plant. A careful consideration of the Owner's terms, as well as a detailed analysis of the pros and cons of each method, is necessary for deciding most suitable method for this project.



Selection of a contract method

The choice of method eventually rests with the Owner, who should take the following elements into consideration.

* technological development level of the Owner's country
* current state of the construction industry of the Owner's country
* the Owner's financial position
* the project background and objective
* capability of the Owner's staff to execute the project

8.1.2 Transportation of Equipment and Construction Materials

Domestic transport in Paraguay is mainly overland by truck. Plant facilities and construction materials procured from abroad will be landed at Paranagua port in Brazil, then trucked to the plant site. This route was used successfully during construction of the nearby Itaipu Dam, and thus should present no problems.

8.1.3 Construction Plan and Training Plan

The construction schedule for the Paraguayan fertilizer plant is diagrammed in Figure 8-1-1. The actual details will be determined when the contract is signed, but if the contract were to go into effect in 1989, the plant should be expected to begin operation in 1992. In order to realize this schedule, the preparatory work of preparing bid specifications, evaluating the bids and deciding on a contractor should be accomplished as speedily as possible. In the schedule shown in Figure 8-1-1, 20 months are allowed for these preliminary steps, but this period can possibly be reduced to 12 months.

One of the important tasks of the Owner during plant construction will be the education and training of personnel. Managers, technicians and chief operators should complete their training 12 months in advance, and other operators 4 months in advance. Training should be accomplished at established plants abroad according to the plans of foreign process owners or the contractors, and also at the Paraguay plant during construction.

At least 3 or 4 managers, technicians and maintenance people for each process should be trained for about 45 days in existing plants abroad. These foreign trained workers should then train the rest of the personnel at the plant. In addition, all personnel should receive final instructions and training from specialists dispatched to the plant by the process owners and machine manufacturers.

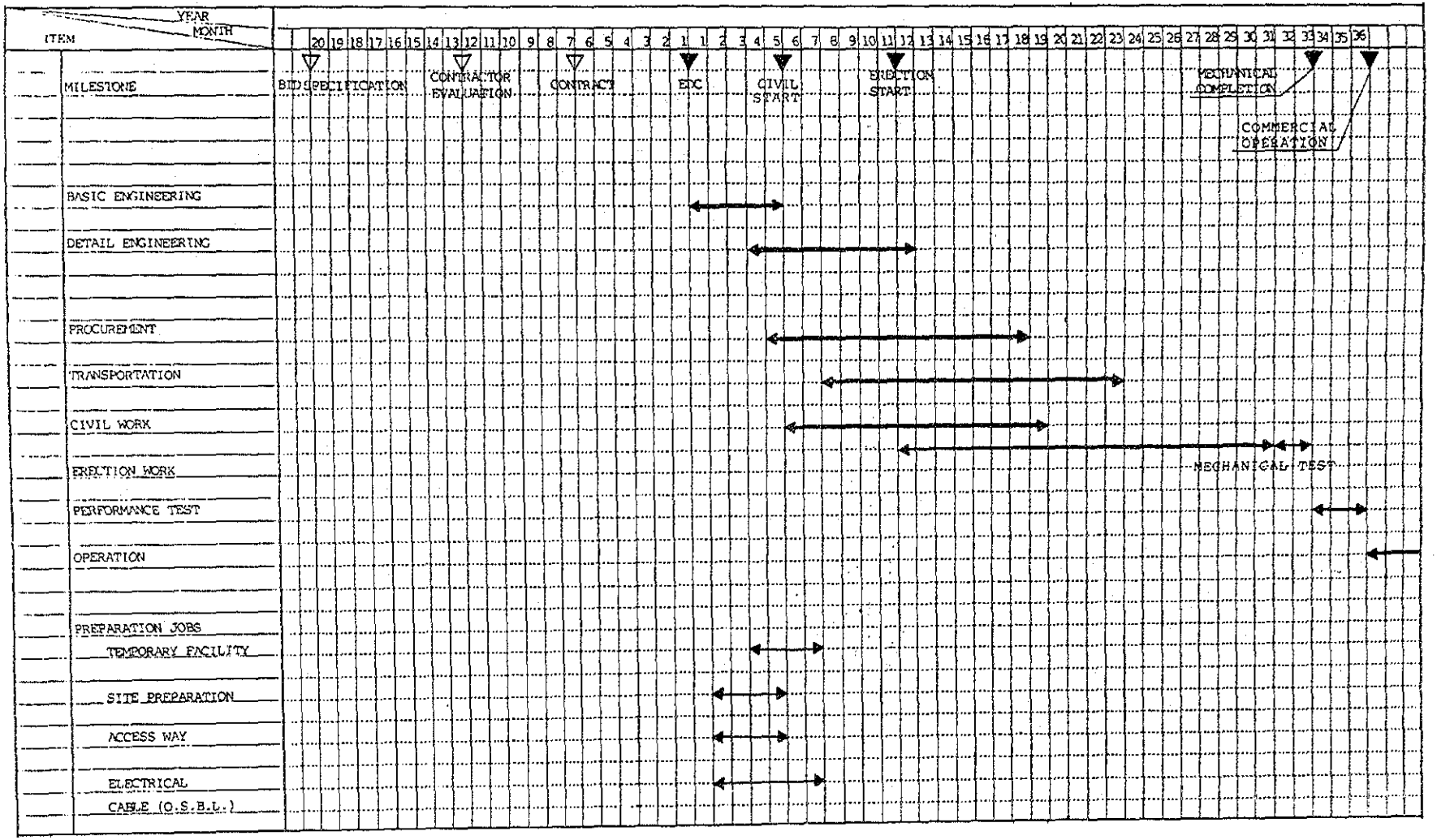


Figure 8-1-1 Time Schedule

8.1.4 Organization and Management of Personnel for Plant Construction

A new public company will be formed to oversee construction and operation of the Paraguayan fertilizer plant. As this is the Paraguay's first fertilizer plant, and also an important national project, seeking the cooperation of international consultants would be advisable.

1) Organization of construction personnel

Section 7-5 deals with the organization of personnel once the plant is completed and operating. Following is a discussion of how personnel might be organized during the actual process of constructing the plant, based on the scenario charted in Figure 8-1-2.

(a) Consultants

As this project is the first of its kind in Paraguay, the advice of experienced international consultants can be important. The main contributors of such consultants would be as follows:

* advice on overall project execution (especially technology and construction management)
* drawing up of specifications for the project plan
* assistance in selecting a contractor
* evaluation of proposed specifications
* contract negotiations
* approval of documents for various technologies
* other technical and managerial aid

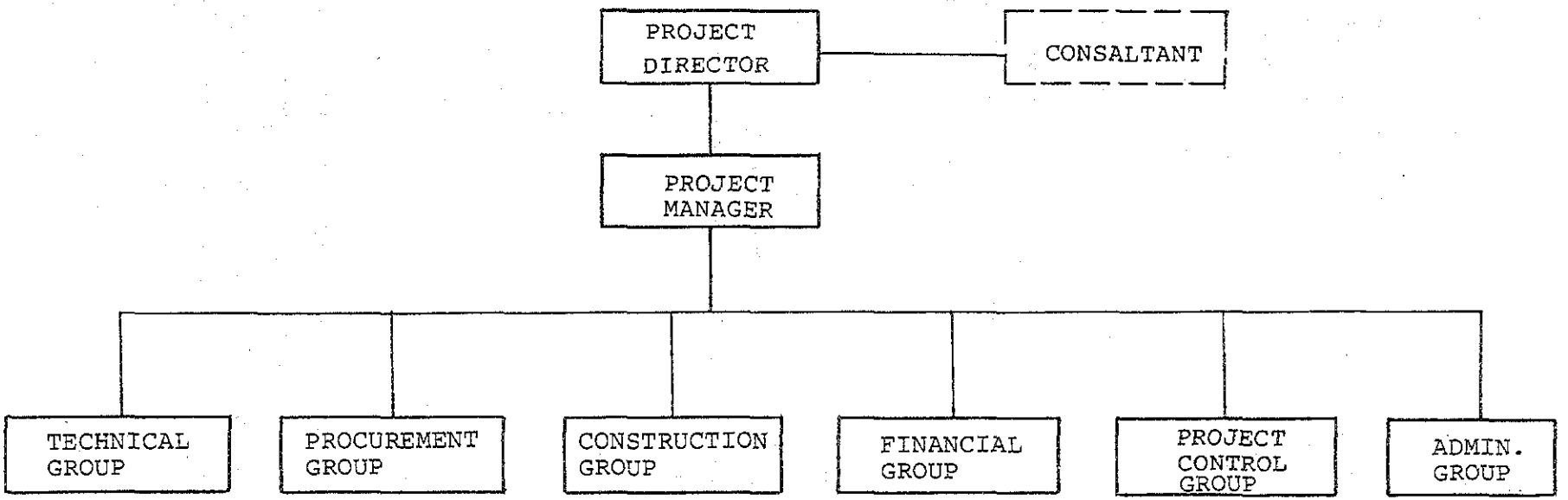


Figure 8-1-2 Typical Organization for Project Execution

(b) Project director

This person would be the chief representative for the Owner in this project, with overall responsibility for all phases of execution, Tasks would include coordinating and overseeing the work of the various subsections, and acting as representative for the Owner in dealings with the contractor and consultants.

(c) Project manager

This position would serve as aide to the project director in all tasks, and also assume responsibility at the practical level for technology, procurement, construction, financing and process management.

(d) Technical group

This group would have overall responsibility for management of all technical aspects. There would be a network of subsections, listed below.

* process group
* machinery group
* electrical group
* instrumentation group

(e) Procurement group

This group would carry responsibility for regulation and management of procurement of all materials necessary to begin operation of the plant, including raw materials, services and chemicals. The following subsections might be considered.

* ordering group
* quality control group
* storage group

(f) Construction engineer

This engineer is responsible for all aspects of plant construction, from site excavation to equipment installation. Usually, the construction engineer controls the following groups lisked below, but the nature of the contract in this project may necessitate some changes.

* domestic construction industry liaison group
* civil works group
* construction group
* construction control management group

(g) Financial expert

Responsibility in this position involves operation and management of the funds necessary for the project. Duties, which begin at inception of the project, include procurement of domestic and foreign funds, payments to the contractor, regulation of various costs and legal matters pertaining to management of finances.

(h) Project control engineer

This person functions as a manager and regulator of progress in all aspects of plant construction. Duties are coordinating progress in the technical, procurement and construction fields, and overseeing the contract relations between the Owner and the contractor.

(i) Administration coordinator

This person is responsible for all personnel, accounting and general affairs matters relating to execution of the project.

2) Personnel plan

In order to implement the personnel organization scheme presented above, the following number of people would be necessary (total of 26).

(a) Project management section

Type of Profession	Number
Project Director	1
Project Manager	1
Sub-total	2
Secretary	1
Total	3

(b) Technical section

Type of Profession	Number
Process Engineer	1
Mechanical Engineer	1
Electrical Engineer	1
Instrument Engineer	1
Total	4

(c) Procurement section

Type of Profession	Number
Ordering Group	2
Quality Control	1
Storage	1
	4

(d) Construction section

Type of Profession	Number
Construction Control Engineer	1

(e) Financial section

Type of Profession	Number
Officer	1
Layer	1
Total	2

(f) Project control section

Type of Profession	Number
Project Control Engineer	1

(g) Administration section

Type of Profession	Number
Officer	2
Typist	2
Driver	2
Miscellaneous Work	3
Guardman	2
Total	11

8.2 Estimation of Plant Construction Cost

Plant construction cost is estimated on the base cost in July, 1986. In the estimation, the following currency exchange rate is applied. Furthermore, the escalation of price (price contingency) is not included in the estimated cost showing hereunder.

US$1 = 240 Gs

8.2.1 Estimated Cost of Plant and Relating Facilities

The estimated plant cost for each Scenario is described briefly and is summarized in the Tables 8-2-1, 8-2-2 and 8-2-3.

1) Land acquisition and preparation

Scenario 1: PA plant, fertilizer plant and related facilities
198.0 Million Gs

Scenario 2: Ammonia plant, PA plant, fertilizer plant and related facilities
205.5 Million Gs

Scenario 3: FMP plant and related facilities
138.0 Million Gs

2) Machine and equipment

Machine and equipment costs for each Scenario are as follows on F.O.B basis.

Scenario	Foreign currency (Million US$)
1	18.37
2	25.30
3	3.45

Table 8-2-1 Plant Construction Cost

- Scenario 1 -

F: Foreign Currency (Unit: million US$)
L: Local Currendy (Unit: million Gs)

YEAR	-3		-2		-1		Sub Total	
CURRENCY	F	L	F	L	F	L	F	L
1. Land Acquisition & Preparation	-	198.0	-	-	-	-	-	198.0
2. Machinery & Equipment	10.07	-	7.62	-	0.68	-	18.37	-
3. Civil & Building	2.08	210.7	0.96	96.2	0.16	21.1	3.2	328.0
4. Erection	0.23	34.9	3.27	238.2	1.06	67.6	4.56	340.7
5. Transportation (Ocean & Inland)	0.46	22.8	0.26	33.9	0.04	4.3	0.76	61.0
6. Engineering & Consultant Fee	2.66	-	-	-	-	-	2.66	-
7. Supervising Fee, etc.	-	-	1.12	28.6	1.91	45.3	3.03	73.9
8. Contingencies	0.78	13.4	0.66	19.9	0.19	6.9	1.63	40.2
Total	16.28	479.8	13.89	416.8	4.04	145.2	34.21	1,041.8

Excluding plant related costs such as access road, electric cable construction and water intake piping works

Table 8-2-2 Plant Construction Cost

- Scenario 2 -

F: Foreign Currency (Unit: million US$)
L: Local Currency (Unit: million Gs)

YEAR	-3		-2		-1		Sub Total	
CURRENCY	F	L	F	L	F	L	F	L
1. Land Acquisition & Preparation	-	205.5	-	-	-	-	-	205.5
2. Machinery & Equipment	13.69	-	10.17	-	1.44	-	25.3	-
3. Civil & Building	2.45	242.7	1.14	112.2	0.21	29.1	3.8	384.0
4. Erection	0.27	73.9	3.72	313.9	1.15	83.3	5.14	471.1
5. Transportation (Ocean & Inland)	0.57	46.2	0.4	64.4	0.07	9.6	1.04	120.2
6. Engineering & Consultant Fee	3.33	-	-	-	-	-	3.33	-
7. Supervising Fee, etc.	-	-	1.75	72.4	2.89	110.6	4.64	183.0
8. Contingencies	1.01	18.1	0.86	28.1	0.29	11.7	2.16	57.9
Total	21.32	586.4	18.04	591.0	6.05	244.3	45.41	1,421.7

Excluding plant related costs such as access road, electric cable construction and water intake piping works

Table 8-2-3 Plant Construction Cost

- Scenario 3 -

F: Foreign Currency (Unit: million US$)
L: Local Currency (Unit: million Gs)

YEAR	-3		-2		-1		Sub Total	
CURRENCY	F	L	F	L	F	L	F	L
1. Land Acquisition & Preparation	-	138.0	-	-	-	-	-	138.0
2. Machinery & Equipment	1.44	-	1.79	-	0.22	-	3.45	-
3. Civil & Building	0.9	77.8	0.42	34.8	0.08	7.3	1.4	119.9
4. Erection	0.03	1.2	0.57	48.1	0.15	11.5	0.75	60.8
5. Transportation (Ocean & Inland)	0.07	2.0	0.05	3.8	0.02	1.5	0.14	7.3
6. Engineering & Consultant Fee	0.84	-	-	-	-	-	0.84	-
7. Supervising Fee, etc.	-	-	0.14	12.0	0.66	18.4	0.8	30.4
8. Contingencies	0.16	4.1	0.15	4.9	0.06	1.9	0.37	10.9
Total	3.44	223.1	3.12	103.6	1.19	40.6	7.75	367.3

Excluding plant related costs such as access road, electric cable construction and water intake piping works

3) Civil and building

The costs for civil and building are estimated based on the following specifications:

Building for process plant
: Concrete structure with slate wall and roof

Storage house, warehouse etc.
: Steel structure with slate wall and roof

Office
: Concrete structure with mortar finishing

Inside road of the factory
: Asphalt with tar-pitch finishing

Open area in the factory
: Gravel finishing

Bulk materials, such a cement, aggregate and blocks, are procured indigenously in Paraguay.

Scenario	Foreign Currency (Million US$)	Local Currency (Million Gs)
1	3.20	328.0
2	3.80	384.0
3	1.40	119.9

4) Installation cost

These costs are of installation of machine, equipment piping, instrumentation and electrical equipment and material. A certain degree of detail engineering will be required for estimation of these costs. Therefore, the costs are calculated based on a similar project in Japan and the production capacity of each plant.

A part of installation works will be carried out by Paraguayan vendors who participate in the project as local sub-contractors.

From the aspect of the above, installation costs are estimated as follows:

Scenario	Foreign Currency (Million US$)	Local Currency (Million Gs)
1	4.56	340.7
2	5.14	471.1
3	0.75	60.8

5) Ocean freight, insurance and inland transportation

(1) Ocean freight and insurance

These expenses are paid in foreign currency and will depend upon the places where machine and equipment are procured. Approximately 5 percent of F.O.B costs for machine and equipment are estimated for these expenses.

Scenario 1: 0.76 Million US$
Scenario 2: 1.04 Million US$
Scenario 3: 0.14 Million US$

(2) Inland transportation

These expenses are paid in local currency. The expenses are calculated on the base of 700 km distance of transportation by truck.

Scenario 1: 61.0 Million Gs
Scenario 2: 120.2 Million Gs
Scenario 3: 7.3 Million Gs

6) Engineering fee

Engineering fee for each Scenario is paid in foreign currency. The fee for basic and detail design executed by contractor and license of process are included in the engineering fee.

Scenario 1: 2.66 Million US$
Scenario 2: 3.33 Million US$
Scenario 3: 0.84 Million US$

7) Fee for supervisory service and training

The fee will depend upon the form of contract between the project Owner and the contractor and will be estimated as follows:

Scenario	Foreign Currency (Million US$)	Local Currency (Million Gs)
1	3.30	73.9
2	4.64	183.0
3	0.80	30.4

8) Physical contingency

To prepare for some supplementary expenses, the physical contingency is reserved in foreign currency.

Scenario	Foreign Currency (Million US$)	Local Currency (Million Gs)
1	1.63	40.2
2	2.16	57.9
3	0.37	10.9

8.2.2 Related Expenses for the Project
(Included in the project cost)

The main items of related expenses for the project are cable works for electric power, water intake works and access road preparation to the factory.

These expenses are paid by the project Owner in local currency.

1) Expense on power cable works

231 Million Gs are the estimated expense on power cable works at the distance of approx. 5 km between the grid of Itaipu and the plant site.

2) Expense on water intake works

The expense on water intake works between the intake point and the plant site (approx. 200 m) are 46 Million Gs. The cost of water intake pumps is included in 8.2.1, 2).

3) Expense on the access road preparation

This estimated expense is 31 Million Gs based on the following specifiations:

Distance and width : Approx. 1 km x 6 m
Material : asphalt with tar-pitch finishing

8.3 Others Expenses

Others expenses to be reserved for the project execution include taxation, spare parts, labor, etc.

1) Import tax

Usually, the government taxes imported goods on the basis of C.I.F. price. This project, however, will be free of such taxation because it is a national industrial project, to which the government will apply preferential duties.

2) General administrative expense

This expense is reserved by the project Owner according to the organization discussed in 8.1. The expense will be calculated based on the labor's condition in Paraguay.

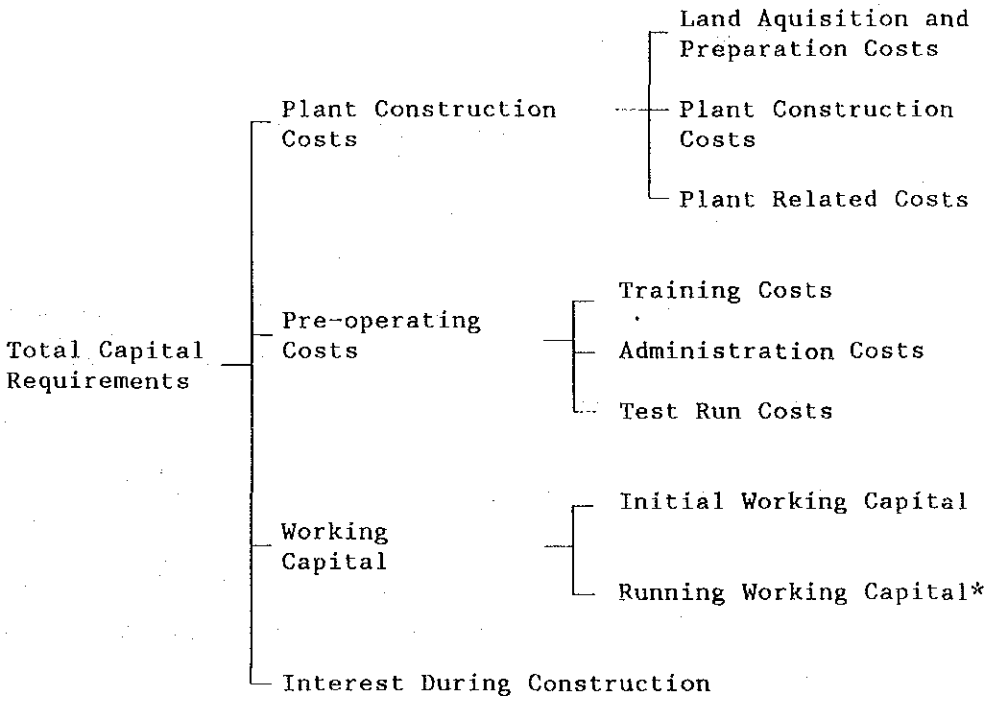
3) Other expenditures

Furniture, fixtures, utilities etc. during the project execution.

CHAPTER IX TOTAL CAPITAL REQUIREMENTS

9.1 General

Total capital requirements, which include the various costs outlined below, are the sum of all investments necessary to bring the fertilizer plant into operating condition.



* Required after operation begins

The total capital requirements based on a plant with phosphate rock and electric power as the main inputs and capable of producing 70,000 tons of phosphate fertilizers anually are described below.

9.2 Major Assumptions

As the source of funding for this project has not yet been secured, the following are assumed for estimating the total capital requirements based on past practices in Paraguay.

1) Contract method

A turnkey/lump sum contract

2) Procurement method

Based on competitive bidding contract

3) Basis of costs

Constant price base as of middle of 1986, no escalation from the figures available for 1986 up to the time when the actual investments is made.

4) Currency and exchange rates

Local costs are calculated in guaranies, and foreign costs in US dollar. The exchange rates used in the analysis are the following three possibilities:

(1) Gs 240/US$ (Base case: Official exchange rate as of July 1986)
(2) Gs 400/US$ (Case 1)
(3) Gs 700/US$ (Case 2)

5) Import tax

Exempt

9.3 Plant Construction Costs

Plant contruction costs for this project have already been described in Section 8.2. Table 9-3-1 lists plant construction costs for Scenario 1, in which imported ammonia would be used in production of phosphate fertilizers, for Scenario 2, in which the ammonia would be produced at the plant, and for Scenario 3, which is a separate plant for producing FMP. Table 9-3-2 shows the costs for plant related costs such for power cable works, water intake works and access road preparation.

Table 9-3-1 Plant Construction Cost Summary

	Scenario 1		Scenario 2		Scenario 3	
	Foreign Currency Portion (Mil.US$)	Domestic Currency Portion (Mil.Gs)	Foreign Currency Portion (Mil.US$)	Domestic Currency Portion (Mil.Gs)	Foreign Currency Portion (Mil.US$)	Domestic Currency Portion (Mil.Gs)
Land Aquisition and Preparation	-	198.0	-	205.4	-	138.0
Plant and Offsite	31.01	515.8	41.61	832.2	6.35	109.4
Civil and Building	3.20	328.0	3.80	384.0	1.40	119.9
Total	34.21	1,041.8	45.41	1,421.6	7.75	367.3

Table 9-3-2 Plant Related Cost Surmmary

Cable Cost	231 Million Gs
Water Pipeline	46 Million Gs
Access Road	31 Million Gs

9.4 Pre-operating Costs

Pre-operating costs, listed in Table 9-4-1 and Table 9-4-2 include training and administration costs that are incurred before the plant starts into operation.

1) Training costs

Training costs for overseas trainees (10 persons @1.5 months each) are given in Table 9-4-1, and include overseas living costs, travelling costs and trainer costs.

Table 9-4-1 Training Cost

(Unit: Million US$)

	Cost
Overseas Living Cost	0.03
Travelling Cost	0.04
Trainer Cost	0.03
Total	0.10

2) Administration costs

Administration costs, listed in Table 9-4-2, include salaries for employees required during construction and other related costs.

Table 9-4-2 Administration Cost (Scenario 1)

(Unit: Million Gs)

Year	-3yr	-2yr	-1yr	Total
Project Director	11.1	11.1	11.1	33.3
Project Manager	7.4	7.4	7.4	22.2
Engineer	33.3	33.3	33.3	33.3
Operator	-	-	45.4	45.4
Staff	29.6	29.6	29.6	88.8
Worker	-	-	45.0	45.0
Sub-Total	81.4	81.4	171.8	334.6
Others	24.4	24.4	51.5	100.2
Total	105.8	105.8	223.3	434.9

3) Test run costs

Test run costs cover costs of utilities and materials used in test operation. The test run period is designed to last for three months during plant construction, and the costs for utilities and materials are expected to be about 50% of full load operation. The cost of utilities and materials used in test operation should be covered by sales of the final products manufactured during this period. Therefore the costs are not counted in the pre-operating costs.

9.5 Working Capital

Working capital is required for financial trouble-free running of the plant during normal operation, and is usually divided into initial working capital and running working capital. In this analysis, only initial working capital is included in the total capital requirements calculation. Running working capital, derived by subtracting the accounts payable amount from the total of raw material inventory costs, product inventory costs and accounts receivable amount, is calculated in the financial statements after the start of commercial operation.

1) Initial working capital

(1) Cash on hand

One year's labor costs is set aside as cash on hand in the year before operation begins.

(2) Spare parts

Spare parts costs are included in the plant construction costs.

2) Running working capital

(1) Raw material inventory costs

These costs are based on an estimated 15 days worth of raw materials kept in inventory, and are calculated according to the per/day cost of the raw materials.

(2) Product inventory costs

Based on an estimated 15 days worth of inventory, these costs are then calculated according to per/day production costs.

(3) Accounts receivable

A one month period of grace is extended to buyers of the fertilizer products, resulting in one month's total sales held in accounts receivable.

(4) Accounts payable

A month period of grace on payment for raw materials is held in accounts payable.

9.6 Financial Plan and Interest During Construction

The following assumptions are used in calculating interest during construction.

1) Equity and Debt

The project owner is expected to bear 30% of the plant construction costs (equity). That portion of the total capital requirements not provided by the project owner should be covered by a long term loan.

2) Conditions on the long term loan

The long term loan's interest and repayment terms are as follows:

Interest: 10% annually
Repayment: 3 year grace period, after which the balance must be repayed in equal amounts once a year for ten years.

9.7 Disbursement Schedule

At the present stage, the contract specifying construction and other costs has not yet been finalized, so an accurate estimate of financing demand is impossible. A generalized disbursement schedule, however, can be studied, and is presented in Table 9-7-1 for Scenario 1. Interest costs during construction are included as one part of construction costs.

9.8 Estimates of Total Capital Requirements

Total capital requirements include all investments necessary before the plant begins operating on a commercial basis. The estimated total capital requirements for Scenario 1, which involces import of ammonia, is listed in Table 9-8-1, and that for Scenario 2, in which ammonia would be produced at the plant, in Table 9-8-2. The tables give alternative figure based on three possible guaranie to US dollar conversion rates. In addition to the total capital requirements for Scenario 1 and 2, that for Scenatio 3 is shown in Table 9-8-3.

Table 9-7-1 Disbursement Schedule of Scenario 1

	-3yr	-2yr	-1yr	Total
Foreign Currency Portion (Million US$)				
Plant Construction Cost	16.28	13.89	4.04	34.21
Pre-operating Cost	-	-	0.10	0.10
Interest-During Construction		1.14	2.22	3.36
Total	16.28	15.03	6.36	37.67
Domestic Currency Portion (Million Gs)				
Land Cost	198.0	-	-	198.0
Plant Construction Cost	281.8	416.8	145.2	843.8
Plant Related Facility Cost	31.0	46.0	231.0	308.0
Pre-operating Cost	105.8	105.8	223.3	434.9
Interest During Construction		43.1	88.7	131.8
Initial Working Capital	-	-	196.3	196.3
Total	616.6	611.7	884.5	2,112.8

Table 9-8-1 Total Capital Requirement of Scenario 1
(Import of Ammonia)
- Middle of 1986 Constant Price Base -

(Unit: Million Gs)

	Base Case (Gs 240/US$)	Case 1 (Gs 400/US$)	Case 2 (Gs 700/US$)
Land Cost	198.0	198.0	198.0
Plant Construction Cost including Plant Related Facilities	9,362.2	14,835.8	25,098.8
Pre-operating Cost	458.9	474.9	504.9
Initial Working Capital	196.3	196.3	196.3
Interest During Construction	938.2	1,476.6	2,486.3
Total	11,153.6	17,181.6	28,484.3

Table 9-8-2 Total Capital Requirement of Scenario 2
(Production of Ammonia)
- Middle of 1986 Constant Price Base -

(Unit: Million Gs)

	Base Case (Gs 240/US$)	Case 1 (Gs 400/US$)	Case 2 (Gs 700/US$)
Land Cost	205.5	205.5	205.5
Plant Construction Cost including Plant Related Facilities	12,422.6	19,688.2	33,311.2
Pre-operating Cost	458.9	474.9	504.9
Initial Working Capital	251.2	251.2	251.2
Interest During Construction	1,213.5	1,917.1	3,236.1
Total	14,551.7	22,536.9	37,508.9

Table 9-8-3 Total Capital Requirement of Scenario 3
(Production of FMP)
- Middle of 1986 Constant Price Base -

(Unit: Million Gs)

	Base Case (Gs 240/US$)	Case 1 (Gs 400/US$)	Case 2 (Gs 700/US$)
Land Cost	138.0	138.0	138.0
Plant Construction Cost including Plant Related Facilities	2,397.3	3,637.3	5,962.3
Pre-operating Cost	427.0	443.0	473.0
Initial Working Capital	127.1	127.1	127.1
Interest During Construction	244.6	360.4	577.1
Total	3,334.0	4,705.8	7,278.1

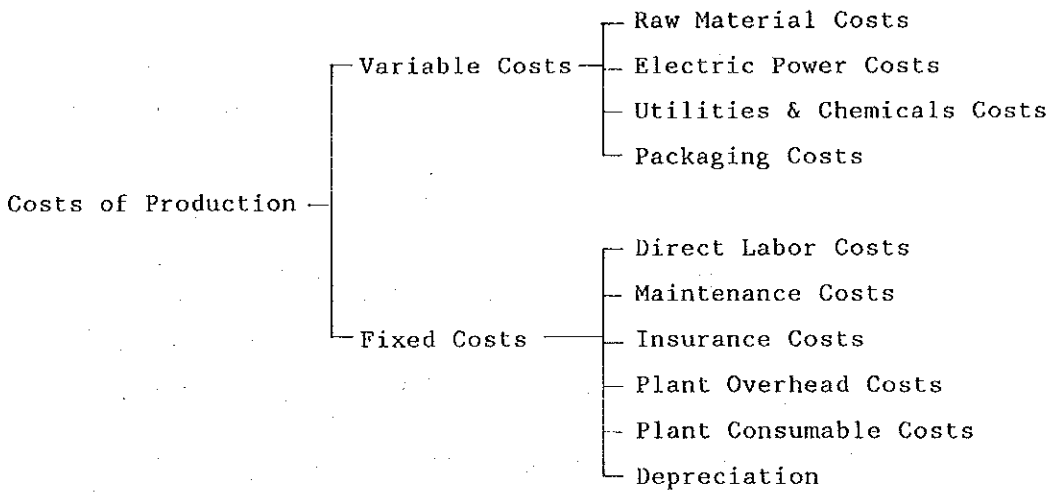
CHAPTER X FINANCIAL ANALYSIS

10.1 General

This financial analysis applied the analytical method commonly used in industrial investment projects to evaluate the financial soundness of the Paraguayan fertilizer plant project. It means that financial statements are drawn up based on the total capital requirements, total costs for production of fertilizers, and expected income from product sales. From financial statements, the financial internal rate of return (FIRR) is calculated and used to appraise the project from a financial standpoint. The analyses of Scenario 1, in which ammonia is imported, and Scenario 2, which is production of ammonia in situ are presented hereinafter, and Scenario 3, which is FMP production, is shown in section 10.5 of this chapter.

10.2 Costs of Production and Cost of Goods Sold

Costs of production can be divided into fixed and variable costs, then broken down further into a number of detailed cost items. Below is a diagram of these followed by a brief description of each.



10.2.1 Raw Material Costs

1) Phosphate rock

At present, phosphate rock suitable for fertilizer production can not be obtained in Paraguay. Until domestic sources are developed, this fertilizer project will thus have to rely on imported phosphate rock for raw material. Florida, Morocco and Brazil are all capable of supplying the necessary rock. As was detailed in Section 6.2, Brazil is favorably located and has deep economic ties with Paraguay. In addition, Goias phosphate rock from Brazil would be offered at a competitive price; and is thus the logical choice for use in the Paraguayan plant. The unit price of this material is as follows:

Price of Phosphate Rock

	Foreign Currency Portion	Domestic Currency Portion
FOB price at Goias	US$31.7/ton	-
Transportation Cost	US$35.0/ton	-
Import Charges	-	8% of foreign currency portion

The plant requires approximately 77,240 ton of phosphate rock annually, resulting in the following estimates of total yearly costs in terms of local currency.

Yearly Cost for Phosphate Rock

(unit: million Gs)

Base Case	(Gs240/US$)	1,335.4
Case 1	(Gs400/US$)	2,225.6
Case 2	(Gs700/US$)	3,894.8

2) Ammonia

In the case of Scenario 1, ammonia would not be produced, but would be imported instead. Followings are the necessary amounts, per unit cost delivered to the plant, and total yearly costs for this material.

Price of Ammonia

	Foreign Currency Portion	Domestic Currency Portion
CIF Price	US$180/ton	--
Import Charges	--	8% of foreign currency portion

Ammonia Requirement

For DAP	For NPK(6-30-10)	For NPK(15-15-15)	Total
6,409t/y	2,371t/y	245t/y	9,025t/y

Yearly cost for Ammonia

		(unit: million Gs)
Base Case	(Gs240/US$)	421.1
Case 1	(Gs400/US$)	701.8
Case 2	(Gs700/US$)	1,228.1

3) Other raw materials

Other raw materials needed for production of phosphate fertilizers are listed below, followed by their yearly requirements and total annual costs.

3) Other Raw Materials

Other raw materials needed for production of phosphate fertilizers are listed below, followed by their yearly requirements and total annual costs.

Price of Other Raw Materials

		Foreign Currency Portion	Domestic Currency Portion
M. Potash	Imp.	US$140/t	8% of foreign currency portion
Silica Gravel	Dom.	-	Gs4,000/t
Coke	Imp.	US$130/t	8% of foreign currency portion
Urea	Imp.	US$75/t	8% of foreign currency portion
Electrode	Imp.	US$3,000/t	8% of foreign currency portion
Coating Agent	Dom.	-	Gs80,000/t

Yearly Requirement of Other Raw Material

	Scenario 1	Scenario 2
M. Potash	6,399t/y	6,399t/y
Silica Gravel	35,270t/y	35,270t/y
Coke	16,240t/y	16,240t/y
Urea	884t/y	884t/y
Elect.Rod	279t/y	279t/y
Coating Agent	360t/y	360t/y
Membrame and Electrode	-	US$235,000/y

Yearly Cost of Other Raw Material

(unit: million Gs)

		Scenario 1	Scenario 2
Base Case	(Gs240/US$)	1,206.4	1,262.8
Case 1	(Gs400/US$)	1,897.3	1,991.3
Case 2	(Gs 700/US$)	3,193.1	3,357.6

10.2.2 Electric Power Costs

This financial analysis is based on purchase of electric power directly from Itaipu Bi-National. The rate would be the same as ANDE now pays to Itaipu, but the power would have to be contracted for on a predetermined monthly amount at least two years in advance.

The present rate payed by ANDE is US$10/kW·M, but this rate is current only through 1986. In addition, a power cable will have to be layed from the Itaipu power station to the plant site, and the cost of this is included in plant construction related costs. The yearly power requirements of the fertilizer plant, based on an annual production figure of 70,000 ton phosphate fertilizers, are listed below.

Power Requirement

	Ammonia	Electric Furnace	Posphoric Acid	DAP	NPK (6-30-10)	NPK (15-15-15)	TSP	Others
Operation(d/y)	301	300	330	137	125	19	39	365
Scenario 1								
Power (kW)	-	23,764	480	353	340	351	267	530
Scenario 2								
Power (kW)	15,000	23,764	480	353	340	351	267	620

Assuming that the ratio of actually used power to contracted power averages 95%, the monthly contracted amounts are as estimated below.

Contracted Power

	Scenario 1	Scenario 2
For 10 months	26,449kW	42,334kW
For 1 month	1,432kW	1,432kW
For 1 month	700kW	700kW

The total annual electric power costs are calculated below. This amount must be paid to ANDE, then ANDE forwards to Itaipu Bi-National in US dollar.

Yearly Power Cost

(unit: million Gs)

		Scenario 1	Scenario 2
Base Case	(Gs240/US$)	639.9	1,021.1
Case 1	(Gs400/US$)	1,066.5	1,701.9
Case 2	(Gs700/US$)	1,866.4	2,978.3

10.2.3 Utilities and Chemicals Costs

Utilities and chemicals necessary for the fertilizer plant are listed below along with their unit price, followed by estimates of the necessary yearly requirements and total annual cost.

Utilities Price

	Foreign Currency Portion	Domestic Currency Portion
Fuel Oil		Gs75/l
Lime (CaO 65%)		Gs20/t
HCl (HCl 36%)	US$140/t	8% of foreign currency portion
NaClO	US$130/t	-ditto-
NaOH	US$350/t	-ditto-
Oxgen	US$1.5/$m^3$	-ditto-
Nitrogen	US$1.8/$m^3$	-ditto-

Yearly Requirement of Utilities

	Scenario 1	Scenario 2
Fuel Oil	1,735t/y	1,735t/y
Line (CaO 65%)	863t/y	863t/y
HCl (HCl 36%)	0.711t/y	0.711t/y
NaClO	3,046t/y	3,046t/y
NaOH	2,538t/y	2,538t/y
Oxygen	40,610m^3/y	-
Nitrogen	1,000m^3	-
Catalyst	-	US$6 thousand/y
Others	Gs10 million/y	Gs10 million/y

Yearly Cost of Utilities

(unit: million Gs)

Base Case (Gs240/US$)	Scenario 1	Scenario 2
Case 1 (Gs400/US$)	516.4	505.6
Case 2 (Gs700/US$)	749.2	731.2
	1,185.6	1,154.4

10.2.4 Packaging Costs

Packaging costs vary greatly depending on whether the product is shipped in gaseous, liquid or solid form. For liquids and gases, the necessary shipping facilities and utilities costs are normally included in the auxiliary facilities cost, and the required labor in direct or indirect labor costs.

For solid such as fertilizers, the packaging cost is incurred in bagging the product for shipment. For convenience of analysis, packaging costs are treated as the independent cost item. Packaging costs include the cost of bags, bagging machines and facilities, loading facilities, and required labor and utilities. The machines and facilities, however, are calculated in the plant construction costs, and the utilities and labor into utilities costs and direct labor costs. This leaves the cost of the bags, which is 300 guranies for one sheet of bag.

1.2.5 Direct Labor Costs

Direct labor costs include those workers, such as operators and shippers, directly involved in work operations, as well as foremen and chiefs. Higher level personnel, engineers, procurement, warehouse service and administrative officers such as accountants, are placed in the indirect labor costs category. Maintenance workers and technicians fall somewhere in between the direct and indirect categories, but as they often not only repair and maintain the plant, but perform other associated tasks as well, they are considered as indirect in many cases. However, in this study, the costs are counted in the category of maintenance costs.

Direct labor costs include those occurred for operators, semi-skilled workers and drivers in the ammonia section, phosphoric acid section, granulation section, testing section, raw materials section, product handling section, water treatment section, electric power section, chemicals handling section, shipping section and storage section. The total personnel requirements of these workers are listed below for Scenario 1 and Scenario 2.

Monthly costs for operators, workers and drivers are listed below. Besides the monthly salary and other associated costs, an annual bonus of one month's pay is also included.

Direct Labor Requirement

	Scenario 1	Scenario 2
Operator	49	57
Worker	81	117
Driver	14	14
Total	143	188

Labor Cost per Head

	Salary	Associated Cost	Bonus
Operator	Gs100,000/M	46%	1 month
Worker	Gs60,000/M	46%	1 month
Driver	Gs60,000/M	46%	1 month

10.2.6 Maintenance Costs

Maintenance costs are those incurred in repairing facilities and equipment. Introduction of new machines, improvements in the plant and large scale replacements come under capital investments, and thus do not figure in maintenance costs. In general, maintenance costs can be broken down into on-the-spot repair of equipment that malfunctions during operation, and periodic repairs during which the plant is shut down.

From another standpoint, maintenance costs can be viewed as composite of materials costs and labor costs. Labor is divided into routine repair work done by technicians, specialized work such as welding and electrical repairs, and work which must be done by outside sub-contractors. Some of the in-house repaire men also perform other tasks associated with the equipment. The labor cost for plant maintenance is counted in the maintenance costs in this study.

With the exception of serious breakdowns outside the scope of normal expectations, maintenance costs can be considered as relatively fixed, and expressed as a percentage of capital investment in equipment. In the fertilizer plant, annual maintenance costs for the main production facilities should be about 3% of the amount invested in these facilities.

For auxiliary facilities, this percentage should be around 1.5%. In this study, however, the total plant maintenance costs, including labor costs for plant maintenance workers, is estimated at 3% of plant construction costs. Approximately half of this should be prepared in foreign currency.

10.2.7 Insurance Costs

Damage insurance rates are not fixed according to terms of the contract, but are expected to decrease each year as the value of the equipment depreciates through loss and aging. In addition, the degree of risk differs between the basic production equipment and the auxiliary facilities, so these naturally should have separate insurance rates. If flood damage insurance is required, the rates will be greater. This study, however, concludes that insurance for the plant, covering only fire and explosion, should be about 0.6% of plant construction costs, payable in local currency.

10.2.8 Plant Overhead Costs

This category includes all costs indirectly necessary for operation of the plant; such as indirect labor cost in the plant, office materials, heating and illumination, fire prevention, crime control, medical, telephone and communications, travel expense accounts and other miscellaneous costs. These costs varies greatly according to the strategy for managing the plant, thus a comprehensive budget plan should be drawn up with guide lines for plant management.

For the Paraguayan fertilizer project, plant overhead cost are estimated at 50% of direct labor cost, payable in local currency.

10.2.9 Plant Consumable Costs

These costs include miscellaneous items and materials necessary for operating the plant, such as machine lubricating oil, greases, protective clothing such as work gloves and long boots, and cleaning utensils such as rags and mops. These costs are difficult to determine in advance, but should be expected to run around 10% of direct labor costs, payable in local currency.

10.2.10 Depreciation

Depreciation is as follows:

For plant and equipment:	6% p.a. straight line
For buildings and civil works:	3% p.a. straight line

There are no fixed rates of amortization of the pre-operating costs and interests during construction, but this calculation assumes them both to be fixed at 6% p.a. Also, the balance of project end on depreciation payment is counted in the residue value of plant.

10.2.11 Cost of Goods Sold

Cost of goods sold is calculated by adding the beginning of the year inventory to the annual production costs, then subtracting the end of the year inventory. Inventory is expected to be 0.5 month's worth. Assuming 100% operation load, the cost of goods sold for Scenario 1 (ammonia imported) and Scenario 2 (ammonia produced in situ) are calculated in Tables 10-2-1 and 10-2-2 respectively.

Table 10-2-1 Cost of Goods Sold (Scenario 1)

(For 5th year of operation)

	(million Gs)	(Gs/kg of Phosphate Fertilizer)
Variable Costs		
Initial Inventory of Raw Materials	123.5	
Raw materials Purchased	2,962.8	
Final Inventory of Raw Materials	123.5	
Raw Materials Consumed	2,962.8	42.3
Electricity	639.9	9.1
Utilities & Chemicals	516.4	7.3
Bag	420.0	6.0
Sub-total	4,539.1	64.8
Fixed Costs		
Direct Labor	196.3	2.8
Maintenance	280.9	4.0
Insurance	46.8	0.7
Plant Consumables	19.6	0.3
Plant Overhead	98.2	1.4
Sub-total	641.8	9.2
Total Operating Costs	5,180.8	74.0
Depreciation	519.6	7.4
Amortization	83.8	1.1
Cost of Production	5,784.3	82.6
Initial Inventory of Products	241.0	
Cost of Production	5,784.3	
Final Inventory of Products	241.0	
Cost of Goods Sold	5,784.3	82.6

Table 10-2-2 Cost of Goods Sold (Scenario 2)

(For 5th year of operation)

	(million Gs)	(Gs/kg of Phosphate Fertilizer)
Variable Costs		
Initial Inventory of Raw Materials	108.3	
Raw Materials Purchased	2,598.1	
Final Inventory of Raw Materials	108.3	
Raw Materials Consumed	2,598.1	37.1
Electricity	1,021.1	14.6
Utitities & Chemicals	505.6	7.2
Bag	420.0	6.0
Sub-total	4,544.9	64.9
Fixed Costs		
Direct Labor	251.2	3.6
Maintenence	372.7	5.3
Insurance	62.1	0.9
Plant Consumables	25.1	0.4
Plant Overhead	125.6	1.8
Sub-total	836.7	12.0
Total Operating Costs	5,381.6	76.9
Depreciation	697.2	10.0
Amortization	100.3	1.4
Cost of Production	6,179.2	88.3
Initial Inventory of Products	257.5	
Cost of Production	6,179.2	
Final Inventory of Products	257.5	
Cost of Goods Sold	6,179.2	88.3

10.3 Sales

10.3.1 Sales Planning

Yearly production and product mix are as follows. 80% operation load is expected during the first year of commercial operation, 90% during the second, and 100% from the third onward. All of the fertilizer produced is expected to be sold.

DAP (18-46-0)	29,000 t/y
TSP (0-46-0)	5,000 t/y
NPK (6-30-1)	32,000 t/y
NPK (15-15-15)	4,000 t/y

10.3.2 Price

Ex-plant prices were settled by discussion with the concerned Paraguayan people based on farm-gate prices described in the market analysis presented in Chapter IV. Table 10-3-1 lists these along with farm-gate prices in Paraguay, FOB Brazil prices for Paraguayan and world market prices. As can be seen, domestic prices in Paraguay are exceptionally high by present world standards.

Table 10-3-1 Selling Price of Products

	Ex-plant Price (Gs/kg)	Farm-gate Price in 1985/86 (Gs/kg)	FOB Brazil for Paraguay 1985 (US$/t)	International Market (US$/t)
DAP (18-46-0)	101	126	341	165-175
TSP (0-46-0)	76	95	250	120-135
NPK (6-30-10)	95	119	-	-
NPK (15-15-15)	86	108	-	-

The World Bank has estimated prices for major fertilizer products for 1990, which are listed below.

DAP	US$363/t	(Gs87/kg)
TSP	US$253/t	(Gs60/kg)
Phosphoric acid	US$506/t	P_2O_5

These represent the minimum prices which phosphate fertilizer makers will offer in an attempt to recover their new investment. Using these estimates for comparison, the present international fertilizer prices can be seen as exceptionally low because of an overability to supply.

If world prices do rise over the next few years as analyzed by the World Bank, the ex-plant prices quoted in this report for the Paraguayan project might not seem so unduly high.

10.3.3 Sales Amounts

The sales amount for each fertilizer type can be calculated by multiplying the yearly capacity by the operation load and the sales prices. The sum of all these is the total annual sales. Table 10-3-2 shows yearly production capacity and sales amounts at full operation period.

Every year, however, inventory will be adjusted by selling 0.5 month's worth. In addition, the calcium silicate slag produced as a by-product of yellow phosphorus will be sold for use in soil restoration and as a silica-lime fertilizer. About half of the excess amount (29,295 ton/yr) can be sold for Gs12/kg.

Ferrophosphorous will also be produced as a by-product, but as no market is yet available for this material, it can not be calculated as part of sales.

Table 10-3-2 Sales Revenue

	Product Price (Gs/kg)	Sales Volume (t/y)	Sales Revenue (million Gs)
DAP	101.0	29,000	29,290.0
TSP	76.0	5,000	380.0
NPK(6-30-10)	95.0	32,000	3,040.0
NPK(15-15-15)	86.0	4,000	344.0
Total	95.6(Av.)	70,000	6,693.0
By Product (Slag)	12.0	29,250	351.0
Total	-	99,250	7,044.0

10.4 Financial Evaluation

10.4.1 General

The financial evaluation is conducted mainly by calculating the financial internal rate of return (FIRR) based on the following financial statements.

- Cost of Goods Sold Table
- Income Statement
- Fund Flow Statement
- Balance Sheet

The above statements are calculated for Scenario 1 (ammonia imported) and Scenario 2 (ammonia produced in situ). A sensitivity analysis is then conducted for whichever Scenario is shown to be the most promising. Following are the basic assumptions under which these analyses are made, followed by the results of both levels of analysis.

10.4.2 Major Assumptions

The major assumptions used in these financial analyses are as follows:

1) Project period for financial analysis

Construction period:	3 years
Operation period:	15 years

2) Currency

In Guranies

3) Cost standards

Based on constant prices in the middle of 1986 (without escalation)

4) Operation rate

First year:	80%
Second year:	90%
Third year and after:	100%

5) Short term loans

Once operation has begun, temporary shortages of funds will be met by short term loan with the following terms:

Interest rates:	25% p.a.
Repayment:	Yearly repayment

6) Corporate tax

Corporation, limited liability companies and other commercial enterprises are dominant in the country and companies are subject to income tax as follows:

Taxation

Taxable Income in Guaranies			Tax	
			Base Amount	Percent on Excess Over Base Amount
From 1	to	500,000		25%
500,001	to	1,000,000	125,000	26%
1,000,001	to	2,000,000	255,000	27%
2,000,001	to	3,500,000	525,000	28%
3,500,001	to	5,000,000	945,000	29%
5,000,001		plus	1,380,000	

A preferential clause, however, exempts 50% of the assessable tax for 5 years following the first taxable income statement.

7) Administration cost

Equivalent to 50% of direct labor cost

8) Sales cost

Equivalent to 10% of direct labor cost

10.4.3 Results of Financial Analysis

1) Scenario comparison

Tables 10-4-1 through 10-4-4 present results of Cost of Goods Sold and Income Statement of Scenario 1 (ammonia imported) and Scenario 2 (ammonia produced in situ) without sales of by-product (slag) for both scenarios.

Scenario 2 results in higher production costs; and as can be seen from the profit and loss statement (Table 10-4-4), it would leave the plant operation in the red for the entire period of project implementation. These losses could possibly be recovered by raising the price of the product fertilizer; but Scenario 1 would allow the fertilizer to be produced at lower costs and sold at the same price, resulting in continuous profits from the 5th year of operation.

This report thus concludes that ammonia should not be produced in Paraguay until the following two conditions are met:

* The demand for ammonia increases to the point where the plant enjoys profit from economy of scale.

* Electric power costs become competitive with natural gas; or a domestic source such as natural gas or some other inexpensive raw material is developed for ammonia production.

Table 10-4-1 Cost of Goods Sold

Scenario 1

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Variable Operating Cost																			
Initial Inventory of Raw Materials	--	--	--	0.0	98.8	111.1	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	--
Raw Materials Purchased	--	--	--	2,469.0	2,678.9	2,975.1	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	43,676.7
Final Inventory of Raw Materials	--	--	--	98.8	111.1	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	--
Raw Materials Consumed	--	--	--	2,370.2	2,666.5	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	43,553.2
Electricity	--	--	--	511.9	575.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	9,406.4
Utilities & Chemicals	--	--	--	413.1	464.7	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	7,590.8
Bag	--	--	--	336.0	378.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	6,174.0
Sub-total	--	--	--	3,631.3	4,085.2	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	66,724.4
Fixed Operating Cost																			
Direct Labor Cost	--	--	--	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	2,944.5
Maintenance Cost	--	--	--	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	4,213.0
Insurance Cost	--	--	--	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	702.2
Plant Consumables	--	--	--	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	294.5
Plant Overhead	--	--	--	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	1,472.3
Sub-total	--	--	--	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	9,626.4
Total Operating Cost	--	--	--	4,273.0	4,726.9	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	76,350.8
Depreciation	--	--	--	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	7,794.2
Amortization	--	--	--	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	1,257.3
Cost of Production	--	--	--	4,876.5	5,330.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,402.3
Initial Inventory of Products	--	--	--	0.0	203.2	222.1	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	--
Cost of Production	--	--	--	4,876.5	5,330.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,402.3
Final Inventory of Products	--	--	--	203.2	222.1	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	--
Costs of Goods Sold	--	--	--	4,673.3	5,311.4	5,765.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,161.3

Excluding sales of by-product (slag)

Table 10-4-2 Income Statement

Scenario 1

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sales Revenue																			
DAP	--	--	--	2,245.6	2,623.9	2,916.8	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	42,934.3
TSP	--	--	--	291.3	340.4	378.4	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	5,570.2
NPK(6-30-10)	--	--	--	2,330.7	2,723.3	3,027.3	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	44,561.3
NPK(15-15-15)	--	--	--	263.7	308.2	342.6	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	5,042.5
By-products	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Revenue	--	--	--	5,131.3	5,995.8	6,665.1	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	98,108.2
Costs of Goods Sold	--	--	--	4,673.3	5,311.4	5,765.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,161.3
Administration Cost	--	--	--	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	1,472.3
Sales Expense	--	--	--	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	294.5
Cost Total	--	--	--	4,791.0	5,429.2	5,883.1	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	86,928.0
Interest on Long-term Loan	--	--	--	808.9	808.9	808.9	808.9	728.0	647.1	566.2	485.3	404.4	323.6	242.7	161.8	80.9	0.0	0.0	6,875.6
Interest on Short-term Loan	--	--	--	0.0	70.1	16.0	0.0	54.2	101.4	141.0	171.9	192.3	200.0	192.2	175.7	142.1	88.1	0.0	1,544.9
Net Profit before Tax	--	--	--	-468.6	-312.4	-42.9	-17.9	8.8	42.5	83.7	133.7	194.2	267.4	356.0	453.5	567.9	702.8	791.0	2,759.8
Tax	--	--	--	0.0	0.0	0.0	0.0	2.0	7.1	13.3	20.7	29.8	81.6	108.2	137.4	171.8	212.2	238.7	1,022.8
Net Profit after Tax	--	--	--	-468.6	-312.4	-42.9	-17.9	6.8	35.4	70.5	113.0	164.4	185.8	247.9	316.1	396.2	490.6	552.3	1,737.0

Excluding sales of by-product (slag)

Table 10-4-3 Cost Goods Sold

Scenario 2

[Unit : MWGs]

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Variable Operating Cost																			
Initial Inventory of Raw Materials	--	--	--	0.0	87.1	97.7	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	--
Raw Materials Purchased	--	--	--	2,176.9	2,354.6	2,608.7	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	38,317.7
Final Inventory of Raw Materials	--	--	--	87.1	97.7	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	108.3	--
Raw Materials Consumed	--	--	--	2,089.8	2,344.0	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	2,598.1	38,209.5
Electricity	--	--	--	816.9	919.0	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	1,021.1	15,019.7
Utilities & Chemicals	--	--	--	404.5	455.1	505.6	505.6	505.6	505.6	505.6	505.6	505.6	505.6	505.6	505.6	505.6	505.6	505.6	7,432.7
Bag	--	--	--	336.0	378.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	6,174.0
Sub-total	--	--	--	3,647.2	4,096.0	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	4,544.9	66,826.8
Fixed Operating Cost																			
Direct Labor Cost	--	--	--	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	3,768.0
Maintenance Cost	--	--	--	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	372.7	5,590.2
Insurance Cost	--	--	--	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	62.1	931.7
Plant Consumables	--	--	--	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	376.8
Plant Overhead	--	--	--	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	1,884.0
Sub-total	--	--	--	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	836.7	12,550.7
Total Operating Cost	--	--	--	4,483.9	4,932.8	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	5,381.6	79,377.5
Depreciation	--	--	--	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	697.2	10,458.5
Amortization	--	--	--	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	1,505.2
Cost of Production	--	--	--	5,281.5	5,730.3	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	91,341.2
Initial Inventory of Products	--	--	--	0.0	220.1	238.8	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	--
Cost of Production	--	--	--	5,281.5	5,730.3	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	91,341.2
Final Inventory of Products	--	--	--	220.1	238.8	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	257.5	--
Costs of Goos Sold	--	--	--	5,061.4	5,711.6	6,160.5	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	91,083.7

Excluding sales of by-product (slag)

Table 10-4-4 Income Statement

Scenario 2

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sales Revenue																			
DAP	--	--	--	2,245.6	2,623.9	2,916.8	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	42,934.3
TSP	--	--	--	291.3	340.4	378.4	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	5,570.2
NPK(6-30-10)	--	--	--	2,330.7	2,723.3	3,027.3	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	44,561.3
NPK(15-15-15)	--	--	--	263.7	308.2	342.6	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	5,042.5
By-products	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Revenue	--	--	--	5,131.3	5,995.8	6,665.1	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	6,693.0	98,108.2
Costs of Goos Sold	--	--	--	5,061.4	5,711.6	6,160.5	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	6,179.2	91,083.7
Administration Cost	--	--	--	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	1,884.0
Sales Expense	--	--	--	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	376.8
Cost Total	--	--	--	5,212.1	5,862.4	6,311.2	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	6,329.9	93,344.5
Interest on Long-term Loan	--	--	--	1,055.0	1,055.0	1,055.0	1,055.0	949.5	844.0	738.5	633.0	527.5	422.0	316.5	211.0	105.5	0.0	0.0	8,967.7
Interest on Short-term Loan	--	--	--	0.0	184.6	274.0	328.0	635.2	990.1	1,405.0	1,894.1	2,475.2	3,170.5	4,087.3	5,019.7	6,249.7	7,749.6	9,331.0	43,713.9
Net Profit before Tax	--	--	--	-1,135.9	-1,106.2	-975.1	-1,020.0	-1,221.6	-1,471.1	-1,780.4	-2,164.0	-2,639.6	-3,229.4	-3,960.7	-4,867.6	-5,992.1	-7,386.5	-8,967.9	-47,918.0
Tax	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit after Tax	--	--	--	-1,135.9	-1,106.2	-975.1	-1,020.0	-1,221.6	-1,471.1	-1,780.4	-2,164.0	-2,639.6	-3,229.4	-3,960.7	-4,867.6	-5,992.1	-7,386.5	-8,967.9	-47,918.0

Excluding sales of by-product (slag)

2) Results of financial analyses for Scenario 1

Tables 10-4-5 through 10-4-8 present results of financial statement for Scenario 1. These calculations assume that half of the excess by-product slag (29,295 ton/yr) is sold. The following discussions concern financial factors of Scenario.

(1) Sales revenue

Sale of the by-product slag at Gs 12/kg would add a substantial boost to this project's financial potential as shown in the financial statements.

The revenue will increase from Gs 6,693.0 million/y to Gs 7,044.5 million/y which shows 5.3% increase. This slag is composed primarily of calcium silicate, and is capable of supplying both the silica and calcium that crops need. In addition, the slag can be used as a soil restorative for correcting the pH balance of overly acidic soil.

(2) Costs of production

In this analysis, costs of production are defined to include fixed and variable costs, as well as depreciation and amortization. Average costs of production for phosphate fertilizer is Gs 82.6/kg. When administrative and sales related expenses are added in, this figure rises to Gs 84.3/kg. With cost of production at this level, the ex-plant price for product fertilizer discussed earlier would be possible.

(3) Income statement/Fund flow statement

When the plant goes into operation, operating rate is assumed to be 80% for 1st year, and for this year, sales revenue will not exceed production costs, but will exceed from 2nd operation year. This project suffers from insufficient cash flow during the 1st operational year but not from 2nd year onward, and can be run at a profit throughout the entire period of operation.

(4) Financial internal rate of return (FIRR)

The financial internal rate of return on investment (FIRR on I) is calculated to be 11.1% before taxes, and 10.2% after taxes. This analysis, however, assumes that the ex-plant fertilizer prices will be sold at the 20% less of the prices now current at farm gate in Paraguay, which are much higher than international prices.

The financial internal rate of return on equity (FIRR on E) is not a particularly high figure, calculated as 12.8% before taxes, and 10.4% after taxes.

Table 10-4-5 Cost of Goods Sold (Scenario 1)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Variable Operating Cost																			
Initial Inventory of Raw Materials	--	--	--	0.0	98.8	111.1	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	--
Raw Materials Purchased	--	--	--	2,469.0	2,678.9	2,975.1	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	43,676.7
Final Inventory of Raw Materials	--	--	--	98.8	111.1	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	--
Raw Materials Consumed	--	--	--	2,370.2	2,666.5	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	2,962.8	43,553.2
Electricity	--	--	--	511.9	575.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	639.9	9,406.4
Utilities & Chemicals	--	--	--	413.1	464.7	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	516.4	7,590.8
Bag	--	--	--	336.0	378.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	6,174.0
Sub-total	--	--	--	3,631.3	4,085.2	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	4,539.1	66,724.4
Fixed Operating Cost																			
Direct Labor Cost	--	--	--	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	2,944.5
Maintenance Cost	--	--	--	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	4,213.0
Insurance Cost	--	--	--	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	46.8	702.2
Plant Consumables	--	--	--	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	294.5
Plant Overhead	--	--	--	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	1,472.3
Sub-total	--	--	--	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	641.8	9,626.4
Total Operating Cost	--	--	--	4,273.0	4,726.9	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	76,350.8
Depreciation	--	--	--	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	519.6	7,794.2
Amortization	--	--	--	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	83.8	1,257.3
Cost of Production	--	--	--	4,876.5	5,330.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,402.3
Initial Inventory of Products	--	--	--	0.0	203.2	222.1	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	--
Cost of Production	--	--	--	4,876.5	5,330.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,402.3
Final Inventory of Products	--	--	--	203.2	222.1	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	--
Costs of Goods Sold	--	--	--	4,673.3	5,311.4	5,765.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,161.3

Including sales of by-product (slag)

Table 10-4-6 Income Statement (Scenario 1)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sales Revenue																			
DAP	--	--	--	2,245.6	2,623.9	2,916.8	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	2,929.0	42,934.3
TSP	--	--	--	291.3	340.4	378.4	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	380.0	5,570.2
NPK(6-30-10)	--	--	--	2,330.7	2,723.3	3,027.3	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	3,040.0	44,561.3
NPK(15-15-15)	--	--	--	263.7	308.2	342.6	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	344.0	5,042.5
By-products	--	--	--	269.5	314.9	350.1	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	5,153.0
Total Revenue	--	--	--	5,400.8	6,310.7	7,015.2	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	103,261.2
Costs of Goods Sold	--	--	--	4,673.3	5,311.4	5,765.4	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	5,784.3	85,161.3
Administration Cost	--	--	--	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	1,472.3
Sales Expense	--	--	--	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	294.5
Cost Total	--	--	--	4,791.0	5,429.2	5,883.1	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	5,902.0	86,928.0
Interest on Long-term Loan	--	--	--	808.9	808.9	808.9	808.9	728.0	647.1	566.2	485.3	404.4	323.6	242.7	161.8	80.9	0.0	0.0	6,875.6
Interest on Short-term Loan	--	--	--	0.0	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8
Net Profit before Tax	--	--	--	-199.1	61.8	323.2	333.6	414.5	495.4	576.3	657.2	738.0	818.9	899.8	980.7	1,061.6	1,142.5	1,142.5	9,446.8
Tax	--	--	--	0.0	10.0	49.2	50.7	62.9	75.0	174.3	198.5	222.8	247.1	271.3	295.6	319.9	344.1	344.1	2,665.4
Net Profit after Tax	--	--	--	-199.1	51.8	274.0	282.9	351.6	420.4	402.0	458.6	515.3	571.9	628.5	685.1	741.7	798.4	798.4	6,781.4

Including sales of by-product (slag)

ROI (before Tax) = 11.1%
ROI (after Tax) = 10.2%
ROE (before Tax) = 12.8%
ROE (after Tax) = 10.4%

Table 10-4-7 Fund Flow Statement (Scenario 1)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sources of Fund																			
Sales Revenue	0.0	0.0	0.0	5,400.8	6,310.7	7,015.2	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	308.2
Equity	1,357.1	1,170.7	536.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long-term Loan	3,166.7	3,048.2	1,874.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Short-term Loan	0.0	0.0	0.0	45.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increase in Account Payable	0.0	0.0	0.0	302.6	37.8	37.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-378.3
Total Source	4,523.8	4,218.9	2,410.9	5,748.5	6,348.6	7,053.0	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	7,044.5	-70.1
Applications of Fund																			
Land	198.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-198.0
Plant Investment	4,220.0	3,796.4	1,345.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1,568.0
Pre-operation Cost	105.8	105.8	247.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Working Capital	0.0	0.0	196.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest during Construction	0.0	316.7	621.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Cost	0.0	0.0	0.0	4,273.0	4,726.9	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	5,180.8	0.0
Administration Cost	0.0	0.0	0.0	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	0.0
Sales Expense	0.0	0.0	0.0	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	0.0
Debt Service																			
- Long-term Loan -																			
Principal	0.0	0.0	0.0	0.0	0.0	0.0	808.9	808.9	808.9	808.9	808.9	808.9	808.9	808.9	808.9	808.9	0.0	0.0	0.0
Interest	0.0	0.0	0.0	808.9	808.9	808.9	808.9	728.0	647.1	566.2	485.3	404.4	323.6	242.7	161.8	80.9	0.0	0.0	0.0
- Short-term Loan -																			
Principal	0.0	0.0	0.0	0.0	45.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest	0.0	0.0	0.0	0.0	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tax Payment	0.0	0.0	0.0	0.0	0.0	10.0	49.2	50.7	62.9	75.0	174.3	198.5	222.8	247.1	271.3	295.6	319.9	344.1	344.1
Increase in Account Recievable	0.0	0.0	0.0	450.1	75.8	58.7	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-587.0
Increase in Raw Material Inventory	0.0	0.0	0.0	98.8	12.3	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-123.5
Total Application	4,523.8	4,218.9	2,410.9	5,748.5	5,797.7	6,188.5	6,968.0	6,886.2	6,817.5	6,748.7	6,767.1	6,710.5	6,653.9	6,597.2	6,540.6	6,484.0	5,618.5	5,642.7	-2,132.4
Cash Surplus	0.0	0.0	0.0	0.0	550.9	864.5	76.5	158.3	227.1	295.8	277.4	334.1	390.7	447.3	503.9	560.6	1,426.1	1,401.8	2,062.3
Cumlative Cash Surplus	0.0	0.0	0.0	0.0	550.9	1,415.4	1,491.9	1,650.2	1,877.3	2,173.1	2,450.5	2,784.6	3,175.2	3,622.6	4,126.5	4,687.0	6,113.1	7,514.9	9,577.2
Cash Flow (ROI before/Tax)	-4,523.8	-3,902.2	-1,789.4	763.8	1,415.7	1,683.4	1,743.5	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	1,745.9	2,406.4
Cash Flow (ROI after/Tax)	-4,523.8	-3,902.2	-1,789.4	763.8	1,415.7	1,673.4	1,694.3	1,695.2	1,683.1	1,670.9	1,571.7	1,547.4	1,523.1	1,498.9	1,474.6	1,450.3	1,426.1	1,401.8	2,062.3
Cash Flow (ROE before/Tax)	-1,357.1	-1,170.7	-536.8	0.0	550.9	874.5	125.7	209.0	289.9	370.8	451.7	532.6	613.5	694.4	775.3	856.1	1,745.9	1,745.9	2,406.4
Cash Flow (ROE after/Tax)	-1,357.1	-1,170.7	-536.8	0.0	550.9	864.5	76.5	158.3	227.1	295.8	277.4	334.1	390.7	447.3	503.9	560.6	1,426.1	1,401.8	2,062.3

Including sales of by-product (slag)

Table 10-4-8 Balance Sheet (Scenario 1)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Current Assets																			
Cash on Hand	0.0	0.0	196.3	196.3	747.2	1,611.7	1,688.2	1,846.5	2,073.6	2,369.4	2,646.8	2,980.9	3,371.5	3,818.9	4,322.8	4,883.3	6,309.4	7,711.2	9,773.5
Account Recievable	0.0	0.0	0.0	450.1	525.9	584.6	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	587.0	0.0
Raw Material Inventory	0.0	0.0	0.0	98.8	111.1	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	123.5	0.0
Product Inventory	0.0	0.0	0.0	203.2	222.1	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	241.0	0.0
Total Current Assets	0.0	0.0	196.3	948.3	1,606.3	2,560.7	2,639.7	2,798.0	3,025.1	3,320.9	3,598.3	3,932.4	4,323.1	4,770.4	5,274.3	5,834.8	7,260.9	8,662.7	9,773.5
Fixed Assets																			
Land	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	0.0
Plant	4,220.0	8,016.4	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	9,362.2	7,794.2
Depreciation	0.0	0.0	0.0	519.6	1,039.2	1,558.8	2,078.4	2,598.1	3,117.7	3,637.3	4,156.9	4,676.5	5,196.1	5,715.7	6,235.3	6,755.0	7,274.6	7,794.2	7,794.2
Book Value	4,220.0	8,016.4	9,362.2	8,842.6	8,323.0	7,803.4	7,283.8	6,764.1	6,244.5	5,724.9	5,205.3	4,685.7	4,166.1	3,646.5	3,126.9	2,607.2	2,087.6	1,568.0	0.0
Intangible Asset	105.8	528.3	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1	1,397.1
Amortization	0.0	0.0	0.0	83.8	167.6	251.5	335.3	419.1	502.9	586.8	670.6	754.4	838.2	922.1	1,005.9	1,089.7	1,173.5	1,257.3	1,257.3
Book Value	105.8	528.3	1,397.1	1,313.2	1,229.4	1,145.6	1,061.8	977.9	894.1	810.3	726.5	642.6	558.8	475.0	391.2	307.4	223.5	139.7	139.7
Total Fixed Assets	4,523.8	8,742.7	10,957.3	10,353.8	9,750.4	9,146.9	8,543.5	7,940.1	7,336.6	6,733.2	6,129.8	5,526.3	4,922.9	4,319.5	3,716.0	3,112.6	2,509.2	1,905.7	139.7
Total Assets	4,523.8	8,742.7	11,153.6	11,302.1	11,356.6	11,707.7	11,183.2	10,738.1	10,361.7	10,054.1	9,728.1	9,458.7	9,246.0	9,089.8	8,990.3	8,947.4	9,770.1	10,568.4	9,913.2
Current Liabilities																			
Account Payable	0.0	0.0	0.0	302.6	340.4	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	0.0
Short-term Loan	0.0	0.0	0.0	45.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tax Payable	0.0	0.0	0.0	0.0	10.0	49.2	50.7	62.9	75.0	174.3	198.5	222.8	247.1	271.3	295.6	319.9	344.1	344.1	0.0
Total Current Liabilities	0.0	0.0	0.0	347.7	350.4	427.4	429.0	441.1	453.3	552.5	576.8	601.0	625.3	649.6	673.9	698.1	722.4	722.4	0.0
Long-term Liabilities	3,166.7	6,214.9	8,088.9	8,088.9	8,088.9	8,088.9	7,280.0	6,471.1	5,662.3	4,853.4	4,044.5	3,235.6	2,426.7	1,617.8	808.9	0.0	0.0	0.0	0.0
Stockholdres Equity																			
Capital	1,357.1	2,527.8	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6	3,064.6
Retained Earning	0.0	0.0	0.0	-199.1	-147.3	126.7	409.6	761.2	1,181.6	1,583.6	2,042.2	2,557.5	3,129.3	3,757.8	4,443.0	5,184.7	5,983.1	6,781.4	6,848.6
Total Equity	1,357.1	2,527.8	3,064.6	2,865.5	2,917.3	3,191.3	3,474.2	3,825.8	4,246.2	4,648.2	5,106.8	5,622.1	6,194.0	6,822.5	7,507.6	8,249.3	9,047.7	9,846.0	9,913.2
Total Equity & Liabilities	4,523.8	8,742.7	11,153.6	11,302.1	11,356.6	11,707.7	11,183.2	10,738.1	10,361.7	10,054.1	9,728.1	9,458.7	9,246.0	9,089.8	8,990.3	8,947.4	9,770.1	10,568.4	9,913.2

Including sales of by-product (slag)

(5) Other indicators

(a) Method for calculating financial indicators

The financial indicators employed in this analysis are calculated according to the following equations.

Debt Service Coverage Ratio
= (Sales Revenue - Cost of Goods Sold - Administration Cost - Sales Expense - Tax Payment)/(Interest on Long Term Loan + Repayment on Long Term Loan)

Profit Breakeven Point

$$= \frac{f}{(r_o - v_o)}$$

f : Fixed Costs + Administration Cost + Sales Expense + Depreciation + Interest on Long Term Loan

r_o : Sales Revenue at Full Capacity

v_o : Variable Costs at Full Capacity

Profit Ratio to Sales
= Profit/Sales Revenue
Cost Benefit Ratio
= Cost of Production/Sales Revenue
Current Ratio
= Current Assets/Current Liability

(b) Results of calculation of financial indicators

Financial indicators calculated according to the above equations are shown in Table 10-4-9, and results are described briefly below.

- Debt service coverage ratio (DSR)

This indicator shows the capability of repayment. The indicator of DSR shows plus for all project years in case that working capital is not counted. The average DSR, however, shows 1.39 which is not high enough.

- Break even point (BEP)

This indicator measures the efficiency of plant operation by comparing sales revenue with production costs. The calculated figure of 0.87 means that 87% of sales revenues can be expected to be sufficient to cover production costs.

- Profit ratio to sales (P/S)

This indicator is designed to measure profitability, but varies widely according to the type of industry. Generally speaking, industries producing high value-added goods will show high profit to sales ratios, while lower order processing will show low values.

Calculations for the Paraguayan fertilizer project come out to 0.06, which is an acceptable level. This indicates that the ex-plant prices determined in the plan are reasonable.

- Cost benefit ratio (C/B)

This is another indicator of profitability, and the ratio of 0.83 calculated for this project demonstrates its soundness.

- Current ratio (C/R)

This indicator measures a project's ability to meet current liabilities. A ratio over 2.0 is usually

considered good. As the Paraguayan plant is not planning to dispose of its profits, the C/R ratio will be very high after the fourth year of operation.

Table 10-4-9 Financial Indicators

	DSR	BEP	P/S	C/B	C/R
1	1.25	0.87	-0.04	0.90	2.73
2	1.81	0.87	0.01	0.84	4.58
3	2.11	0.87	0.04	0.82	5.99
4	1.05	0.87	0.04	0.82	6.15
5	1.10	0.83	0.05	0.82	6.34
6	1.16	0.80	0.06	0.82	6.67
7	1.22	0.77	0.06	0.82	6.01
8	1.21	0.74	0.07	0.82	6.24
9	1.28	0.71	0.07	0.82	6.54
10	1.34	0.67	0.08	0.82	6.91
11	1.43	0.64	0.09	0.82	7.34
12	1.52	0.61	0.10	0.82	7.83
13	1.63	0.58	0.11	0.82	8.36
14	-	0.54	0.11	0.82	10.05
15	-	0.54	0.11	0.82	11.99
Average	1.39	0.73	0.06	0.83	6.92

(6) Sensitivity analysis

Sensitivity Analyses is used to asess the impact against the project by the variation of factors such as selling price of fertilizer, plant construction cost.

(a) Selected factors

The following factors and amount of change have been chosen for sensitivity analysis.

Selling price of fertilizers:	±10%
Plant construction costs:	±10%
Electric power costs:	US$14.06/kW·M
Total operating cost:	±10%
Operating rate:	±10%
Interest on long-term loan:	5% p.a.

(b) Results

The results of the sensitivity analysis are summarized in Table 10-4-10 below.

Table 10-4-10 Results of Sensitivity Analysis

		FIRR on I		FIRR on E	
		Before Tax	After Tax	Before Tax	After Tax
Base Case		11.1	10.2	12.8	10.4
Selling Price	+10%	15.9	14.3	24.6	21.4
	-10%	5.3	5.3	-	-
Plant Construction	+10%	9.7	9.0	9.3	7.3
Cost	-10%	12.7	11.5	16.7	14.0
Electric Cost	US$14.06/kW·M	9.0	8.4	7.2	5.4
Total Operation Cost	+10%	6.7	6.7	-	-
	-10%	14.9	13.5	22.2	19.2
Operating Rate	+10%	13.0	11.8	17.4	14.7
	-10%	9.1	8.5	7.6	5.7
Interest	5% p.a.			20.1	17.1

(c) Evaluation of results

i) Selling price of fertilizers

Changes in the selling price of the product fertilizer would assert a strong influence on the project's feasibility. If the ex-plant price were to increase 10% over the base case figure, after tax FIRR on I would rise from 10.2% to 14.3%, and FIRR on E 10.4% to 21.4%.

Such a rise in fertilizer selling price would be a welcome change, but if a drop of similar magnitude were to occur, the government would be forced to artificially adjust the price to keep the plant operating on a commercial basis.

Thus the possibility of having to compete with prices on the foreign market should be given due consideration in determining the price structure for the plant's products.

ii) Plant construction costs

If a significant change in economic conditions or other unexpected occurrence should emerge during the construction period, the plant construction cost will occasionally exceed the budget.

A 10% increase in plant construction costs would have not so deep impact on the project's feasibility, causing the after tax FIRR on I and FIRR on E to fall to 1.2% and 3.1% respectively.

iii) Electric power costs

If electric power costs were to rise from US$10.00/kW·M to US$14.06/kW·M (expected price from 1987), the FIRR on I (after taxes) would drop to 8.4%, and FIRR on E to 5.4% (after taxes). A rise in electric power costs by itself at this level would show a particularly devastating influence on the project's profitability.

iv) Total operating cost

A 10% increase in total operating costs would exert a powerful destructive effect on the project's feasibility, causing the after tax FIRR on I to fall to 6.7%, and the after tax FIRR on E shows minus value. Thus it is necessary to do everything possible to keep production costs down.

v) Operating rate

The large decrease of operating rate of the plant operation will make financially this project infeasible. It is required that the smooth supply of raw material, careful plant operation and aggressive sales of products in order to maintain high operating rate of the plant.

vi) Interest on long term loan

Interest on the long term loan is one of vital factor for project feasibility.

In case of decrease of interest on lont term loan from 10% p.a. to 5% p.a., after tax FIRR on E rises from 10.4% to 17.1%.

3) Results of the case study

If the exchange rate were to fluctuate from the official rate of Gs 240/US$ current as of mid-1986, the ex-plant selling price of fertilizer would be calculated to show a 10% FIRR on I (after taxes). These calculations are presented in Table 10-4-11 below.

Table 10-4-11 Product Price

	Base Case	Case 1 (Gs400/US$)	Case 2 (Gs700/US$)	Additional Case (Gs550/US$)
DAP	101	156	258	207
TSP	76	117	194	156
NPK(6-30-10)	95	146	243	195
NPK(15-15-15)	86	133	220	176
Slag	12	12	12	12

10.5 Financial Analysis of Scenario 3 (FMP)

10.5.1 Major Assumptions

The major assumptions for the financial analysis for Scenario 3 are the same as for Scenarios 1 and 2.

10.5.2 Cost Base

1) Electricity

Electricity requirement is 2,526kW for 11 months and 450kW for 1 month. The price of electricity for the calculation is US$10/kW·M.

2) Materials and Utilities

The requirements of materials and utilities are as follows:

Phosphate Rock	8,100 t/y*1
Serpentine	6,800 t/y*2
Silica Gravel	885 t/t*1
Electrodes	30 t/y*3
Fuel Oil	150 kl/y*1
Lime	204 t/y*1
NaClO	111 t/y*1

Note:

*1 The prices are the same prices applied to the calculation for Scenarios 1 and 2.

*2 The price of serpentine is estimated at Gs20/kg.

*3 The electrode for FMP production is US$2,500/t and import charges are 8% of US$2,500/t.

3) Others

The other costs required for the production of FMP are the same applied to the analysis for Scenarios 1 and 2 excluding direct labor requirement shown below:

The direct labor requirement for FMP plant operation is as follows:

Operator: 44 person
Worker : 45 person
Driver : 14 person

The cost for labor is the same applied to the calculation of analysis of Scenarios 1 and 2.

10.5.3 Evaluation

From Table 10-5-1 to Table 10-5-4 show the financial statements for FMP production. The price of FMP should normally be lower than that of TSP. In this case, however, the Gs89/kg FMP price which is the price to get 10% of FIRR on I after tax is higher than that of TSP. Thus production of FMP in Paraguay can not be expected to be financially feasible.

Table 10-5-1 Cost of Goods Sold (Scenario 3)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Variable Operating Cost																			
Initial Inventory of Raw Materials	--	--	--	0.0	8.8	9.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	--
Raw Materials Purchased	--	--	--	220.8	239.6	266.1	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	3,906.8
Final Inventory of Raw Materials	--	--	--	8.8	9.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	--
Raw Materials Consumed	--	--	--	212.0	238.5	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	265.0	3,895.8
Electricity	--	--	--	54.2	61.0	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	67.8	996.2
Utilities & Chemicals	--	--	--	16.1	18.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	295.0
Bag	--	--	--	48.0	54.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	882.0
Sub-total	--	--	--	330.3	371.6	412.9	412.9	412.9	412.9	412.9	412.9	412.9	412.9	412.9	412.9	412.9	412.9	412.9	6,069.0
Fixed Operating Cost																			
Direct Labor Cost	--	--	--	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	147.1	2,206.5
Maintenance Cost	--	--	--	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	1,078.8
Insurance Cost	--	--	--	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	179.8
Plant Consumables	--	--	--	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	220.7
Plant Overhead	--	--	--	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	1,103.3
Sub-total	--	--	--	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	319.3	4,789.0
Total Operating Cost	--	--	--	649.5	690.8	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	10,857.9
Depreciation	--	--	--	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	120.9	1,813.8
Amortization	--	--	--	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	604.4
Cost of Production	--	--	--	810.8	852.0	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	13,276.2
Initial Inventory of Products	--	--	--	0.0	33.8	35.5	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	--
Cost of Production	--	--	--	810.8	852.0	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	13,276.2
Final Inventory of Products	--	--	--	33.8	35.5	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	--
Costs of Goods Sold	--	--	--	777.0	850.3	891.6	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	13,238.9

Table 10-5-2 Income Statement (Scenario 3)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Sales Revenue																			
FMP	--	--	--	1,023.5	1,195.9	1,329.4	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	19,568.9
Total Revenue	--	--	--	1,023.5	1,195.9	1,329.4	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	19,568.9
Costs of Goods Sold	--	--	--	777.0	850.3	891.6	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	893.3	13,238.9
Administration Cost	--	--	--	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	1,103.3
Sales Expense	--	--	--	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	220.7
Cost Total	--	--	--	865.2	938.6	979.9	981.6	981.6	981.6	981.6	981.6	981.6	981.6	981.6	981.6	981.6	981.6	981.6	14,562.8
Interest on Long-term Loan	--	--	--	240.7	240.7	240.7	240.7	216.6	192.6	168.5	144.4	120.4	96.3	72.2	48.1	24.1	0.0	0.0	2,046.1
Interest on Short-term Loan	--	--	--	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2
Net Profit before Tax	--	--	--	-82.5	11.4	108.8	112.7	136.8	160.8	184.9	209.0	233.0	257.1	281.2	305.3	329.3	353.4	353.4	2,954.8
Tax	--	--	--	0.0	2.4	17.0	17.6	21.2	24.8	56.9	64.1	71.3	78.5	85.7	93.0	100.2	107.4	107.4	847.5
Net Profit after Tax	--	--	--	-82.5	9.0	91.8	95.1	115.6	136.0	128.1	144.9	161.8	178.6	195.5	212.3	229.2	246.0	246.0	2,107.3

ROI (before Tax) = 11.1%
ROI (after Tax) = 10.0%
ROE (before Tax) = 12.6%
ROE (after Tax) = 10.0%

Table 10-5-3 Fund Flow Statement (Scenario 3)

(Unit : MMGs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sources of Fund																			
Sales Revenue	0.0	0.0	0.0	1,023.5	1,195.9	1,329.4	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	55.6
Equity	355.7	301.3	269.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long-term Loan	829.9	785.9	791.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Short-term Loan	0.0	0.0	0.0	21.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Increase in Account Payable	0.0	0.0	0.0	27.5	3.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-34.4
Total Source	1,185.5	1,087.2	1,061.3	1,072.6	1,199.4	1,332.9	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	1,335.0	21.2
Applications of Fund																			
Land	138.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-138.0
Plant Investment	941.7	898.4	557.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-583.5
Pre-operation Cost	105.8	105.8	215.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Initial Working Capital	0.0	0.0	127.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest during Construction	0.0	85.0	161.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Cost	0.0	0.0	0.0	649.5	690.8	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	732.1	0.0
Administration Cost	0.0	0.0	0.0	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	73.6	0.0
Sales Expense	0.0	0.0	0.0	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	0.0
Debt Service																			
- Long-term Loan -																			
Principal	0.0	0.0	0.0	0.0	0.0	0.0	240.7	240.7	240.7	240.7	240.7	240.7	240.7	240.7	240.7	240.7	0.0	0.0	0.0
Interest	0.0	0.0	0.0	240.7	240.7	240.7	240.7	216.6	192.6	168.5	144.4	120.4	96.3	72.2	48.1	24.1	0.0	0.0	0.0
- Short-term Loan -																			
Principal	0.0	0.0	0.0	0.0	21.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tax Payment	0.0	0.0	0.0	0.0	0.0	2.4	17.0	17.6	21.2	24.8	56.9	64.1	71.3	78.5	85.7	93.0	109.2	107.4	107.4
Increase in Account Recievable	0.0	0.0	0.0	85.3	14.4	11.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-111.3
Increase in Raw Material Inventory	0.0	0.0	0.0	8.8	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-11.0
Total Application	1,185.5	1,087.2	1,061.3	1,072.6	1,062.1	1,075.7	1,319.3	1,295.3	1,274.9	1,254.4	1,262.4	1,245.5	1,228.7	1,211.8	1,195.0	1,178.1	920.6	927.8	-736.4
Cash Surplus	0.0	0.0	0.0	0.0	137.3	257.1	15.7	39.7	60.1	80.6	72.6	89.5	106.3	123.2	140.0	156.9	414.4	407.2	757.6
Cumlative Cash Surplus	0.0	0.0	0.0	0.0	137.3	394.4	410.1	449.8	509.9	590.5	663.2	752.6	859.0	982.1	1,122.2	1,279.0	1,693.5	2,100.7	2,858.3
Cash Flow (ROI before/Tax)	-1,185.5	-1,004.2	-899.7	219.1	404.8	500.3	514.2	514.6	514.6	514.6	514.6	514.6	514.6	514.6	514.6	514.6	514.6	514.6	865.0
Cash Flow (ROI after/Tax)	-1,185.5	-1,004.2	-899.7	219.1	404.8	497.9	497.1	497.0	493.4	489.8	457.8	450.5	443.3	436.1	428.9	421.7	414.4	407.2	757.6
Cash Flow (ROE before/Tax)	-355.7	-301.3	-269.9	0.0	137.3	259.6	32.7	57.3	81.3	105.4	129.5	153.5	177.6	201.7	225.8	249.8	514.6	514.6	865.0
Cash Flow (ROE after/Tax)	-355.7	-301.3	-269.9	0.0	137.3	257.1	15.7	39.7	60.1	80.6	72.6	89.5	106.3	123.2	140.0	156.9	414.4	407.2	757.6

Table 10-5-4 Balance Sheet (Scenario 3)

(Unit : MMBs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Current Assets																			
Cash on Hand	0.0	0.0	127.1	127.1	264.4	521.5	537.2	576.9	637.0	717.6	790.3	879.7	986.1	1,109.2	1,249.3	1,406.1	1,820.6	2,227.8	2,985.4
Account Recievable	0.0	0.0	0.0	85.3	99.7	110.8	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	111.3	0.0
Raw Material Inventory	0.0	0.0	0.0	8.8	9.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	0.0
Product Inventory	0.0	0.0	0.0	33.8	35.5	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.2	0.0
Total Current Assets	0.0	0.0	127.1	255.0	409.5	680.6	696.8	736.4	796.6	877.1	949.8	1,039.2	1,145.6	1,268.7	1,408.8	1,565.6	1,980.1	2,387.3	2,985.4
Fixed Assets																			
Land	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	138.0	0.0
Plant	941.7	1,840.1	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	2,397.3	1,813.8
Depreciation	0.0	0.0	0.0	120.9	241.8	362.8	483.7	604.6	725.5	846.4	967.4	1,088.3	1,209.2	1,330.1	1,451.1	1,572.0	1,692.9	1,813.8	1,813.8
Book Value	941.7	1,840.1	2,397.3	2,276.4	2,155.5	2,034.5	1,913.6	1,792.7	1,671.8	1,550.9	1,429.9	1,309.0	1,188.1	1,067.2	946.2	825.3	704.4	583.5	0.0
Intangible Asset	105.8	294.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6	671.6
Amortization	0.0	0.0	0.0	40.3	80.6	120.9	161.2	201.5	241.8	282.1	322.4	362.6	402.9	443.2	483.5	523.8	564.1	604.4	604.4
Book Value	105.8	294.6	671.6	631.3	591.0	550.7	510.4	470.1	429.8	389.5	349.2	308.9	268.6	228.3	188.0	147.7	107.5	67.2	67.2
Total Fixed Assets	1,185.5	2,272.7	3,206.9	3,045.6	2,884.4	2,723.2	2,562.0	2,400.8	2,239.6	2,078.4	1,917.1	1,755.9	1,594.7	1,433.5	1,272.3	1,111.1	949.9	788.6	67.2
Total Assets	1,185.5	2,272.7	3,334.0	3,300.7	3,293.9	3,403.8	3,258.8	3,137.2	3,036.1	2,955.5	2,866.9	2,795.2	2,740.3	2,702.2	2,681.1	2,676.7	2,929.9	3,175.9	3,052.5
Current Liabilities																			
Account Payable	0.0	0.0	0.0	27.5	31.0	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	34.4	0.0
Short-term Loan	0.0	0.0	0.0	21.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tax Payable	0.0	0.0	0.0	0.0	2.4	17.0	17.6	21.2	24.8	56.9	64.1	71.3	78.5	85.7	93.0	100.2	107.4	107.4	0.0
Total Current Liabilities	0.0	0.0	0.0	49.1	33.4	51.4	52.0	55.6	59.2	91.3	98.5	105.7	112.9	120.1	127.4	134.6	141.8	141.8	0.0
Long-term Liabilities	829.9	1,615.8	2,407.1	2,407.1	2,407.1	2,407.1	2,166.4	1,925.7	1,685.0	1,444.3	1,203.6	962.9	722.1	481.4	240.7	0.0	0.0	0.0	0.0
Stockholdres Equity																			
Capital	355.7	656.9	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8	926.8
Retained Earning	0.0	0.0	0.0	-82.5	-73.4	18.4	113.5	229.1	365.1	493.1	638.0	799.8	978.4	1,173.9	1,386.2	1,615.3	1,861.3	2,107.3	2,125.7
Total Equity	355.7	656.9	926.8	844.4	853.4	945.2	1,040.3	1,155.9	1,291.9	1,420.0	1,564.9	1,726.6	1,905.2	2,100.7	2,313.0	2,542.1	2,788.1	3,034.1	3,052.5
Total Equity & Liabilities	1,185.5	2,272.7	3,334.0	3,300.7	3,293.9	3,403.8	3,258.8	3,137.2	3,036.1	2,955.5	2,866.9	2,795.2	2,740.3	2,702.2	2,681.1	2,676.7	2,929.9	3,175.9	3,052.5

Definition of FIRR

FIRR on I (Financial Internal Rate of Return on Investment	
Inflow	Outflow
Sales Revenue Increase in Account Payable	Investment (ex. IDC) Operating Cost Administration Cost Sales Expenses Increase in Account Receivable Increase in Raw Material Inventory Tax Payment (in case of after tax) Salvage Value
FIRR on E (Financial Internal Rate on Equity	
Inflow	Outflow
Sales Revenue Long-term Loan Short-term Loan Increase in Account Payable	Investment (incl. IDC) Operating Cost Administration Cost Sales Expense Increase in Account Receivable Increase in Raw Material Inventory Tax Payment (in case of after tax) Repayment Interest Salvage Value

CHAPTER XI ECONOMIC ANALYSIS

11.1 General

A detailed financial analysis of project feasibility was presented in the previous chapter. The next important step is to determine what economic impact the project will have at the national level. This chapter thus analyzes, for Scenario 1 (ammonia is imported), such indicators as economic cost and benefit, economic internal rate of return (EIRR) and balance of payments.

11.2 Economic Cost and Benefit

The major components used to evaluate economic cost and benefit are listed in Table 11-2-1 below.

Table 11-2-1 Economic Cost and Benefit

Benefit	Cost
Fertilizer production	Investment costs
Slag production	Pre-operation costs
Increase of employment opportunity	Raw material and utility costs
Development of fertilizer	Direct labor costs
related industry	Maintenance costs
	Plant consumable costs
	Plant over head costs
	Administration costs
	Sales expenses

11.2.1 Economic Benefit

1) Direct benefit

The direct economic benefit of this project is the economic value of the fertilizer produced. Table 11-2-2 lists this value for periods of full production (100% operation load). The economic price is the fertilizer prices at border of Paraguay and adjusted by shadow foreign exchange rate. The shadow foreign exchange rate (2.5) is calculated by the current exchange rate (Gs 600/US$)/ official exchange rate (Gs 240/US$).

Table 11-2-2 Direct Benefit

	Production (t/y)	Economic Price (Gs/t)				Direct Benefit (million Gs)
		(US$/t)	(Gs/$)		*	
DAP	29,000	394	x 240	x	2.5	6,855.6
TSP	5,000	271	x 240	x	2.5	813.0
NPK(6-30-10)	32,000	294	x 240	x	2.5	5,644.8
NPK(15-15-15)	4,000	331	x 240	x	2.5	794.4
Slag	29,295	12,000				351.5

* Shadow foreign exchange rate

2) Indirect benefit

(1) Increase in employment opportunities

New employment opportunities for 287 people will be created by the workforce needed to staff the plant. In addition, 280 million guaranies worth of goods and services will be necessary for maintenance of facilities associated with operation of the plant, which can be expected to create considerable new employment positions in the region around the plant.

(2) Ripple effect on related industries

Support industries necessary for construction and operation of the fertilizer plant are listed in Table 11-2-3. Of these, public works and construction industries are already in place in Paraguay, but the engineering and machinery fields have not yet to be fully developed.

Thus foreign contractors will be necessary for construction of the plant. Once the plant is in operation, however, the need for periodic maintenance and repair will stimulate local development in these fields.

(3) Use of surplus electric power

This project will make good use of a valuable national resource, the abundant electric power produced at Itaipu station.

(4) Supply of fertilizer

Implementation of the project will make fertilizer supply in Paraguay independent of supply and demand on the world market. This will allow farmers to obtain a reliable supply of fertilizer at a stable price.

Table 11-2-3 Supporting Industries

Stage	Type of Supporting Industries
Construction	. Site preparation, foundation, erection, electrical wiring, piping . Building materials supply . Steel works and metal fabrication . Transportation of goods
Operation	. Repair workshops, repairing, electrical machinery repairing, heavy machinery repairing . Steel works and metal fabricators . Machining shops . Foundry and forging works . Electroplating and galvanizing works . Automobile garage (Repairing)

11.2.2 Economic Cost

The main components of economic cost are as follows:

1) Initial economic cost

Initial economic cost includes costs for construction of the fertilizer plant and other pre-operating costs. These costs were calculated in the financial analysis of the previous chapter. The calculations presented here are based on the shadow exchange rate of 2.5 for foreign currency portion.

2) Economic production cost

Production cost includes such items as labor costs, raw materials costs, and utilities and chemical costs; as well as the cost of providing maintenance of the facilities. Interest and loan repayments are considered as transfer costs, and are thus not calculated in the economic analysis. These have been calculated using the 2.5 shadow exchange rate. The cost of imported raw materials is derived by multiplying the CIF cost by the shadow exchange rate. As personnel required for plant operation need considerable training, the shadow price is not used for labor costs.

11.3 Economic Internal Rate of Return (EIRR)

Economic internal rate of return is calculated from economic benefit and cost as explained in the previous chapter. Table 11-3-1 lists economic benefit and plant cost for 15 years of plant operation. EIRR is calculated from this Table as a base case, then recalculated assuming 10% increase and decrease in economic benefit and cost. The results of these calculations are shown in Table 11-3-2.

Table 11-3-2 EIRR

(Unit: %)

Base Case		10.7
Economic Benefit	+10%	15.8
	-10%	4.1
Economic Cost	+10%	4.8
	-10%	16.3

According to guidelines constructed by various international organizations, the minimum EIRR (cut-off rate) varies according to the type of project, but is generally set at between 8 and 12%. This places the Paraguayan fertilizer project, with a base case EIRR of 10.7%, in a borderline position.

Table 11-3-1 Economic Benefit and Cost

EIRR (%) = 10.7

(Unit : MMBs)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Economic Benefit																			
DAP	0.0	0.0	0.0	5,484.5	6,170.0	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	6,855.6	100,777.3
TSP	0.0	0.0	0.0	650.4	731.7	813.0	813.0	813.0	813.0	813.0	813.0	813.0	813.0	813.0	813.0	813.0	813.0	813.0	11,951.1
NPK(6-30-10)	0.0	0.0	0.0	4,515.8	5,080.3	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	5,644.8	82,978.6
NPK(15-15-15)	0.0	0.0	0.0	635.5	715.0	794.4	794.4	794.4	794.4	794.4	794.4	794.4	794.4	794.4	794.4	794.4	794.4	794.4	11,677.7
By-Product	0.0	0.0	0.0	281.2	316.4	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	351.5	5,167.6
Total Economic Benefit	0.0	0.0	0.0	11,567.5	13,013.4	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	14,459.3	212,552.3
Economic Cost																			
Plant Investment Cost	10,278.8	8,796.8	2,800.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21,875.8
Pre-operation Cost	105.8	105.8	283.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	494.9
Variable Operating Cost																			
Raw Materials	0.0	0.0	0.0	5,473.5	6,157.7	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	6,841.9	100,575.4
Electricity	0.0	0.0	0.0	1,279.8	1,439.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	1,599.8	23,516.3
Utilities & Chemicals	0.0	0.0	0.0	801.0	901.2	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	1,001.3	14,719.1
Bag	0.0	0.0	0.0	336.0	378.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	420.0	6,174.0
Sub-total	0.0	0.0	0.0	7,890.3	8,876.6	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	9,862.9	144,984.8
Fixed Operating Cost																			
Direct Labor	0.0	0.0	0.0	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	196.3	2,944.5
Maintenance Cost	0.0	0.0	0.0	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	491.5	7,372.7
Plant Consumables	0.0	0.0	0.0	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	294.5
Plant Overhead	0.0	0.0	0.0	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	1,472.3
Sub-total	0.0	0.0	0.0	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	805.6	12,083.9
Administration Cost	0.0	0.0	0.0	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	98.2	1,472.3
Sales Expenses	0.0	0.0	0.0	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	294.5
Total Economic Cost	10,384.6	8,902.6	3,083.5	8,813.7	9,800.0	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	10,786.3	181,206.2
Balance	-10,384.6	-8,902.6	-3,083.5	2,753.8	3,213.4	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	3,673.1	31,346.1
Discounted Flow	-10,384.6	-8,042.7	-2,516.6	2,030.4	2,140.4	2,210.3	1,996.8	1,803.9	1,629.7	1,472.2	1,330.0	1,201.6	1,085.5	980.6	885.9	800.3	723.0	653.2	0.0

11.4 Effect on Balance of Payment

If the Paraguayan fertilizer project were to be implemented, the effects on the national balance of payments can be anticipated as follows.

11.4.1 Foreign Currency Requirements

Foreign currency requirements can be divided into those necessary during construction and those necessary during operation. Foreign currency requirements during construction include interest and liability payments associated with the loan; requirements during operation are the part of operation cost which must be payed in foreign currency. The total foreign currency requirements for the full period of project implementation will be approximately 337.7 million US dollar.

1) Requirements during construction

Foreign currency requirements are broken down as part of total capital requirements. These foreign currency requirements total 39.1 million US dollar. The funds will be covered by the long-term loan. Thus 39.1 million US dollar will be received initially, but this will be paid out again for facilities and equipment, leaving the debt.

2) Requirements during operation

During operation, foreign currency will be required for part of the operation costs and for interest and installments on the long-term loan. These requirements will total approximately 298.6 million US dollar over the full 15 years of project duration.

3) Foreign currency savings

The fertilizer produced at the Paraguayan plant will all be marketed domestically. Export is not expected. Thus foreign currency savings are equal to the amount of fertilizer produced multiplied by the CIF price. These savings will amount to approximately 384.8 million US dollar over the 15 years of project operation.

4) Balance of payments

Implementation of this project will result in a foreign currency balance of 47.1 million US dollar remaining after 15 years. Table 11-4-1 shows the foreign currency balance.

Table 11-4-1 Foreign Currency Balance

(Unit : MMUS$)

<< Project Year >>	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Foreign Inflow																			
Long-term Loan	16.3	15.5	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.1
DAP	0.0	0.0	0.0	9.1	10.3	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	168.0
TSP	0.0	0.0	0.0	1.1	1.2	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	19.9
NPK(6-30-10)	0.0	0.0	0.0	7.5	8.5	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	138.3
NPK(15-15-15)	0.0	0.0	0.0	1.1	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	19.5
Total Inflow	16.3	15.5	7.3	18.8	21.2	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	384.8
Foreign Outflow																			
Plant Investment Cost	16.3	13.9	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.2
Pre-operation Cost	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Interest during Construction	0.0	1.6	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
Raw Materials	0.0	0.0	0.0	8.6	9.7	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	158.4
Electricity	0.0	0.0	0.0	2.1	2.4	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	39.2
Utilities & Chemicals	0.0	0.0	0.0	1.1	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	19.8
Maintenance	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	8.8
Repayment on Long-term Loan	0.0	0.0	0.0	0.0	0.0	0.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	0.0	0.0	39.1
Interest on Long-term Loan	0.0	0.0	0.0	3.9	3.9	3.9	3.9	3.5	3.1	2.7	2.3	2.0	1.6	1.2	0.8	0.4	0.0	0.0	33.3
Total Outflow	16.3	15.5	7.3	16.3	17.8	19.3	23.2	22.8	22.4	22.0	21.6	21.2	20.9	20.5	20.1	19.7	15.4	15.4	337.7
Foreign Currency Balance	0.0	0.0	0.0	2.5	3.4	4.2	0.3	0.7	1.1	1.5	1.9	2.3	2.7	3.1	3.4	3.8	8.1	8.1	47.1

CHAPTER XII CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

Based on the analysis of domestic demand for fertilizers, the plant capacity was decided at 70,000 ton/yr. The recommended fertilizer plant is Scenario 1 consisting of phosphoric acid plant and fertilizer plant without the production of ammonia. Since the recommended production processes have a long history of commercial use worldwide, they present no problems judging from the operational experiences.

Furthermore, in terms of site selection, required infrastructure, and the potential of Paraguay's engineers for the operation of plant, this project is feasible.

There are some problems, however, to be considered for the project: one is the need to rely on Brazilian imports for the large quantities of phosphate rock, the main raw material in the production process.

The other is the fertilizer production costs. In a processing industry like this fertilizer project, securing a reliable supply of raw materials is of utmost importance for continuous normal operation. In the Paraguayan case, imports must be relied on not only for phosphate rock, but for other major raw materials as well. To add to this problem, Paraguay is a landlocked country isolated from the producing regions, which means that transportation costs are always high. These high transportation costs are naturally reflected in high production costs.

If the Paraguayan fertilizer plant were to offer its products at the prices currently available on the world market or in eastern Brazil (DAP US$ 250-300/ton), this project is not feasible in view of financial profitability.

At present, however, individual traders import bagged fertilizers into Paraguay in small quantities over long distances, and prices are thus exceptionally high.

The fertilizer plant, in order to maintain reasonable profits, would have to offer ex-plant prices of products at least at the level of 80% of end user prices with the conditions of ammonia importation for the production of phosphate fertilizers and sales of excess slag.

For an agricultural nation like Paraguay, however, construction of this fertilizer plant would be an important project with significant contributions to social and economic development.

12.1.1 Market Evaluation

Use of fertilizers in the Paraguayan agricultural industry is relatively recent, having a history of only ten years or so. The demand for phosphate fertilizers in 1985 stood at 31,500 ton/yr; and the farm gate price was exceptionally high, about Gs 126/kg for DAP (US$ 525/ton), calculated at the official exchange rate of Gs 240/US$, current as of mid 1986 . Prices for TSP (Gs 76/kg) and 5-30-10 NPK (Gs 95/kg) were equally high, while the prices that farmers received for their crops were comparatively low.

In this unfavorable price environment, farmers are unlikely to increase the per unit area dosages of fertilizer applied to their crops. As the benefits of initial levels of fertilization are substantial, however, farmers who are not presently using fertilizers can be expected to adopt the practice in future years. Thus demand for phosphate, NP and NPK fertilizers is estimated to reach 71,400 ton/yr in 1995. The recommended plant product mix with the capacity of 70,000 ton/yr is based on this estimate.

12.1.2 Raw Materials

In a processing industry such as the Paraguayan fertilizer plant, a reliable supply of raw materials is of prime importance.

For manufacture of phosphate fertilizers, phosphate rock is the crucial raw material. No deposits of acceptable quality phosphate rock, however, have been discovered in Paraguay to date. The project will thus be forced to rely entirely on imported rock. The Goias mine in Brazil is presently producing a large surplus of high quality phosphate rock; and as the price is competitive, this is the most promising source of imports.

Other supplementary raw materials, such as coke and electrodes, must also be imported from abroad. Although high transportation costs, and some operational snags for these materials will be unavoidable, there should be no technical problems in terms of shipping and delivery. In order to insure that these foreign imports can be obtained on a steady basis, however, special arrangements will have to be made to facilitate customs clearance procedures at the border.

12.1.3 Technical Aspects

Sources of phosphorus and nitrogen are necessary for production of phosphate fertilizers such as DAP, TSP and NPK. In Paraguay, there are no sulfur deposits or sulfuric acid plants, but the fertilizer project will have access to abundant electric power from Itaipu power station. Thus the "dry" process, instead of the "wet" process which uses sulfuric acid, will be employed in producing yellow phosphorus to produce phosphoric acid.

Ammonia is required as nitrogen source. As hydrocarbon sources such as natural gas and oil have not been developed in Paraguay, the following two Scenarios are studied:

Scenario 1: Ammonia will be imported.

Scenario 2: Ammonia will be produced by reacting nitrogen separated from air with hydrogen obtained through water electrosis.

According to the financial analysis results Scenario 2 is not viable; and ammonia will thus be imported. The process recommended for production of phosphoric acid has already been completely developed, and has a long history of stable operation and results.

Paraguayan engineers and technicians possess a relatively high potential, and with transfer of the necessary technology, should have no problems in operating and maintaining the plant. Thus the Paraguayan fertilizer project should not expect to be beset by technical difficulties.

12.1.4 Financial and Economic Aspects

At present, however, as fertilizer is imported to Paraguay over long distance in bags rather than in bulk and the amounts handled are rather low, prices are substantially higher than on the world market. For example, the farm gate price for DAP in mid-1986 was Gs 126/kg.

This price, however, includes delivery costs in Paraguay and the commissions taken by the traders and agricultural cooperatives. If those costs amount to 20% of the price, this leaves Gs 101/kg as the ex-plant price. If the Paraguayan plant were to offer fertilizer at this price level, a financial internal rate of return on investment (FIRR on I) of 7.9% could be had after taxes.

In the electric furnace used to produce yellow phosphorus, a calcium silicate slag is produced as a by-product. This slag can be used as a fertilizer capable of supplying crops with the required silica and calcium; and also is very effective when used as a soil restorative to help balance pH. The slag by-product will thus not only be useful to the Paraguayan agriculture; but if half the excess amount is sold at Gs 12/kg, will bring the FIRR on I up from 7.9% to 10.2% as well. In this case, an economic internal rate of return (EIRR) shows 10.7%.

Thus the Paraguayan fertilizer plant, in the absence of a price war instigated by drastic cuts in price of imported fertilizer, should be able to operate on a feasible, financial profitability basis.

12.2 Recommendations

This is the first fertilizer plant to be constructed in Paraguay. Thus the government, when drawing up plans for a national fertilizer production industry, should give due consideration to the following recommendations.

12.2.1 Market

1) Soils in Paraguay are lacking in phosphorus. The government should actively support a fertilization promotion program while considering the possibilities of domestic fertilizer production.

2) If this project were to be implemented at the recommended capacity, a balance between domestic supply and demand would be achieved by 1995/96. From this stage onward, the additional supply would have to be made up either by imports or expansion of plant capacity. These options should be considered while observing the functioning of the plant once it has moved into commercial operating status.

3) The government needs to conduct extensive statistical research on importation of fertilizer. A thorough knowledge of the supply and demand conditions is necessary for drawing up plans for a fertilizer development program. The amount of officially imported fertilizer needs to be accurately verified, and it is equally important to find out more about the inflow not shown in the statistics. The government should take necessary measures for making sufficient quantities and desired types of imported fertilizer available on a timely basis and at a reasonable price.

4) As farmer's production costs in Paraguay are dependent upon agricultural credits, these programs should be expanded. Along with increasing the budget framework of BNF, which is the central financing organ for the industry, the mortgage requirements and interest rates should be softened. These measures will allow the credit system to reach a greater number of farmers. In addition, the government should consider the subsidy to fertilizer itself.

5) Paraguayan farmers have been using fertilizers for only a relatively short time. In the future, experimental research should be carried out at institutes like CRIA and the JICA's Estacion to determine which fertilizer types are best suited to local soils. This research should include the testing of fused magnesium phosphate fertilizer.

6) Until the establishment of the fertilizer plant in Paraguay, the government should institute measures to facilitate application for import permits. In addition, fertilizers should be granted preferential status in terms of foreign exchange quotas.

12.2.2 Raw Materials

1) A stable supply of raw materials, particularly phosphate rock and coke, is essential for smooth operation of this project. To assure such a steady supply, raw materials for fertilizer production should be given preference for foreign exchange allocations. In addition, long term contracts should be signed with suppliers, and smooth transportation and delivery should be assured under the protection of the Paraguayan government.

2) It is especially important that the electricity pricing system for this project should be established in order to reduce the electric power cost, as the phosphoric acid production process to be employed will consume large amount of power. One of the recommendations is that

electric power is purchased directly from Itaipu power station at the level of US$10/kW•M. Direct reception will be advantageous from a technical standpoint, and power outages can be reduced. This will help to keep the plant running smoothly. In addition, purchasing power directly from Itaipu will be beneficial from the standpoint of costs.

For the reference, the electric power pricing system in Japan to decrease the price of electricity is as follows:

- The electric power prices for industrial use are cheaper than those for households.
- The electric power prices for night period are cheaper than those for day time.

3) Paraguay retains the right to receive half of the power generated at Itaipu station, but excess power will be contracted to Brazil. Bartering this power for phosphate rock should be investigated as a possible method of securing a stable supply of this most crucial raw material.

4) Although no reserves of phosphate rock of a quality acceptable for fertilizer production have not yet to be discovered in Paraguay, mineral surveys are still in progress. If a domestic reserve were to be located, a major problem, that of relying on imports for the most important raw material, would be solved. Thus efforts to locate such a source should be continued into the future.

5) The option of producing ammonia at the plant has been investigated. The capacity, however, would be only 30 ton/day. In addition, electric power cost, US$ 10/kW·M, would be higher than the energy costs for natural gas experienced in other areas. Thus production costs for ammonia would be high by world standards, and the Paraguayan project should import the necessary amounts.

12.2.3 Technology

1) A great deal of operational know-how is necessary for running the "dry" process phosphoric acid and fertilizer plants. Thus not only should technicians and operators be trained before the plant begins operation, but highly experienced foreign personnel should be stationed at the plant for the first three years or so of operation. These experts will be necessary for effecting the technology transfer, and for training and educating Paraguayan technicians.

2) Coke is necessary as a reducing agent for production of phosphoric acid in the "dry" process. The possibilities of substituting wood charcoal for coke have been investigated. Under the existing technology, however, wood charcoal has been found to lack the necessary strength, and is thus unusable. None the less, as coke is not produced in Paraguay, efforts should be taken to develop a method for using wood charcoal instead.

12.2.4 Financial Aspects

1) If fertilizers produced at the plant were sold at the domestic prices now prevailing in Paraguay, the operation would be financially feasible.

   If the price of imported fertilizer were to drop substantially, however, and the plant were forced to engage in a price war to retain the market, government subsidies would be necessary.

2) The following measures should be implemented to improve the financial feasibility of the project:

   (1) As was recommended in Section 12.2.2, importation of ammonia is financially advantageous.

(2) Numerous fees and charges, such as LC opening fees, custom tariffs and import handling charges, are levied on the import of raw materials. The government should institute a system giving preferential treatment to these raw materials, thus helping to reduce costs.

(3) Research should be conducted on how to sell the by-product slag at a higher value-added price.

3) If the foreign exchange rate were to drop (official rate now pegged at Gs 240/US$), not only production costs, but raw materials costs as well would rise. A sudden increase in the price of fertilizer would invite a decrease in demand, perhaps forcing the plant to reduce its operation load. In this case, the government should consider the possibility of establishing a preferential exchange rate for import of raw materials for the fertilizer plant.

4) Based on the results of market analysis, the plant capacity of FMP is determined to be 15,000 ton/yr. The price of FMP with 18-20% P_2O_5 content should normally be less than that of TSP with 46-48% content. At this capacity, however, the ex-plant price of FMP in Paraguay, based on an after tax FIRR on I for 10%, would be Gs 89/kg, which is higher than that of TSP (Gs 76/kg). Production of FMP at the Paraguayan plant can thus not be expected to be financial feasibility and if this fertilizer is required, it is recommended that the necessary amount be imported.

12.2.5 Others

The decrease of operating rate of the plant will make this project infeasible like other industrial projects. The operating rate of this project is scheduled to be 80% of the rated plant capacity for 1st year, 90% for 2nd year, and 100% for 3rd year and after. This operating rate is equivalent to 70% of the actual production capacity for 1st year, 79% for 2nd year and 88% for 3rd year and after.

In order to achieve the operating rate described above, the following efforts are required.

- Prompt financing arrangement including foreign currency for the importation of raw materials
- Smooth transportation of raw materials
- Appropriate control of raw material inventories
- Training of plant operators
- Excellent maintenance of plant
- Aggressive sales promotion of fertilizers
- Reasonable business administration
- Good quality control

Study Member

Team Leader	Yukihiko Fujiki
Team Member	
(Field and Domestic Survey)	Yoichi Izumiyama
	Haruo Itoh
	Hiroshi Kurita
	Kunio Ohtuka
	Akinori Hashimoto
(Domestic Survey)	Nobuo Yamanaka
	Mitsuo Kobayashi
	Yoshitada Kamiya

Counter Part of Study

Ministry of Industry and Commercial (MIC)

Dirctor of Technical Cabinet (MIC)	Emilio A. Ramirez Russo
Coordinator of Technical Cabinet (MIC)	Dionisio Coronel
Staff of Technical Cabinet (MIC)	Raul Silvero Silvagni

Ministry of Agriclture and Livestock (MAG)

Director of Technical Cabinet (MAG)	Oscar Meza Rojas
Coordinator of Technical Cabinet (MAG)	Conrado Pappalardo M.
Staff of Technical Cabinet (MAG)	Elvio D. Morinigo A.

Field Survey in Paraguay (1986)

June 16 Mon. Leave Tokyo

17 Tue. Arrive at Asunción (14:30 by PZ) Discuss with JICA, Visit Embassy of Japan

18 Wed. Meeting with MIC, Presentation of Inception Report, Collection of answer of questionnaire requested by the Preliminary Survey Team, Visit JICA

19 Thu. Meeting with MAG, Presentation of Inception Report

20 Fri. Meeting with Par-Trade (Fertilizer Trading Company), Meeting with Kasba (Fertilizer Trading Company), Meeting with Empresa(Inland Transportation Company)

21 Sat. Internal meeting, Analysis of collected data and information

22 Sun. Internal meeting

	A group (Technical)	B group (Market)	C group(Financial/Economic
23 Mon.	Wether Bureau, STP, C.C.C.(Civil & Infra.)	Wether Bureau, STP, Kasba(Fertilizer Trader)	Wether Bureau,JICA,Embassy of Japan, C.C.C.
24 Tue	ANDE, OTI(Construction Company), Military of Defence, Natural Resource Div.)	ANDE, MAG, Military of Defence (Natural Resource Div.)	ANDE, Military of Defence (Natural Resource Div.)
25 Wed.	Industria Nacional del Cemento, Flota Mercante, Agriex	MAG, Agriex	Flota Mercante, Agriex
26 Thu.	Industria Nacional del Cemento, SENASA	Banco Nacional de Fomento, Agr.Friesland, FECOPROD	Banco Nacional de Fomento, SENASA
27 Fri.	Petropar	University of Asunción, IAN	Banco Central, Ministry of Finance
28 Sat.	Trip from Asunción to Stroessner		
29 Sun.	Internal Meeting, Site Survey		
30 Mon.	Stroessner City Office, Itaipú Dam and Power Station, Site Survey		

July 1 Tue. Site Survey, Hernandarias City Office — Yguazú JICA, Takushin Yopoira

2 Wed. Site Survey, Agriex

3 Thu. Alto Paraná JICA, Cooperative Pirapó, and Japanese Farmer

4 Fri. Cooperative UNIDAS, CEDFO, CEMA, and CRIA

5 Sat. Encarnación JICA, CAISISA, Cooperative FRAM, CHAVEZ, and Japanese Farmers

6 Sun. Trip from Encarnación to Asunción

	A group	B group	C group
7 Mon.	JICA, MOPC, INTN	JICA, MOPC	JICA, MOPC, INTN
8 Tue.	ANDE, BID, Military of Defence(Natural Resources)	UNDP, B I D	ANDE, BID
9 Wed.	Preparation of Progress Report	Preparation of Progress Report	MIC, Preparation of Progress Report
10 Thu.	Flota Mercante	MAG, FECOPROD	BID, Trans Paraguay (Inland transportation)
11 Fri.	MIC / MAG	MIC/MAG	MIC/MAC
12 Sat.	Internal Meeting		
13 Sun.	Internal Meeting		
14 Mon.	Signing Minutes of Meeting between JICA Mission and MIC, Visit Embassy of Japan, Visit JICA		
15 Tue.	Leave Asunción (15:15 by RG)		
16 Wed.			
17 Thu.	Arrive at Tokyo