THE FEASIBILITY STUDY REPORT
ON
THE DEVELOPMENT OF PLANT PROCESSING EQUIPMENT INDUSTRY
IN
THE REPUBLIC OF INDONESIA

FEBRUARY, 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a feasibility study on the Plant Processing Equipment Industry Promotion Project and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Indonesia a survey team headed by Mr. Nobuo Miyazima from July 22 to August 24, 1984.

The team had discussions on the Project with the officials concerned of the Government of Indonesia and conducted a field survey in the Project-related areas, including Jakarta, Surabaya, Pasuruan and Tegal. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the team.

Tokyo, February 1985

Keisuke Arita

Keisuke Arita
President
JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

LIST OF TABLE

Chapter 4 Barata Surabaya Machine Shop

Barata Gresik

Barata Jakarta

Barata Tegal

Boma Bistma Indra, Indra

Boma Bisma Indra, Wahana Sub Unit

Boma Stork, Pasuruan

Chapter 5

Chapter 6

Chapter 7

LIST OF FIGURE

Barata Gresik

Barata Jakarta

Barata Tegal

Boma Bisma Indra, Indra

Boma Bisma Indra Wahana

Boma Stork, Pasuruan

Chapter 6

Chapter 7

LIST

CONCLUSION AND RECOMMENDATION

Conclusion and Recommendation

(1) Market Aspects

1) The significant amount of plant processing equipment demand can be expected in Indonesia as far as the industrial development policy as stated in PELITA IV is realized.

2) The potential demand of plant processing equipment to be domestically manufactured is calculated to be approximately 180 thousand tons p.a. It includes the equipment demand of the five designated plants and that which BABIBO presently manufactures and will be able to manufacture.

3) In addition to the above demand, there is other promising demand which was not studied in this report. Considering these demand, the potential demand will increase further.

4) Therfore, the establishment of plant processing equipment manufacturing industry can be justified in Indonesia.

5) On the other hand, the final production capacity of BABIBO will reach 85 thousand tons p.a. In view of the potential demand and the capacity, it can be said that the renovation plan is reasonable.

6) However, BABIBO's production capacity after renovation will increase to more than four times as much as the present capacity. The marketing force to deal with such large volume of products has to be reformed and reinforced to great extent.

7) In line with the reform of marketing force, it is advised to carry out the education and training of sales personnel by experienced instructor(s) who has a thorough knowledge in this field so that their capabilities can be improved.

8) The education and training should be performed in accordance with the long-term, not short-term, training program in which the actual marketing activities are incorporated.

(2) **Technical fields**

1) While the basic material industry and the assembling industry have grown remarkably in Indonesia, the equipment machineries of these industrial fields depend chiefly on imports even now. So the present development plan of the plant processing equipment manufacturing industry is most opportune for planning.

2) Judging from the results of the market study, the market for the manufacturing industry of localized machineries is promissing.

3) At present the technical level of each factory is not necessarily high. They, however, have been making effort to elevate their technical level, and are very enthusiastic for the future development.

4) Factory spaces for the production of 85,000 T/Y are already available.

5) Together with the introduction of new equipment machineries, systemization of quality control, clarification of managerial organization and execution of training for engineers and workers are strictly advisable.

6) For the purpose of smooth transportation of large-sized and/or heavy products, roads and harbor facilities are to be improved and reinforced.

(3) **Financial and economic aspects**

1) The development of plant processing equipment manufacturing industry is significantly important in view of the industrialization of Indonesia and ripple effects on other industries.

2) The one of indicators which shows the profitability of project, Financial Internal Rate of Return after tax of the designated projects, indicates higher than 10% as listed below.

BARATA	BBI	BOMA STORK
10.6%	10.2%	25.1%

3) As the results of financial analysis, the financial position of each company will be improved after the development of existing factories.

4) The economic indicator, Economic Internal Rate of Return of projects, shows 23.8% which is higher than cut-off rate (8 - 10%) of project which is normally adopted to select projects.

5) Accordingly, the designated project is feasible in case that the premise of the financial and economic evaluation is not adversely changed.

(4) The further modifications and/or re-investments to the selected production facilities

1) The selection of the production facilities in this feasibility study report were planned on the basis of the following pre-conditions:

① The capacity of the machine-tools were designed in accordance with the specifications (material/dimension/weight) of the components for the plants, of which category and sizing (capacity) were also defined from the market research and in the product mix plan.
For example, the facing lathe machine for P.T. Barata indonesia Gresik factory has been designed to have a capacity of machining the raw mill flange for 1,000,000 Ton/Year Cement Plant, and also the floor type boring/milling machine for P.T. Barata Indonesia Surabaya machine shop is to be equipped with a capacity to machine the mill cheek for 4,000 Ton/Day Sugar Plant.

② The specifications of the machine-tools including cutter tools and accessories were selected referring to the current production technology and considering the present situation of each individual factory of P.T. Barata Indonesia, P.T. Boma-Bisma-Indra and P.T. Boma Stork respectively.

For example:

Ⓐ The floor type boring/milling machine for P.T. Barata Indonesia Surabaya machine shop is to be equipped with MDI-NC devices

together with the various accessories instead of the C.A.M. system, because the C.A.M. system would be really effective only when operated in combination with the C.A.D. system which P.T. Barata has not yet applied.

Ⓑ The CNC drilling center machines for P.T. Barata Indonesia Gresik factory and P.T. Boma-Bisma-Indra Wahana unit are designed for high efficiency in drilling tube plates of heat exchangers.

Ⓒ Semi-automatic welding machines are to be equipped respectively in P.T. Barata Indonesia Gresik/Jakarta factories and P.T. Boma-Bisma-Indra Wahana/Indra units with IC control devices for automatic control of the welding current and voltage.

Ⓓ The exclusive-use lathes specialized for high efficiency in machining of cane rolls are selected for P.T. Barata Indonesia Tegal workshop, because exclusive-use machines are deemed more efficient than NC machines or copying machines especially in case that the machined objects are in the similar shapes with various different sizes.

Ⓔ The automatic welding equipment combined with exclusive type manipulators and turning rolls are selected for P.T. Boma Stork, because the weld-beams in the boiler drums/pressure vessels require decfectless quality and P.T. Boma Stork is expecting constant and repeated orders of those items as their main products.

③ The quantity of the similar category of the production facility in each factory was settled respectively based on the production load plans that were estimated/calculated in accordance with the expected share of each factory in the total market demand forecast.
However, careful consideration to avoid an overlapping investment and/or extremely low loading factor was paid to the final investment plan.

For example:

Ⓐ The large type hobbing machine and/or the high frequency induction

hardening equipment are to be introduced only to P.T. Barata Surabaya machine shop and it is recommended to avoid further investment of the same or similar facility to other factories.

Ⓑ Although the end plate is the essential component of the boilers/pressure vessels which are the main products of P.T. Boma Stork, no flanging machine is to be installed in P.T. Boma Stork.
The reason is that formed end plates are obtainable from outside like P.T. Boma-Bisma-Indra Wahana unit closely located and belonging to the same group of the company, and moreover the utmost utilization of narrow working floor in Pasuruan workshop is also important for P.T. Boma Stork to increase the production capacity.

④ Some of the production facilities are to be introduced from viewpoints of the skill training and the future proficiency, which is somewhat irrespective of the present production plan and/or production loading factors.

For example:

Ⓐ Each one of the floor type boring/milling machine with MDI-NC device is to be introduced to P.T. Barata Indonesia Tegal workshop and P.T. Boma Stork respectively in consideration of the practical training plan thereabout.

Ⓑ Three units of radio controlled overhead travelling cranes are to be introduced to P.T. Barata Indonesia Tegal workshop for the urgent enhancement of the productivity especially in the material handling.

2) Regarding future modifications and/or re-investments for each factory, following points are recommended to be considered carefully on the abovementioned selection basis of the production facilities.

① As far as future technology/license transfers do not exceed the capacity and/or category of the plant equipment defined in this report, no further investments and/or modifications of machine tools shall be required.

② Even When new machining technology should be developed drastically in the future, the adoption of such new technology would have to be carefully decided considering the actual situation of products, workers' skill and production control system.

③ When the situation surrounding the factories' production activity should be remarkably deviated from the planned condition, minimum modification with minimum re-investment would be recommended for suitable machine-tools and relating facilities.

For example:

Ⓐ When P.T. Barata Indonesia completes and thoroughly masters the C.A.D. system in the engineering center, only the MDI-NC devices of the floor boring/milling machines and the vertical lathe shall be raplaced with C.A.M. system together with the rewiring of the telelphone system whose P.A.B.X. has already been applicable to computerized control system.

Ⓑ When P.T. Barata Indonesia Surabaya machine shop is required to assemble a product over 50 Ton, the co-work of 50 Ton crane plus 25 Ton crane shall be adopted at first, then another 50 Ton crane shall be considered to be additionally invested in.
Such a short circuit idea to build a new bay equipped with a 100 Ton crane shall not be recommended.

④ If the product mix plan should be extremely deviated from the original plan and/or load balance among categorized machine tools should be remarkably changed, the following steps shall be applied prior to the decision making of re-investments:

Ⓐ To reinvestigate and reconfirm whether such unbalanced load is a temporay phenomenon or long term tendency.

Ⓑ To consider how to utilize the existing machine tools with combination of jigs and/or special accessories/adaptors.

Ⓒ To check the availability of utilizing subcontractors and/or maintenance facilities of other industrial fields, such as steel mills, shipyards and cement factories, etc.

⑤ Continued study and forecast on the tendency of technology and market are strongly recommended as well as constant improvement of production technique and routine maintenance of the facilities.
This sort of routine maintenance and jig manufacturing costs after the renovation are covered in this report.

Chapter 1

OBJECTIVES AND SCOPE OF STUDIES

Chapter 1. Objectives and Scope of Studies

1.1 Historical Background

A number of constructions of plant etc. have so far been made in developing countries, most of which being situated in Asia under economical cooperation of Japan, but owing to the aging of the equipment or insufficient maintenance, the rate of operation or operation efficiency has decreased. As such a case has increased in number, the rise of production cost is worried about.

In Indonesia too, the most of the machine tools to manufacture plant processing equipment now working comprises such machine as was used before 1940's. Besides, the new machine investment and the engineering transfer so far made are very much limited and the rate of factory operation as well as the quality of products still remain in a low level.

On the other hand, in the Second 5-Year Plan that started in 1974, emphasis was put on the volume increase of massive necessaries as well as the increase of employment opportunity, and at the same time, strategical investment in the basic material sector of the First 5-year Plan continued, as a result of which, the investment in the basic material sector was rewarded with good fruits, evidenced by such a rapid production increase of urea fertilizer as from 103,000 tons in 1971 to 990,000 tons in 1978 and that of cement as from 515,000 tons in 1971 to 3,649,000 tons in 1978.

In the Third 5-Year Plan that started in 1979 on the basis of such an outcome as abovementioned, the upbringing of such large-scaled assembly industry as airplane, ship, locomotive, passenger as well as goods wagon in addition to automobile and motorcycle was started. This was based on the strategy to bring up such an up-stream industry as basic materials etc. in the first place, then bring up such a down-stream industry as the assembly of final materials and for the third step, to strengthen those industries that fasten the above two.

In the Fourth 5-Year Plan that started in April, 1984, the upbringing of those industries that fill up the gap between the both of them was taken up as the most important item to be achieved, for the third step.

This idea can be regarded as a development strategy that meets the flow of the times, if we understand the present status that while the basic materials sector has so far progressed comparatively smoothly, the various machinery manufacturing sector is the problem awaiting solution in future.

Under such circumstances, the renovation as well as reactivation of plant processing equipment manufacturing plants are a matter requiring immediate attention and the Indonesian government has requested Japan to cooperate with them accordingly. Above all, much importance is attached to the promotion of plant equipment manufacturing industry from the view-point of foreign currency saving as well as basic engineering advancement, to which the top priority is given in the Fourth 5-Year Plan.

The Japan International Cooperation Agency has agreed to execute a full-scale survey, by way of sending a preparatory investigation committee in February, 1984 and a preliminary investigation committee in May, 1984 as requested by the Indonesian government. Those plants that become the objectives of the renovation this time are as follows:

- o P.T. BARATA:
  - o JAKARTA Plant (except the foundry center)
  - o SURABAYA Plant (except the foundry as well as construction equipment workshops)
  - o GRESIK Plant (added to the Scope as a result of the discussion with MOI)
  - o TEGAL Plant

- o P.T. BOMA-BISMA-INDRA (P.T. BBI):
  - o SURABAYA Plant - INDRA Unit (including WAHANA sub-unit, but excluding the foundry)

- o P.T. BOMA STORK:
  - o PASURUAN Plant

Agreement has also been made with the Ministry of Industry to put the equipment plan of the 3 corporations taken as the objects (BABIBO) into practice under the assumption to produce the following main items.

- o P.T. BARATA:
  Mechanical equipment for (1) sugar plant and (2) cement plant

- o P.T. BBI:
  Processing equipment for (1) fertilizer plant and (2) pulp and paper plant

- o P.T. BOMASTORK:
  Mechanical and processing equipment for (1) sugar plant and (2) palm oil plant

1.2 Objectives of Study

The objectives of this study are to make up a renovation plan to achieve the target of increasing productive capacity as well as productive efficiency, while improving product quality after making a general investigation from the market, technical, financial as well as economical points of view, with reference to the possibility of effecting a renovation, through the diagnosis of each plant of BABIBO, taking the kind of plant equipment and demand volume into full account. As to the renovation plan, we have not limited the matter to the aspect of equipment alone, but have also made a diagnosis on the present status of management, control, educational training, maintenance system, safety control of these plants and finally proposed a renovation plan.

The main objective of the study lies in the manufacture of plant equipment for the designated 5 plants, but since the manufacture of other items will also be available by virtue of this renovation, we have also taken up these items for our dynamic study and have made comments on them.

1.3 Scope of Work

(1) Diagnosis of the present status of the plants concerned.

Diagnosis has been made on each individual workshop of facilities engineering technique and management.

(2) **Market survey**

After effecting a market survey putting weight on plant processing equipment for the designated 5 plants, we have finally made up the BABIBO PRODUCT MIX.

(3) **Material survey**

(4) **Making-up of a renovation plan**

We have made up a renovation program in consideration of economical efficiency as well as technical environment.

1) Establishment of a renovation plan which looks reasonable from the viewpoints of facilities engineering technique and management.

2) Calculation of the required capital cost.

3) Establishment of an educational training plan.

(5) **Financial analysis as well as assessment of this project.**

(6) **Economical evaluation of this project.**

(7) **Conclusion and recommendation.**

Chapter 2

OUTLINE OF PLANT PROCESSING EQUIPMENT MANUFACTURING INDUSTRY AND FIVE DESIGNATED INDUSTRIES

Chapter 2. Outline of Plant Processing Equipment Manufacturing Industry and Five Designated Industries

2.1 Plant Processing Equipment Manufacturing Industries

At present, there are about 40 plant processing equipment manufacturers in Indonesia. They consist of government-owned as well as private enterprises. Their capabilities are mostly concentrated on producing spare parts, machinery components and plant processing equipment primarily for sugar mills, palm oil factories, and hydro power plants. The production in 1982 was around 60,000 tons p.a. None of these companies is able to manufacture a complete plant.

The 1982 demand for the plant processing equipment was around 200,000 tons while the domestic production capability of 60,000 tons p.a. is only 30% of this total demand.

The leading plant processing equipment manufacturers in Indonesia are P.T. Barata, P.T. Boma Bisma Indra (BBI), and P.T. Boma Stork. The Technical Study outlines these companies in the following chapter.

Their main production experience is in the following areas:

- Equipment for sugar mills, palm oil factories, cement plants, etc.
- Equipment for mini-hydro power stations such as turbines, penstocks, and watergates.
- Power transmission towers.
- Industrial and packaged boilers.
- Storage tanks.
- Parts such as gears, spindles, shafts, metal bearings, etc.
- Structures such as bridges.

2.2 Five Designated Plants

2.2.1 Cement Plant

The cement industry developed rapidly over the periods covered by PELITA I (First Five Year Plan, 1969/70 - 1973/74) and PELITA II (1974/75 - 1978/79) with average annual growth rates in production capacity of 23.6% and in production volume of 24.1%. In PELITA III (1979/80 - 1983/84), it developed further to production of 7.7 million tons in 1982/83.

Indonesia now has the nine cement mills listed in Table 2-1 with a combined production capacity of 11.7 million tons in 1983/84.

In 1983, 8.5 million tons of cement were produced, while 9 million tons were consumed. The net balance is a deficit of some 500 thousand tons.

Since Indonesia has abundant supplies of limestone, the raw material of cement production and cement is so basic to the infrastructure, the development of the cement industry is of great importance.

Table 2-1 Cement Plant List in Operation and under Construction

Company Name	Location	Capacity (t/Y)	Start-up	Owner
PT SEMEN PADANG (PTSP)	Padang (West Sumatra)			Gov. owned
INDARUNG I		330,000	1973	
INDARUNG II		600,000		
INDARUNG III A		600,000	1983	
INDARUNG III B		600,000	1984	
PT SEMEN GRESIK (PTSG)				Gov. owned
GRESIK I	Gresik (East Java)	500,000	1957	
GRESIK II		1,000,000		
PT SEMEN TONASA (PTST)	South Sulawesi			Gov. owned
TONASA I		120,000	1968	
TONASA II		500,000		
TONASA III		590,000	1984	
PT SEMEN CIBINONG (PTSC)	Cibinong (West Java)			J/V of PTSG 44.2% and Kaiser Group 55.8%
CIBINONG I		600,000	1975	
CIBINONG II		600,000	1978	
PENINGKATAN PRODUSKI		800,000	1985	
PT INDOCEMENT				
DISTINCT I		500,000	1975	
DISTINCT II		500,000		
PERKASA I		1,000,000		
PERKASA II		1,000,000		
PERKASA AGUNG UTAMA		1,500,000		
PERKASA INTI ABADI	Cibinong (West Java)	1,500,000	1984	
TRI DAYA MANUNGGAL	Cirebon (West Java)	1,200,000	1984	
PERKASA ABADI MULIA		1,500,000	1985	
SEMEN NUSANTARA (PTSN)	Cilacap (Central Java)	750,000	1977	PT GUNUNG NAGADEG JAVA 30% ONODA 35%, MITUI 35%
SEMEN ANDALAS	Aceh	1,000,000	1983	BLUE CIRCLE IND. (U.K.) 70%, RENCONG ACEH SEMEN 30%
PT SEMEN BATURAJA	Batraja			Gov. 88%, PTSG 7%, PTSP 5%
BATURAJA I		500,000	1981	
BATURAJA II		500,000	1985	
PT SEMEN KUPANG		120,000		

2.2.2 Sugar Plant

Indonesian sugar mills are mostly state-owned companies which operate under the control of the Ministry of Agriculture. For administrative purposes, the Ministry has grouped them by region into P.T.P.'s.

The P.T.P.'s which produce sugar are travelling from east to west on the island of Java, P.T.P. 24/25, P.T.P. 21/22, P.T.P. 20, P.T.P. 15/16 and P.T.P. 14. Since it is difficult to develop any new sugar plantations on Java, future plantation development and sugar mill construction will be primarily outside Java on islands such as Sumatra.

As of 1984, there are 69 sugar mills including mills under construction. They consist of 9 private mills and 60 state-owned mills. The locations and capacities of the above mills are shown in Table 2-2.

Older mills have small capacities - with few above 3000 TCD, which is considered the minimum economically feasible capacity. As a result, the sugar production costs are quite high. 4000 TCD has set as the minimum standard capacity for new sugar mills.

Table 2-2 Sugar Plant List in Operation and under Construction (1/4)

	Company Name		Location		Capacity (t/D)	Start-up Year	Remarks
I.	P.T. PERKEBUNAN IX (PERSERO)		- Jl. Tembakau Deli No.4 Medan				
	1. P.G. Cot Girek	- Lhok Sukon	- Aceh		1,040		
	2. P.G. Sai Semayang I	- Sunggal	- Medan		-	1983	
	3. P.G. Kuala Madu		- Medan		4,000	1984	
II.	P.T. PERKEBUNAN XIV (PERSERO)		- Jl. Dr. Wahidin Sudirohusodo 38 Cirebon				
	1. P.G. Kadipaten	- Majalengka	- Majalengka		1,130		
	2. P.G. Jatiwangi	- Jatiwangi	- Majalengka		870		
	3. P.G. Gempol	- Palimanan	- Cirebon		1,070		
	4. P.G. Sindang Laut	- Sindanglaut	- Cirebon		1,400		
	5. P.G. Karang Suwung	- Karangsuwung	- Cirebon		-		
	6. P.G. Tusana Baru	- Babakan	- Cirebon		2,460		
	7. P.G. Jatitujuh (Proy)	- Jatibarang	- Cirebon		3,140		
	8. P.G. Subang		- West Java		3,000	1984	Heavy Mechanical Complex Ltd. of Pakistan/P.T. Aneka Usaha Perkebunan, Local Contents: 60%
III.	P.T. PERKEBUNAN XV-XVI (PERSERO)		- Jl. Ronggowarsito 164 Solo				
	1. P.G. Banjaratma	- Tanjung	- Brebes	)	1,520		
	2. P.G. Jatibarang	- Brebes	- Brebes	)	1,640		
	3. P.G. Pangka	- Pangka	- Tegal	) Jateng Bag. utara	1,330		
	4. P.G. Sumberharjo	- Pemalang	- Pemalang	)	1,520		
	5. P.G. Sragi	- Wiradesa	- Pekalongan	)	3,090		
	6. P.G. Cepiring	- Waleri	- Kendal	)	1,690		
	7. P.G. Rendeng	- Kudus	- Kudus	)	1,400		
	8. P.G. Gondang Baru	- Gondang Winangun	- Klaten	) Jateng Bag. Selatan	1,440		
	9. P.G. Ceper Baru	- Klaten	- Klaten	)	1,270		

Table 2-2 Sugar Plant List in Operation and under Construction (2/4)

	Company Name		Location	Capacity (t/D)	Start-up Year	Remarks
	10. P.G. Colomadu	- Colomadu	- Karanganyar)	1,110		
	11. P.G. Tasikmadu	- Karanganyar	- Karanganyar)	2,190		
	12. P.G. Mojosragen	- Sragen	- Sragen)	1,600		
	13. P.G. Kalibagor	- Sukaraja	- Banyumas)	1,050		
IV.	P.T. PERKEBUNAN XX (PERSERO)		- Jl. Merak No. 1 Surabaya			
	1. P.G. Sudhono	- Ngawi	- Ngawi	2,100		
	2. P.G. Purwodadi	- Maospati	- Magetan	1,860		
	3. P.G. Rejosari	- Gorang-Gareng	- Magetan	1,790		
	4. P.G. Pagotan	- Uteran	- Madiun	1,780		
	5. P.G. Kanigoro	- Kanigoro	- Madiun	1,970		
	6. P.G. Bone	- Arasoe	- Sulawesi Selatan	1,940		
V.	P.T. PERKEBUNAN XXI-XXII (PERSERO)		- Jl. Jembatan Merah 3/5 Surabaya			
	1. P.G. Lestari	- Lestari	- Nganjuk	1,570		
	2. P.G. Merican	- Gringging	- Kediri	1,090		
	3. P.G. Pesantren Baru	- Pesantren	- Kediri	3,090		
	4. P.G. Ngadirejo	- Ngadiluwih	- Kediri	1,650		
	5. P.G. Mojopanggung	- Kalangbret	- Tulungagung	1,480		
	6. P.G. Krian	- Krian	- Sidoharjo	920		
	7. P.G. Watutulis	- Prembon	- Sidoarjo	1,370		
	8. P.G. Tulangan	- Tulangan	- Sidoarjo	1,120		
	9. P.G. Krembung	- Krembung	- Sidoarjo	1,050		
	10. P.G. Gempolkerep	- Gedek	- Mojokerto	3,100		
	11. P.G. Jombang Baru	- Jombang	- Jombang	1,070		
	12. P.G. Cukir	- Diwek	- Jombang	1,570		
	13. P.G. Cinta Manis		- South Sumatora	4,000	1984	Marubeni/P.T. Aneka Usaha Perkebunan

Table 2-2 Sugar Plant List in Operation and under Construction (3/4)

	Company Name		Location	Capacity (t/D)	Start-up Year	Remarks
VI.	P.T. PERKEBUNAN XXIV-XXV (PERSERO)		- Jl. Merak No. 1 Surabaya			
	1. P.G. Kedawung	- Grati	- Pasuruan	1,240		
	2. P.G. Wonolangan	- Probolinggo	- Probolinggo	1,170		
	3. P.G. Gending	- Dringu	- Probolinggo	1,150		
	4. P.G. Pajarakan	- Kraksaen	- Probolinggo	1,060		
	5. P.B. Jatiroto	- *Ranulamongan*	- *Lumajang*	4,530		
	6. P.G. Semboro	- Tanggul	- Jember	4,100		
	7. P.G. De Maas	- Besuki	- Situbondo	710		
	8. P.G. Wringinanom	- Panarukan	- Situbondo	1,050		
	9. P.G. Olean	- Situbondo	- Situbondo	1,080		
	10. P.G. Panji	- Situbondo	- Situbondo	1,620		
	11. P.G. Asembagus	- Sumberwaru	- Situbondo	1,520		
	12. P.G. Prajekan	- Prajekan	- Bondowoso	1,800		
VII.	INDUSTRIAL MANAGEMENT CO. LTD. (PT. IMACO)		- Jl. Undaan Kulon 57-59 Surabaya			
	1. P.G. Redjo Agung		- Madiun	2,990		
	2. P.G. Krebet Baru I	- Bululawang	- Malang Selatan	1,880		
	3. P.G. Krebet Baru II	- Bululawang	- Malang Selatan	2,860		
VIII.	P.T. PABRIK GULA "KEBON AGUNG"		- Jl. Simpang Dukuh 46 Surabaya			
	Direksi PT. Tri Gunabina					
	1. P.G. Kebon Agung	- Kebonsari	- Malang	3,220		
	2. P.G. Trangkil	- Tayu	- Pati	1,870		
XI.	P.T. PABRIK 2 GULA "MADU BARU"		- Tromol Pos 49/Telp. 87049 Yogyakarta			
	P.G. Madukismo		- Yogyakarata	2,290		

Table 2-2 Sugar Plant List in Operation and under Construction (4/4)

	Company Name		Location	Capacity (t/D)	Start-up Year	Remarks
X.	YAYASAN DIPONEGORO		- Semarang			
	P.G. Pakis Baru	- Tayu	- Pati	980		
XI.	P.T. GUNUNG MADU PLANTATIONS		- Jl. Cut Mutiah 30 Teluk Betung - Lampung			
	P.G. Gunung Madu		- Lampung	-		
XII.	P.T. CANDI	- Jl. Rapa Candi	- Sidoarjo			
	P.G. Candi	- Candi	- Sidoarjo	1,260		
	Camming Project		- South Sulawesi	3,000	1984	Tribeni of India/P.T. Aneka Usaha Perkebunan

2.2.3 Fertilizer Plants

The fertilizer industry is closely tied to agriculture. Agriculture is of major importance to the Indonesian economy, employing over 60% of the country's labor force and contributing one-third of the national GDP. Over the last decade the government has assigned top priority to further development in this sector, in an attempt to increase Indonesia's self-sufficiency in food supply and to compete in export markets.

The significant growth in the fertilizer industry occurred during the 1970's due to the introduction of the government's plan to increase both consumption and production of nitrogenous fertilizers. The government supplied farmers with fertilizers at subsidized prices to create an incentive for the increase of crop production.

The fertilizer plants are located in the six locations shown in Table 2-3. The largest of these is the Pusri complex, which encompasses four ammonia plants and four urea plants with a total urea capacity of 744,000 t/YN.

Table 2-3 Fertilizer Plants in Operation and under Construction (1/2)

Company Name	Location	Type of Fertilizer								Capacity (T/Y)	Process	Engineering/Contractor	Plant Cost	Raw Material	Start-up Year
		Ammonia	Urea	Phosphoric Acid	NPK	TSP	DAP	Ammonium Sulfate	Others						
PT Petrokimia Gresik	Gresik	o								73,000	Shell	Topsoe		Oil	1972
			o							66,000	Inventa				1972
				o						200,000 P_2O_5	*Nissan Chemical*	Hitachi Zosen			1985
					o					50,000					1979
						o				330,000					1979
						o				500,000	TVA	Spie Batignolles			1983
							o			80,000					1979
								o		125,000					1979
								o		52,000N	Chemical Construction	Barnard/Hitachi Zosen			1985
PT Pupuk Kujang	Cikampek	o								330,000	Kellogg	Kellogg		N.G.	1978
			o							570,000	Mitsui Toatsu	TEC			1978
PT Pusri (I)	Palembang	o								60,000	C&I/Girdler	Morrison Knudsen		N.G.	1963
(II)		o								218,000	Kellogg	Kellogg		N.G.	1974
(III)		o								330,000	Kellogg	Kellogg		N.G.	1976
(IV)		o								330,000	Kellogg	Kellogg		N.G.	1978
(I)			o							100,000	Mitsui Toatsu	Morrison Knudsen			1963
(II)			o							380,000	Mitsui Toatsu	TEC			1974
(III)			o							570,000	Mitsui Toatsu	TEC			1977
(IV)			o							570,000	Mitsui Toatsu	TEC			1978

Table 2-3 Fertilizer Plants in Operation and under Construction (2/2)

Company Name	Location	Type of Fertilizer								Capacity (T/Y)	Process	Engineering/Contractor	Plant Cost	Raw Material	Start-up Year
		Ammonia	Urea	Phosphoric Acid	NPK	TSP	DAP	Ammonium Sulfate	Others						
PT Pupuk Kaltim (I)	Kalimantan	o								495,000	Lurgi	Lummus/Kobe Steel		N.G.	1984
(II)		o								495,000	Kellogg	Kellogg		N.G.	1985
(I)			o							570,000	Stamicarbon	Kobe Steel			1984
(II)			o							570,000	Stamicarbon	Kellogg			1985
PT ASEAN Aceh Fertilizer	Aceh	o								330,000	Kellogg	TEC	$400MM	N.G.	1984
				o						570,000	Mitsui Toatsu	TEC			1984
PT Iskandar Muda	Aceh	o								330,000	Kellogg	TEC	$385MM	N.G.	1985
				o						570,000	Mitsui Toatsu	TEC			1985

2.2.4 Pulp and Paper Plant

A series of new paper mills began production from the latter half of the 1960's so that the country's paper production capacity grew from 51,500 t/Y in 1969 to 537,200 t/Y in 1983. There are 29 paper-making companies, of which 14 companies are integrated paper mills equipped with their own pulp-making units. The remaining 15 companies have to rely on outside sources of pulp. Only two of the 29 paper companies involve foreign investment. The rest are local companies, five of which are government owned.

Table 2-4 lists these paper making companies and their capacities in 1982. P.T. Indah Kiat Tangerang in West Java and state-owned P.N. Kertas Leces at Probolinggo in East Java are currently the largest writing paper producers with an annual capacity of 33,000 tons and 30,000 tons, respectively. The largest packaging-paper producer is P.T. Kertas Bekasi Teguh at Bekasi with an annual capacity of 28,000 tons of kraft liner and 56,000 tons of corrugated medium.

The paper goods are categorized into three types: (1) cultural paper, (2) industrial paper and (3) tissue. Table 2-5 shows the total paper making capacities as of early 1983. Cultural paper, which consists of writing and printing paper, accounts for almost 38% of the country's total paper production capacity.

Table 2-4 Paper Making Companies and Capacity (as of 1982)

(Unit: T/Y)

Company	Location	Writing/ Printing	Kraft Liner	Corrugated Medium	Board	Duplex	Cigarette	Tissue	Total
- PT Kertas Padalarang	Padalarang	4,400	-	-	-	-	1,500	-	5,900
- PN Leces	Probolinggo	30,000	-	-	-	-	-	-	30,000
- PN Blabak	Magelang	7,200	-	-	-	-	-	-	7,200
- Perum Kertas Gowa	Gowa	20,000	-	-	-	-	-	-	20,000
- Perum Kertas Besuki Raclmat	Banyuwangi	13,800	-	-	-	-	-	-	13,800
- PT Delima Delta	Medan	-	-	-	-	-	1,200	-	1,200
- PT Surya Agung Kertas	Surabaya	9,000	-	-	27,000	-	-	-	36,000
- PT Inpama	Tangerang	-	-	-	-	-	-	1,500	1,500
- PT Bekasi Teguh	Bekasi	-	28,000	56,000	-	-	-	-	84,000
- PT Lontar Papyrus	Aceh	-	7,500	-	-	-	-	-	7,500
- PT Pindo Deli	Kerawang	7,000	-	-	15,000	-	-	-	22,000
- PT Unipa Daya	Tangerang	-	16,740	-	-	-	-	-	16,740
- PT Saraswati Bhakti	Sidoarjo	14,000	-	-	-	-	-	-	14,000
- PT Karya Tulada	Tangerang	-	-	-	5,400	-	-	-	5,400
- PT Papyrus Sakti	Bandung	-	4,700	-	-	-	-	-	4,700
- PT Eureka Aba	Mojokerto	-	-	9,000	-	-	-	-	9,000
- PT Pakerin	Mojokerto	-	-	-	24,000	-	-	-	24,000
- PT Pura Kertas	Kudus	-	4,500	-	-	-	-	-	4,500
- PT Sinar Kudus	Kudus	-	1,500	-	-	-	-	-	1,500
- PT Ciwi Kimia	Sidoarjo	12,000	-	-	-	-	-	-	12,000
- PT Uninga	Sukabumi	-	2,000	-	-	-	-	-	2,000
- PT Asia Pacific Agung	Cengkareng	-	1,000	2,000	-	-	-	-	3,000
- PT Indah Kiat	Tangerang	33,000	-	-	-	-	-	-	33,000
- PT Nores	Bekasi	-	-	-	5,000	5,000	-	-	10,000
- PT Pelita	Cengkareng	-	-	-	19,000	-	-	-	19,000
- PT Sonar Sakti	Tangerang	-	-	-	-	4,500	-	-	4,500
- PT Suparma	Surabaya	360	20,040	-	-	-	-	-	20,400
- PT Sunda Raya	Bogor	-	-	-	9,000	-	-	-	9,000
- PT Golden Martapura	Martapura	15,000	-	-	-	-	-	-	15,000
Total		165,760	85,980	67,000	104,900	9,500	2,700	1,500	437,340

Table 2-5 Paper Making Capacity as of Early 1983

Type of Paper	Annual Capaicty (ton)	% of Total
CULTURAL PAPER		
- Writing & printing paper	165,760	37.9
INDUSTRIAL PAPER		
- Kraft liner	85,980	19.7
- Corrugated medium	67,000	15.3
- Paper board	104,900	24.0
- Duplex	9,500	2.2
TISSUE		
- Cigarette paper	2,700	0.6
- Tissue for household use	1,500	0.3
Total	437,340	100.0

Source: Directorate General for Basic Chemical Industries.

2.2.5 Palm Oil Plant

The government places high priority on the development of oil palm plantations and the palm oil industry, actively encouraging private investment in this agro-business venture. Palm oil, required as a basic material for a wide range of industrial products, has been enjoying strong demand in the international markets. Table 2-6 lists palm oil processing plants.

Table 2-6 Palm Oil Processing Plant (1982)

No.	Province	Number of Firm	Production Capaity (ton per ann)	Production (ton per ann)				
				Fractioning	Refining	Soap	Margarine	Chemicals
1.	North Sumatera	37	351,156	331,400	1,200	19,556	-	-
2.	West Sumatera	3	4,952	-	-	2,752	-	-
3.	Riau	2	300	-	-	300	-	-
4.	Jambi	6	2,360	-	-	2,364	-	-
5.	Lampung	10	40,000	10,800	7,000	22,200	-	-
6.	West Java	4	52,600	30,000	23,400	2,200	-	-
7.	D.K.I. Jakarta	26	402,220	281,400	40,764	33,180	40,896	9,600
8.	Central Java	7	20,175	-	6,840	9,315	900	-
9.	East Java	8	159,168	123,000	31,968	3,120	4,200	-
	Total	103	1,032,931	776,600	111,172	95,007	45,996	9,600

Source: Ministry of Industry.

Chapter 3

MARKET STUDY

Chapter 3. Market Study

3.1 Methodology for Market Study

The market study was conducted according to the study flow as shown in Fig. 3-1 using various data and information obtained through the field survey. Each item is explained below.

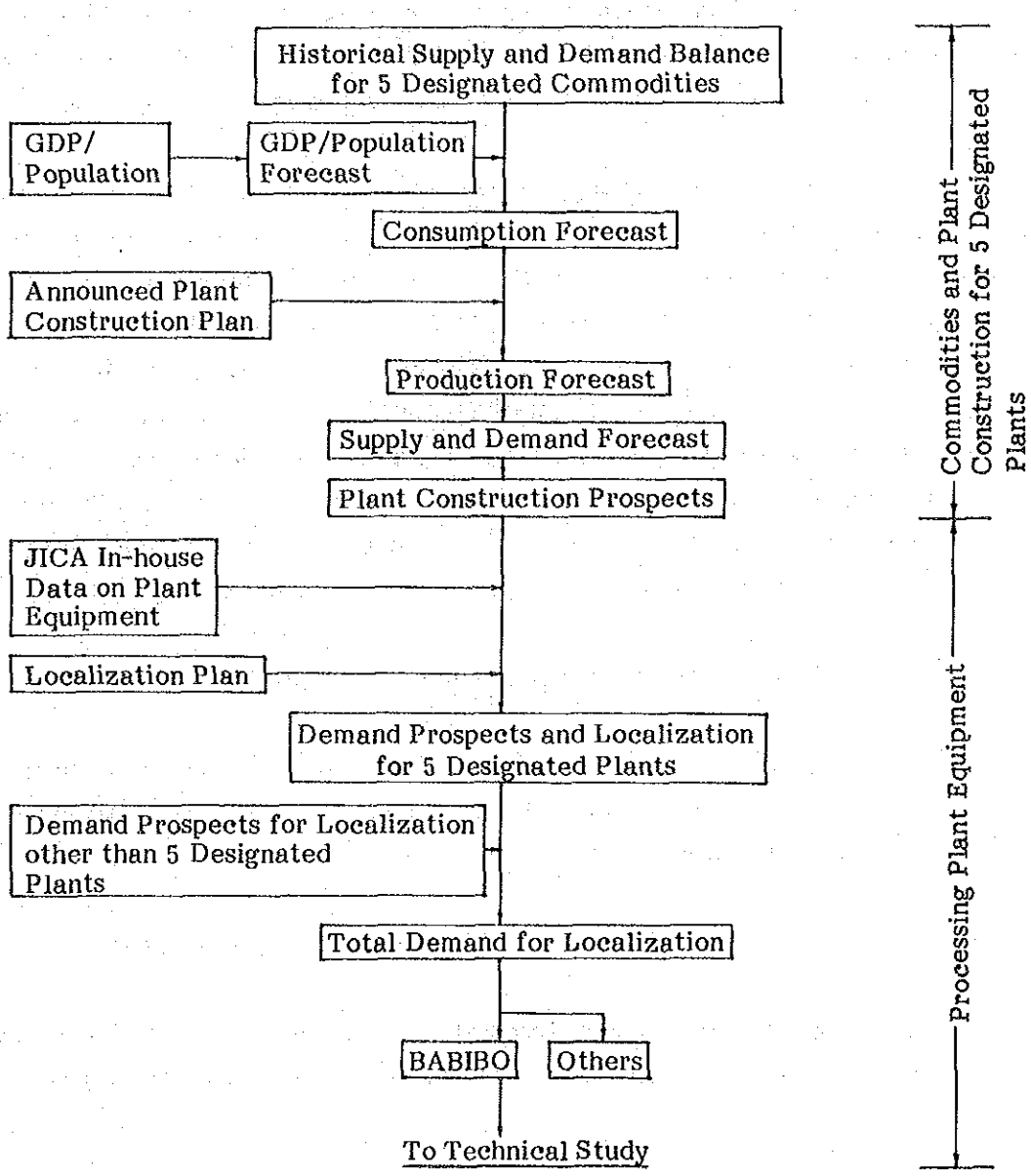

Fig. 3-1 Market Study Flow

3.1.1 Historical Supply and Demand Balance for Five Designated Commodities

The supply and demand balance of the five designated commodities was studied for the past ten years in principle. Although the records of supply and demand balance have some discrepancy depending on the data sources, the one considered the most reasonable was adopted.

3.1.2 Consumption Forecast for Five Designated Commodities

The GDP and population were projected to study the relationships between the consumption, and GDP and population (per capita consumption). The forecast was made by setting the average annual increase rate on the basis of the published data.

The consumption was forecasted by principally using the correlation with the GDP. The per capita consumption was calculated to assess the consumption level of commodities. The ultimate purpose of the market study in this survey was to study the demand of plant processing equipment of five designated plants and others which can be produced in each BABIBO company. Therefore, the consumption forecast of five designated commodities adopted a relatively simple method using single regression analysis of the consumption volume of commodity and GDP under a recognition that it is a step in obtaining the final output. The result was further compared with the forecast made by another organizations for verification. The consumption forecast by this method, therefore, is considered sufficient in view of the purpose of this survey.

3.1.3 Production Forecast for Five Designated Commodities

The production was forecasted by referring to the above consumption forecast and announced plant construction plans, taking the supply and demand pattern (self-supply or export oriented) into consideration.

3.1.4 Supply and Demand Forecast for Five Designated Commodities

The supply and demand forecast was made by summarizing the above consumption and production forecast, and the balance for each year was calculated.

3.1.5 Plant Construction Prospects for Five Designated Plants

The plant construction prospects were made according to the production forecast.

3.1.6 Demand Prospects and Localization of Plant Processing Equipment for Five Designated Plants

The plant processing equipment for the five designated plants was classified into the Function level in accordance with the Engineering Advancement Association (ENAA) classification using the JICA in-house data. They are further divided into the imported equipment and local one. The result is combined with the plant construction prospects to obtain the demand of the plant processing equipment and the local contents.

3.1.7 Total Demand Prospects of Plant Processing Equipment for Localization

Furthermore, the demand for some plant processing equipment which BABIBO presently manufactures and those which BABIBO will be able to manufacture was forecasted. The result was combined with the demand of plant processing equipment for five designated plants to calculate the potential demand for plant processing equipment to be manufactured in Indonesia.

3.1.8 Prospects of Contract Award to Be Received by BABIBO Companies

The amount of orders to be received by BABIBO companies and factories were planned on the basis of the potential demand for the plant processing equipment to be manufactured in Indonesia. The result is used as the basis for product mix calculation in the Technical Study.

3.2 Projection of Population and Gross Domestic Products (GDP)

The population and GDP required for the forecast of the supply and demand balance for the five designated commodities were projected as follows.

3.2.1 Projection of Population

Table 3-1 shows the projection of population until PELITA VI. The annual growth rate of population was 2.1% for PELITA II and 2.2% for PELITA III, arriving at 158 million in 1983.

To cope with the rapidly increasing population, the Government makes the population control policy. In PELITA IV, the Government sets the annual growth rate at 2.0%. On the other hand, the growth rate of population estimated by other organizations is as follows:

Organization	*Period*	*Growth Rate (%/y)*
BPS	1980-85	2.2
	1986-95	1.9
World Bank	1980-2000	2.0

Source: The Indonesian Quarterly, Vol. XII, No. 1, 1984

Here, the following population growth rate is set taking above data into consideration:

PELITA	Period	Growth Rate (%/y)
IV	1984-88	2.0
V	1989-93	2.0
VI	1994-98	1.9

Table 3-1 Projection of Population

PELITA	Year	Population (Million)	Av. Annual Growth Rate for PELITA (%)
	1973	127.6	
	74	130.5	
	75	133.5	
II	76	135.2	2.1 (actual)
	77	138.3	
	78	141.6	
	79	144.1	
	80	147.5	
III	81	151.3	2.2 (actual)
	82	154.7	
	83	158.1	
	84	161.6	
	85	165.2	
IV	86	168.7	2.0
	87	172.2	
	88	175.6	
	89	179.1	
	90	182.7	
V	91	186.3	2.0
	92	190.1	
	93	193.9	
	94	197.6	
	95	201.3	
VI	96	205.1	1.9
	97	209.0	
	98	213.0	

3.2.2 Projection of GDP

The annual growth rate of GDP for PELITA IV between 1984 and 1988 is set at 5%. On the other hand, the annual growth rate of GDP per capita forecasted by other organizations is shown below. In the table the growth rate of GDP is calculated considering the growth rate of the population.

		Growth Rate of GDP per Capita (%/y)		Growth Rate of GDP (%/y) *1	
Organization	Period	Low	High	Low	High
LPEM *2 (1980)	1978-1985	3.90	4.90	ca.4.0	ca.5.0
	1985-2000	3.60	5.10	ca.3.7	ca.5.2
World Bank (1979)	1973-1990	4.54		ca.4.6	

Source: The Indonesian Quarterly Review, Vol. XII, No. 1, 1984

*1: Calculation by JICA

*2: Institute for Economic and Social Research at the University of Indonesia

In consideration of the above, the annual growth rate of GDP is set as follows:

PELITA	Period	GDP Growth Rate (%/y)
IV	1984-88	5.0
V	1989-93	4.6
VI	1994-98	4.2

Table 3-2 shows the GDP projection.

Table 3-2 GDP Projection (At Constant 1973 Market Price)

PELITA	Year	GDP (Rp Billion)	Annual Growth Rate (%) Annual	Av. for PELITA
	1973	6,753.4	-	
	74	7,269.0	7.6	
	75	7,630.8	5.0	
II	76	8,156.3	6.9	6.9% (actual)
	77	8,870.9	8.8	
	78	9,566.5 (9,471.2)	7.8	
	79	10,164.9	6.3	
	80	11,169.2	9.9	
III	81	12,055	7.9	6.0% (actual)
	82	12,325	2.25	
	83	12,707*	3.1*	
	84	13,342	5.0	
	85	14,009	5.0	
IV	86	14,710	5.0	5.0%
	87	15,445	5.0	
	88	16,218	5.0	
	89	16,964	4.6	
	90	17,744	4.6	
V	91	18,560	4.6	4.6%
	92	19,414	4.6	
	93	20,307	4.6	
	94	21,160	4.2	
	95	22,049	4.2	4.2%
VI	96	22,975	4.2	
	97	23,940	4.2	
	98	24,945	4.2	

1) *: Provisional

2) Figure in parenthesis indicates GDP for PELITA III planning

3.3 Plant Construction Prospects for Five Designated Plants

3.3.1 Cement Plant

(1) Supply and demand balance of cement

1) Historical supply and demand balance of cement

Table 3-3 shows the supply and demand balance of cement in Indonesia. The average annual growth rate of cement in the period between 1974 and 1983 was 29.5% which was far above the average annual growth rate of consumption of 14.9%. The self-sufficiency of cement is almost attained now. In 1983, the production was 8.5 million tons which was 0.5 million tons less than the consumption (9 million tons). When the plant now under construction starts to operate as scheduled, the production will increase further so that surplus for export is expected to arise from 1984 and onward.

The per capita cement consumption is about 57 kg which is much lower than 180 kg (1978) in Malaysia not to speak of 660 kg in Japan. In this circumstance, the cement consumption is expected to show steady growth in the future.

2) Cement consumption forecast

A linear correlation equation was made on the past cement consumption record with GDP. The line is extended further to obtain the cement consumption for corresponding to the projected GDP figure.

Fig. 3-2 shows the relation between the GDP and the cement consumption. As apparent from the figure, the relation between the GDP and the consumption changed with 1978 as the boundary. Two correlation equations were made for the period before 1978 and the period after 1978. Single regression analysis with the cement consumption as y (1,000 t/year) and the GDP as x (billion Rp) gives following equations:

$$y = 0.58676x - 1608.4 \quad (1974 \text{ to } 1978)$$
$$y = 1.5311x - 11045 \quad (1978 \text{ to } 1983)$$

Table 3-3 Supply and Demand Balance of Cement

		Supply				Demand						
		Production				Consumption						
			Growth Rate(%/Y)			Growth Rate(%/Y)			Per CAPITA			
PELITA	Year	1,000T	Annual	Av. for 5-Yr	Import (1,000T)	1,000T	Annual	Av. for 5-Yr	KG/CAPITA	Growth Rate(%/Y) Annual	Growth Rate(%/Y) Av. for 5-Yr	Export (1,000T)
	1974	829			1,738	2,567			19.7			
	75	1,241	49.7		1,609	2,850	11.0		21.3	8.1		
II	76	1,979	59.5	44.6	1,434	3,413	19.8	11.8	25.2	18.3	9.5	
	77	2,879	45.5		590	3,469	1.6		25.1	-0.4		
	78	3,629	26.1		420	4,006	15.5		28.3	12.7		43
	79	4,705	29.7		148	4,314	7.7		29.9	5.7		539
	80	5,852	24.4		327	5,820	34.9		39.5	32.1		359
III	81	6,844	17.0	18.6	366	6,756	16.1	17.6	44.6	12.9	15.0	454
	82	7,651	11.8		492	7,936	17.5		51.3	15.0		207
	83	8,500	11.1		691	8,993	13.3		56.9	10.9		198

Note) (Consumption) = (Production) + (Import) - (Export)

Source:

1) Production: State Address by President Soeharto (1974-81), MOI (1982-83)

2) Import : BPS

3) Export : Indonesia Cement Association (1978-80), BPS (1981-83)

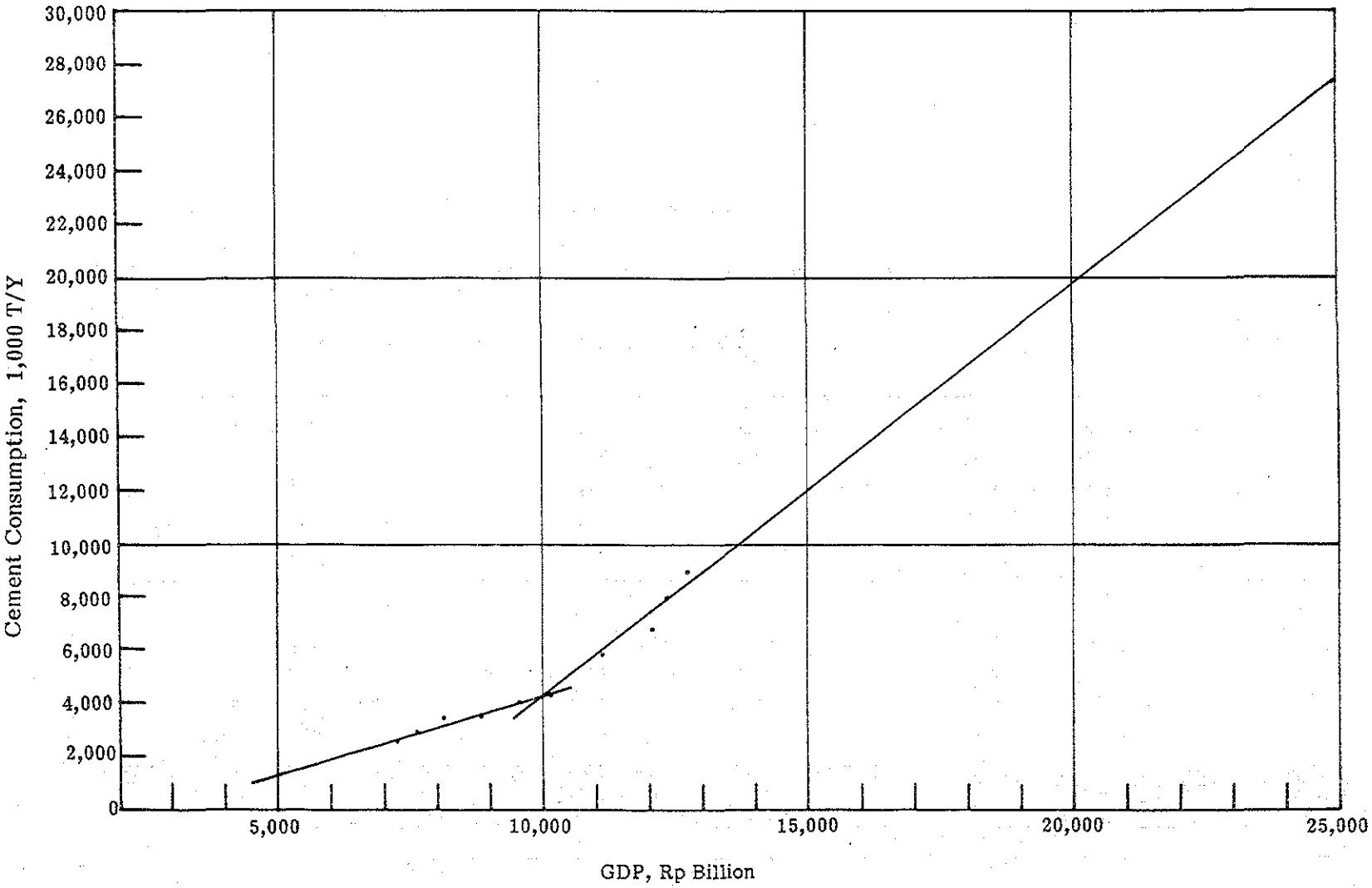

Fig. 3-2 GDP and Cement Consumption

The cement consumption on and after 1984 was forecasted by using the latter equation, and the calculation result is summarized in Table 3-4. In 1988, at the end of PELITA IV, the forecasted consumption is 13.8 million tons. The consumption will reach about 27.1 million tons in 1998. The average annual growth rate between 1983 and 1998 is 7.6%

Table 3-4 Estimate of Cement Consumption

PELITA	Year	Consumption(1,000T)	Av. Annual Growth Rate during PELITA (%)
III	1983	8,993	
	84	9,383	
	85	10,404	
IV	86	11,477	8.9
	87	12,602	
	88	13,786	
	89	14,928	
	90	16,123	
V	91	17,372	7.8
	92	18,679	
	93	20,047	
	94	21,353	
	95	22,714	
VI	96	24,132	6.3
	97	25,609	
	98	27,148	

Table 3-5 shows comparison of this result with consumption forecasts made by other organizations.

JICA's estimate is slightly above the values forecasted by Indonesian Cement Association (ICA) until 1989, and is almost the same for 1990. In comparison with the MOI's forecast, the values are slightly lower than the values forecasted by the MOI.

Therefore, JICA's forecast is considered reasonable in view of the forecasts by ICA and MOI.

Table 3-5 Comparison of Cement Consumption Estimates

(Unit : 1,000T)

Year	Estimates of Cement Consumption		
	JICA	ICA[1)]	MOI[2)]
1983	8,993	8,239	9,140
84	9,383	8,611	10,500
85	10,404	9,508	12,000
86	11,477	10,605	13,900
87	12,602	11,843	
88	13,786	13,155	
89	14,928	14,633	
90	16,123	16,188	

Source:

1) Indonesia Cement Association
2) Ministry of Industry, Pengembangan Kapasitas Nasional Sector Industri (1983-1986)

3) Cement production forecast

The cement production was forecasted on the basis of the cement consumption forecast made in 2) and the announced cement plant construction plan. Since almost all raw materials other than gypsum are obtained in Indonesia in addition to heavy oil and coal as the fuel, there is no restriction for increase of cement production as far as raw materials are concerned.

Table 3-6 shows the announced cement plant construction plans. The table does not include the plants now under construction.

Table 3-6 Cement Plant Construction Plan

Company Name	Location	Capacity (T/Y)
PT. Semen Sugih Harapan	Grobogan Jateng.	3,000,000
PT. Perkasa Krida Hasta Indonesia CE.	Madura Jatim	I. 1,500,000 II. 1,500,000
PT. Perkasa Sambada Karya Indonesia CE.	Cilacap Jateng	1,500,000
PT. Perkasa Ansana Abadi Indonesia CE.	Bogor Jabar.	1,500,000
PT. Semen Purwodadi	Grobogan Purwo dadi Jateng	I. 2,000,000 II. 1,000,000

Source: Ministry of Industry

The announced plant construction plans cover a production capacity of twelve million tons per year. In addition PT. Semen Padang is said to have an expansion plan corresponding to six million tons per year. In total, cement plants amounting to eighteen million tons per year in production capacity are going to be constructed by 2000.

The self-sufficiency for domestic consumption has almost been attained, and some room for export will be expected in the future. Assuming the tendency to continue and taking the above cement plant construction plans into account the production forecast was made.

Table 3-7 shows the cement production forecast on assumption that one 1.5 million t/year scale cement plant starts construction every year in a period between 1984 and 1998 excluding 1988, 1989, 1995 and 1997 (totaled 16.5 million tons per year). The assumption was made for the production forecast as follows:

The construction period is three years. The production starts from the fourth year after the start of construction. The capacity utilization is 60% in the initial year, 70% in the second year, and 80% in the third year and on.

The production capacity is 11.72 million tons in 1983. It will reach 19.41 million tons in 1988. This value is slightly lower than 21 million tons which is the target value for PELITA IV.

Table 3-7 Cement Production Forecast

PELITA	Year	Capacity 1,000T	Cap. Utilization (%)	Production 1,000T	Growth Rate (%/Y) Annual	Av. for 5-Yr
III	83	11,720	72.5	8,500	11.1	
	84	15,610	69.4	10,840	27.5	
	85	17,910	70.0	12,540	15.7	
IV	86	17,910	75.0	13,430	7.1	12.4
	87	17,910	80.0	14,330	6.7	
	88	19,410	78.5	15,230	6.3	
	89	20,910	77.9	16,280	6.9	
	90	22,410	78.0	17,480	7.4	
V	91	23,910	78.1	18,680	6.9	4.7
	92	23,910	79.4	18,980	1.6	
	93	23,910	80.0	19,130	0.8	
	94	25,410	78.8	20,030	4.7	
	95	26,910	78.3	21,080	5.2	
VI	96	28,410	78.4	22,280	5.7	5.2
	97	29,910	78.5	23,480	5.4	
	98	31,410	78.6	24,680	5.1	

The production capacity in 1998 is about 31.4 million tons per year. The average annual growth rate in a period between 1983 and 1998 is 6.8%. On the other hand, the annual production will grow from 8.5 million tons in 1983 to about 24.7 million tons in 1998. The average annual growth rate in that period is 7.4%.

4) Cement supply and demand balance forecast

Table 3-8 shows the supply and demand balance of cement obtained by combining the results of forecasts in items 2) and 3) above.

Table 3-8 Supply and Demand Balance of Cement

PELITA	Year	Production Capacity (1,000 T/Y)	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
	1983	11,720	8,500	8,993	-493
	84	15,610	10,840	9,383	1,457
	85	17,910	12,540	10,404	2,136
IV	86	17,910	13,430	11,477	1,953
	87	17,910	14,330	12,603	1,727
	88	19,410	15,230	13,786	1,444
	89	20,910	16,280	14,928	1,352
	90	22,410	17,480	16,123	1,357
V	91	23,910	18,680	17,372	1,308
	92	23,910	18,980	18,679	301
	93	23,910	19,130	20,047	-917
	94	25,410	20,030	21,353	-1,323
	95	26,910	21,080	22,714	-1,634
VI	96	28,410	22,280	24,132	-1,852
	97	29,910	23,480	25,609	-2,129
	98	31,410	24,680	27,148	-2,468

The production exceeds the consumption in a period between 1984 and 1992. After that period, however, the consumption exceeds the production. In 1998, the consumption is about 27.1 million tons and a shortage of about 2.5 million tons of cement is estimated. However, the production capacity is 31.4 million tons. Improvement of the capacity utilization could cover the shortage.

(2) Cement Plant Construction Prospects

Table 3-9 shows the prospects of cement plant construction on the basis of the above study results.

Table 3-9 Cement Plant Construction Prospects

Standard Production Capacity: 1 Million T/Y

PELITA	Year	No. of Plant Construction
	1984	1.5
	85	1.5
IV	86	1.5
	87	1.5
	88	
	89	
	90	1.5
V	91	1.5
	92	1.5
	93	1.5
	94	1.5
	95	
VI	96	1.5
	97	
	98	1.5

3.3.2 Sugar Plant

(1) Supply and Demand Balance of Sugar

1) Historical supply and demand balance of sugar

Table 3-10 shows the supply and demand balance of sugar in Indonesia. The growth of sugar production was small and the average annual growth rate in a period between 1973 and 1983 was only 4.4%. On the other hand, the average annual growth rate of consumption in the same period was 7.1%. Since the sugar consumption far exceeds the production, a large volume of sugar is imported at present. In 1983 the production was 1.55 million tons while the consumption was 2.10 million tons, resulting in a shortage of 550 thousand tons. The Government plans to increase the sugar cane plantation, but the self-sufficiency of sugar is not expected in the near future because of a great gap existing in the supply and demand balance. The per capita sugar consumption is 13.3 kg, which is low as compared with other ASEAN countries.

In this circumstance, the sugar consumption in Indonesia will continue to increase in the future.

Table 3-10 Supply and Demand Balance of Cement

		Supply				Demand						
		Production				Consumption						
			Growth Rate(%/Y)				Growth Rate(%/Y)		Per CAPITA			
PELITA	Year	1,000T	Annual	Av. for 5-Yr	Import (1,000T)	1,000T	Annual	Av. for 5-Yr	KG/CAPITA	Growth Rate(%/Y) Annual	Av. for 5-Yr	Export (1,000T)
	1973	1,010	-		46.9	1,056.9	-		8.3	-		
	74	1,024.8	1.5		83.6	1,108.4	4.9		8.5	2.4		
	75	1,029.9	0.0		88.5	1,117.6	0.8		8.4	- 1.2		0.8
II	76	1,055.7	2.5	2.2	219.1	1,274.8	14.1	8.5	9.4	11.9	6.2	
	77	1,104.8	4.7		240.4	1,345.2	5.5		9.7	3.2		
	78	1,125.8	1.9		466.7	1,592.5	18.4		11.2	15.5		
	79	1,275.4	13.3		318.3	1,593.7	0.0		11.1	- 0.9		
	80	1,183.3	-7.2		432.2	1,615.5	1.4		11.0	- 0.9		
III	81	1,080.9	-8.7	6.7	782.5	1,863.4	15.3	5.7	12.3	11.8	3.5	
	82	1,565.2	44.8		745.3	2,310.5	24.0		14.9	21.1		
	83	1,553.6	-0.7		n.a.	2,104*	-8.9		13.3	-10.7		

* : Estimate

Note) (Consumption) = (Production) + (Import) - (Export)

Source:

1) Production: BPS
2) Import : FAO
3) Export : FAO

2) **Sugar consumption forecast**

A linear correlation equation of the sugar consumption with GDP was made on the basis of their past relation. Using this equation, the sugar consumption was forecasted for the corresponding GDP for each year.

Fig. 3-3 shows the relation between the GDP and the sugar consumption. Single regression analysis with the sugar consumption as (1,000 t/y) and GDP as (billion Rp) gives the following equation:

$$= 0.18612 - 260.91$$

Table 3-11 shows the sugar consumption forecast in 1984 and onward by using this regression equation. In 1988, at the end of PELITA IV, the consumption is forecasted to be about 2.76 million tons. It will grow to about 4.38 million tons in 1998. The average annual growth rate of consumption in a period between 1983 and 1998 is 5.8%.
The per capita sugar consumption is estimated to grow from 13.3 kg in 1983 to 20.6 kg in 1998.

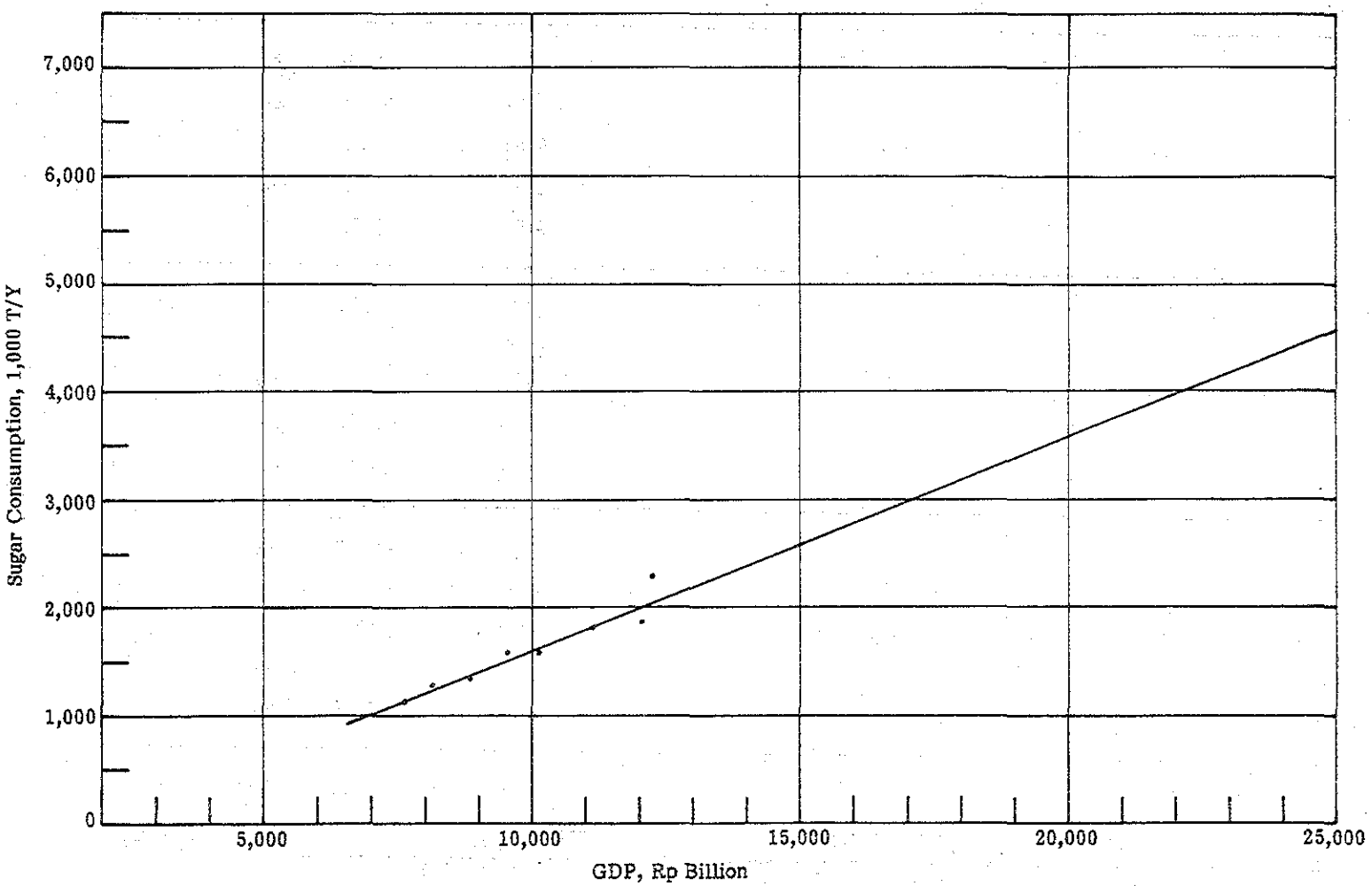

Fig. 3-3 GDP and Sugar Consumption

Table 3-11 Estimate of Sugar Consumption

PELITA	Year	Consumption 1,000T	Consumption kg/Capita	Av. Annual Growth Rate during PELITA (%) Consumption	Per Capita
III	1983	2,014	13.3		
	84	2,222	18.8		
	85	2,346	14.2		
IV	86	2,477	14.7	5.6	3.4
	87	2,614	15.2		
	88	2,758	15.7		
	89	2,896	16.2		
	90	3,042	16.7		
V	91	3,193	17.1	5.0	2.9
	92	3,352	17.6		
	93	3,519	18.1		
	94	3,677	18.6		
	95	3,843	19.1		
VI	96	4,015	19.6	4.5	2.6
	97	4,195	20.1		
	98	4,382	20.6		

Table 3-12 compares the result with the consumption estimated by another organization.

Table 3-12 Comparison of Sugar Consumption Estimates

(Unit : 1,000T)

Year	Estimates of Sugar Consumption	
	JICA	MOA *
1983	2,014	1,995
84	2,222	2,136
85	2,346	2,287
86	2,477	2,450
87	2,614	2,623
88	2,758	2,809

* : Ministry of Agriculture

The values estimated by JICA are almost equal to those estimated by the Ministry of Agriculture, so they can be considered reasonable.

3) Sugar production forecast

Indonesia is not self-sufficient in sugar. Increase of sugar production will continue in the future to attain the self-sufficiency. In PELITA IV, the sugar production is planned to be increased at an annual rate of 5.6% on an average. The target sugar production quantity in 1988, at the end of PELITA IV, is about 2.14 million tons. The sugar consumption in 1988 is estimated to be about 2.8 million tons, and the self-sufficiency of sugar can not be attained even then.

The plantation in Java Island has almost reached the limit. The government policy emphasizes plantation outside Java Island.

Assuming further continuation of production increase for the self sufficiency in sugar in the period after PELITA IV, the annual production growth rate in 1989 and on was set at the same 5.6% as in PELITA IV in preparing the production forecast.

Table 3-13 shows the result of production forecast. The annual production will grow from 1.63 million tons in 1983 to 3.69 million tons (about 2.3 times) in 1998.

Table 3-13 Sugar Production Forecast

PELITA	Year	Production 1,000T	Growth Rate (%) Annual	Av. for 5-YR.
III	1983	1,630*		
	84	1,721	5.6	
	85	1,818	5.6	
IV	86	1,919	5.6	5.6
	87	2,027	5.6	
	88	2,141	5.6	
	89	2,261	5.6	
	90	2,388	5.6	
V	91	2,521	5.6	5.6
	92	2,662	5.6	
	93	2,811	5.6	
	94	2,969	5.6	
	95	3,135	5.6	
VI	96	3,311	5.6	5.6
	97	3,496	5.6	
	98	3,692	5.6	

* : Figure for PELITA IV (1,554 T in actual)

4) Sugar supply and demand balance forecast

Table 3-14 shows the supply and demand balance of sugar combining the forecasts in 2) and 3) above.

Table 3-14 Supply and Demand Balance of Sugar

PELITA	Year	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
III	1983	1,630	2,014	-384
	84	1,721	2,222	-501
	85	1,818	2,346	-528
IV	86	1,919	2,477	-558
	87	2,027	2,614	-587
	88	2,141	2,758	-617
	89	2,261	2,896	-635
	90	2,388	3,042	-654
V	91	2,521	3,193	-672
	92	2,662	3,352	-690
	93	2,811	3,519	-708
	94	2,969	3,677	-708
	95	3,135	3,843	-708
IV	96	3,311	4,015	-704
	97	3,496	4,195	-699
	98	3,692	4,382	-690

The production quantity will grow at an annual growth rate of 5.6% on average from 1.55 million tons in 1983 to 3.69 million tons in 1998. On the other hand, the consumption will grow at an annual rate of 5.3% on an average from 2.01 million tons in 1983 to 4.38 million tons in 1998.

Therefore, the self-sufficiency in sugar will not be achieved. The shortage of 500 to 700 thousand tons annually is anticipated. To attain the self-sufficiency in sugar, extensive increase of the plantation is necessary but the possibility seems to be little when considering the past growth of the plantation area.

(2) Sugar plant construction prospects.

Table 3-15 shows the sugar plant construction prospects according to the result of the above study.

Table 3-15 Sugar Plant Construction Prospects

Standard Production Capacity : 4,000 TCD

PELITA	Year	No. of Plant Construction
	1984	3
	85	3
IV	86	3
	87	3
	88	3
	89	4
	90	4
V	91	4
	92	4
	93	4
	94	5
	95	5
VI	96	5
	97	5
	98	5

3.3.3 Fertilizer Plants

The types of fertilizers mainly used in Indonesia at present are urea and ammonium sulfate as nitrogenous fertilizers, and triple super phosphate (TSP) as a phosphate fertilizer. Therefore, the types of fertilizers investigated in the study were restricted to the above fertilizers and their raw materials as shown below.

-Ammonia (raw material for urea)
-Urea
-Ammonium sulfate
-Phosphoric acid (raw material for phosphate fertilizers such as TSP)
-TSP

As regards potassium fertilizers, there is no potassium resources in Indonesia and whole quantity is being imported. They were excluded from the study, because of little possibility of potassium fertilizer plant construction in the future.

(1) Supply and demand balance of fertilizers

Assuming the materials (ammonia and phosphoric acid) required for the fertilizer production is consumed domestically without export, the supply and demand balances of these raw materials can be calculated form the supply and demand balances of fertilizers. The supply and demand balances of ammonia and phosphoric acid are not discussed here for this reason.

1) Historical supply and demand balances of fertilizers

(1) Urea fertilizer

Urea is the main nitrogenous fertilizer used in Indonesia, and it accounts for 90% or more (converted to N) of the total nitrogenous fertilizer in quantity. Table 3-16 shows the supply and demand balance of urea fertilizer.

Table 3-16 Supply and Demand Balance of Urea Fertilizer

PELITA	Year	Supply: Production 1,000T	Supply: Production Growth Rate(%/Y) Annual	Supply: Production Growth Rate(%/Y) Av. for 5-Yr	Supply: Import (1,000T)	Demand: Consumption 1,000T	Demand: Consumption Growth Rate(%/Y) Annual	Demand: Consumption Growth Rate(%/Y) Av. for 5-Yr	Demand: Export (1,000T)
	1974	209							
	75	387	85.2			676			
III	76	406	4.9	61.9		686	1.5		
	77	990	143.8			932	35.9		
	78	1,437	45.2			1,065	14.3		227
	79	1,827	27.1			1,222	14.7		295
	80	1,985	8.6		211	1,656	35.5		177
IV	81	2,007	1.1	9.4	308	1,992	20.3	17.1	38
	82	2,190	9.1		292	1,985	-0.4		45
	83	2,255	3.0		185	2,348	18.3		329

Source:

(1) Production : State Address by President Soeharto(before 1981), British Sulfur(1982-83)

(2) Import : FAO(1980-81), BPS(1982-83)

(3) Consumption: FAO(before 1981), British Sulfur(1982-83)

(4) Export : FAO(before 1981), BPS(1982-83)

The urea production quantity was only 210 thousand tons in 1974, but it increased to 2.26 million tons in 1983. The average annual growth rate of the production in this period was as high as 30.3%. The consumption also increased greatly from 680 thousand tons in 1975 to 2.35 million tons in 1983. The average annual growth rate of consumption was 16.8%.

The self-sufficiency was attained in 1983. Since the plants started up in 1983 will put into normal operation from 1984 and the plants under construction is planned to be operated in 1985, there will be a room for export.

(2) Ammonium sulfate

Ammonium sulfate is the second major nitrogenous fertilizer, but its share in the total nitrogenous fertilizer consumption is low at less than 10% (converted to N). Table 3-17 shows the supply and demand balance of ammonium sulfate.

The production quantity of ammonium sulfate for the past few years has been about two million tons per year while the annual consumption has been three million tons or more. The shortage has been sufficed by imports.

Table 3-17 Supply and Demand Balance of Ammonium Sulphate

PELITA	Year	Supply: Production 1,000T	Supply: Production Growth Rate(%/Y) Annual	Supply: Production Growth Rate(%/Y) Av. for 5-Yr	Supply: Import (1,000T)	Demand: Consumption 1,000T	Demand: Consumption Growth Rate(%/Y) Annual	Demand: Consumption Growth Rate(%/Y) Av. for 5-Yr
	1974	129						
	75	114	-11.6					
II	76	105	- 7.9	2.2				
	77	93	-11.4					
	78	141	51.6		44	151		
	79	148	5.0		24	191	26.5	
	80	181	22.2		75	321	68.1	
III	81	195	7.7	8.1	156	275	-14.3	18.5
	82	210	7.7		n.a.	332	20.7	
	83	208	- 1.0		208	353*	6.3	

*: Estimate

Note) Export is zero before 1983.

Source:

(1) Production : State Address by President Soeharto(before 1981), British Sulfur(1982-83)

(2) Import : FAO(before 1981), BPS(1982-83)

(3) Consumption: FAO(before 1981), MOI(1982-83)

(3) TSP

The main phosphate fertilizer used in Indonesia is TSP. It accounts for 90% or more (converted to P_2O_5) of the total phosphate fertilizer consumption. Table 3-18 shows the supply and demand balance of TSP.

Table 3-18 Supply and Demand Balance of TSP

		Supply				Demand			
		Production				Consumption			
		Growth Rate(%/Y)			Import	Growth Rate(%/Y)			Export
PELITA	Year	1,000T	Annual	Av. for 5-Yr	(1,000T)	1,000T	Annual	Av. for 5-Yr	(1,000T)
	1978	0			207	207			
	79	114	-		108	222	7.2		
	80	465	307.9		24	489	120.3		
III	81	559	20.2	-	206	765	56.4	36.1	
	82	535	- 4.3		200	735	- 3.9		
	83	783	46.4		182	965	31.3		13

Note) Consumption = (Production) + (Import) - (Export)

Source:
(1) Production: MOA(1978-82), British Sulfur(1983)
(2) Import : BPS
(3) Export : BPS

Since startup of the first TSP plant in Indonesia in 1979, the production quantity has increased to about 7.8 million tons in 1983. The consumption has also increased rapidly to about 9.7 million tons in 1983.

2) Fertilizer consumption forecast

A linear correlation equation was prepared according to the past consumption and GDP of the fertilizer. The fertilizer consumption was forecasted according to the projected GDP value for each year.

(1) Urea fertilizer

Fig. 3-4 shows the relation between the GDP and urea fertilizer consumption. Single regression analysis with the urea fertilizer consumption as y (1,000 t/y) and GDP as x (billion Rp) gives the following equation:

$$y = 0.32549x - 1954.8$$

Table 3-19 shows the urea fertilizer consumption estimated using this regression equation. The average annual growth rate of consumption in a period between 1983 and 1998 is 6.6%.

Table 3-19 Estimate of Urea Consumption

PELITA	Year	Consumption (1,000T)	Av. Annual Growth Rate during PELITA (%)
III	1983	2,348(actual)	
	84	2,388	
	85	2,605	
IV	86	2,833	7.2
	87	3,072	
	88	3,324	
	89	3,567	
	90	3,821	
V	91	4,086	7.0
	92	4,364	
	93	4,655	
	94	4,933	
	95	5,223	
VI	96	5,523	5.8
	97	5,837	
	98	6,165	

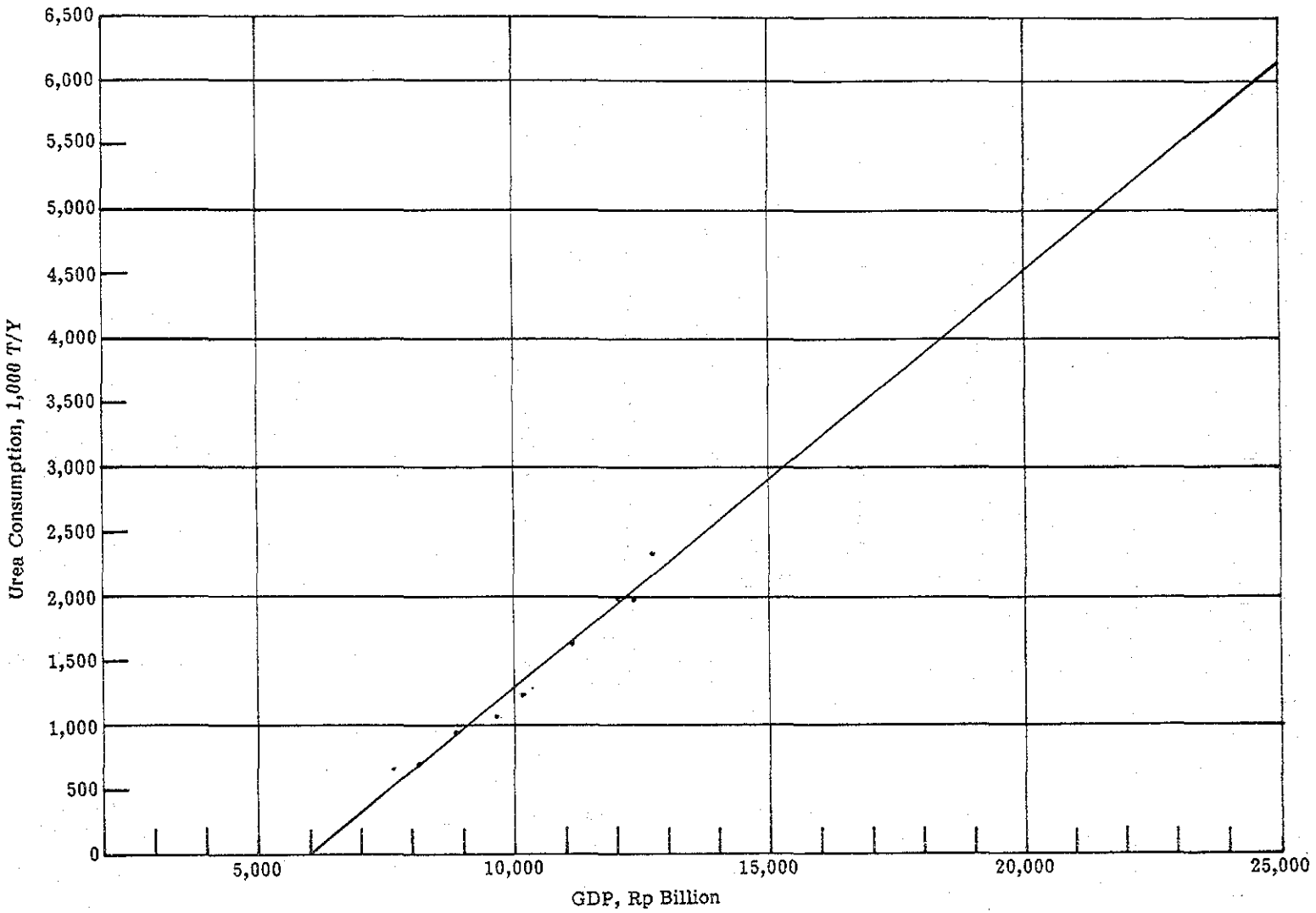

Fig. 3-4 GDP and Urea Consumptin

Table 3-20 compares this result with the consumption values estimated by other organizations.

Table 3-20 Comparison of Urea Consumption Estimates

(Unit : 1,000T)

Year	Estimates of Urea Consumption			
	JICA	MOA[1)]	MOI[2)]	BS[3)]
1983	2,348*		2,732	2,474
84	2,388	3,073	3,380	2,770
85	2,605	3,282	3,680	3,102
86	2,833	3,414	4,109	3,475
87	3,072	3,563		3,894
88	3,324	3,675		4,361
89	3,567			4,884
90	3,821			5,469

* : actual

Source:

1) Ministry of Agriculture (Fertilizer International No. 183, 19 July 1984)
2) Ministry of Industry (Pengembangan Kapasitas National Sector Industri 1983-1986)
3) British Sulfur (Fertilizer International No. 157, July 1982)

The values forecasted by JICA are lower than those by other organizations. The estimated values for 1984 by these organization are considerably greater than the actual consumption of 2.35 million tons in 1983. In actual, however, the consumption in 1984 is considered to be much less than these values. If the estimates of these three organizations are adjusted accordingly, they will be reduced, resulting in approaching the values estimated by JICA.

Therefore, JICA's values are considered reasonable.

(2) Ammonium sulfate

Fig. 3-5 shows the relation between the GDP and ammonium sulfate consumption. Single regression analysis with ammonium sulfate consumption as y (1,000 t/y) and GDP as x (billion Rp) gives the following equation:

$$y = 0.060570x - 415.16$$

Table 3-21 shows the ammonium sulfate consumption forecast using this equation. The average annual growth rate of consumption in the period between 1983 and 1988 is 7.8%.

Table 3-21 Estimate of Ammonium Sulfate Consumption

PELITA	Year	Consumption (1,000T)	Av. Annual Growth Rate during PELITA (%)
III	1983	353	
IV	84	391	9.8
	85	431	
	86	473	
	87	517	
	88	563	
V	89	608	7.5
	90	654	
	91	703	
	92	754	
	93	808	
VI	94	859	6.1
	95	912	
	96	967	
	97	1,025	
	98	1,085	

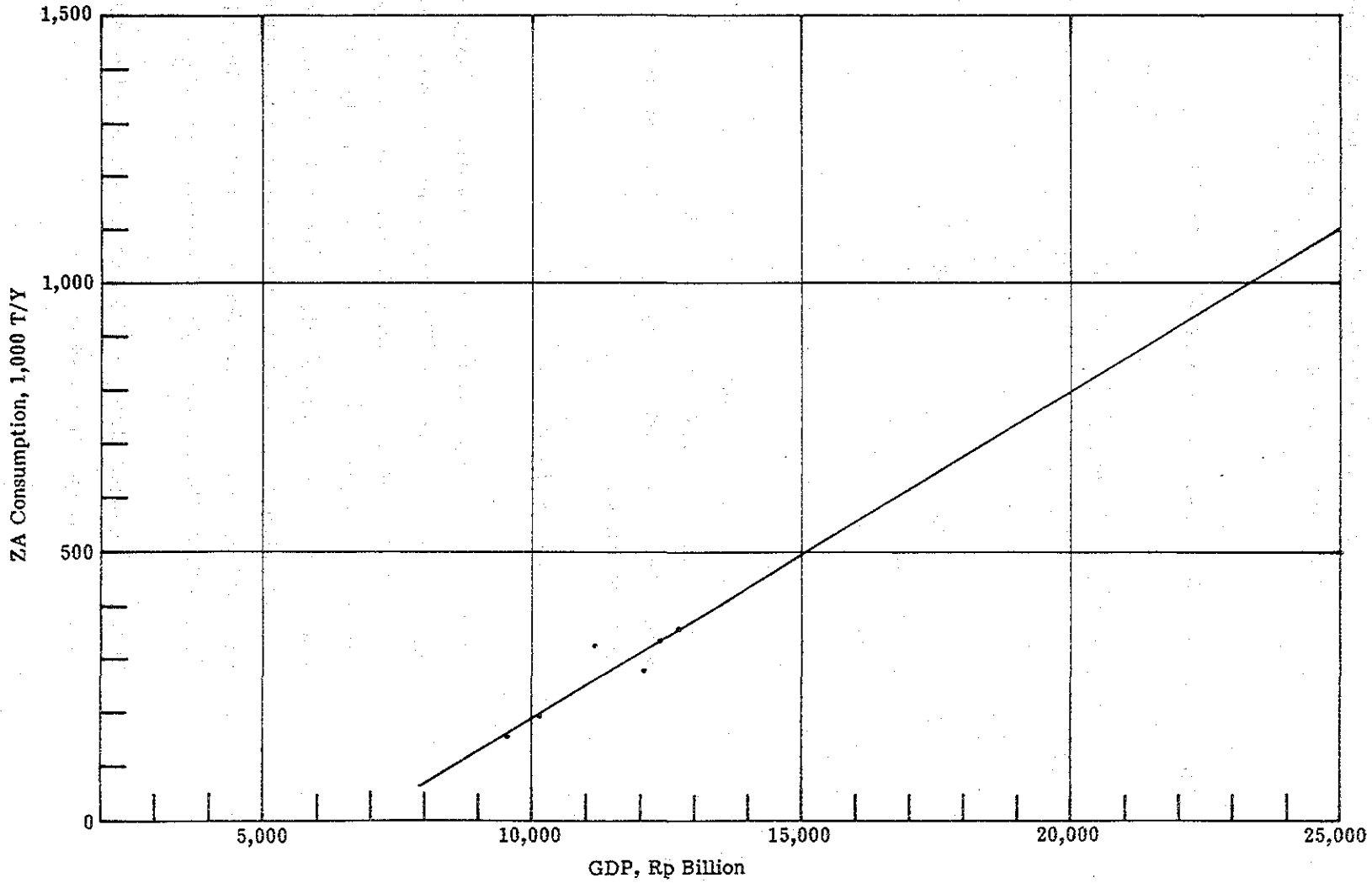

Fig. 3-5 GDP and ZA Consumption

Table 3-22 compares this result with the consumption estimated by another organization. JICA's values are slightly lower than those by the MOI, but are considered reasonable.

Table 3-22 Comparison of Ammonium Sulfate Consumption

(Unit : 1,000T)

Year	Estimates of Ammonium Sulfate Consumption	
	JICA	MOI
1983	353	357
84	391	383
85	431	409
86	473	437

(3) TSP

Fig. 3-6 shows the relation between the GDP and TSP consumption. Single regression analysis with the TSP consumption as y (1,000 t/y) and GDP as x (billion Rp) gives the following equation:

$$y = 0.24138x - 2171.3$$

The TSP consumption estimated by this equation is considerably high because the growth of TSP consumption in these several years is far higher as compared with the growth of the phosphate fertilizer consumption in the past. The reason for this rapid growth is considered to result from construction of the first TSP plant in Indonesia at Gresik in 1979 followed by its expansion. This tendency cannot be considered to continue in the future. The growth of TSP will slow down at a certain time point.

On the other hand, Table 3-24 shows the consumption ratio of three fertilizer elements in Indonesia.

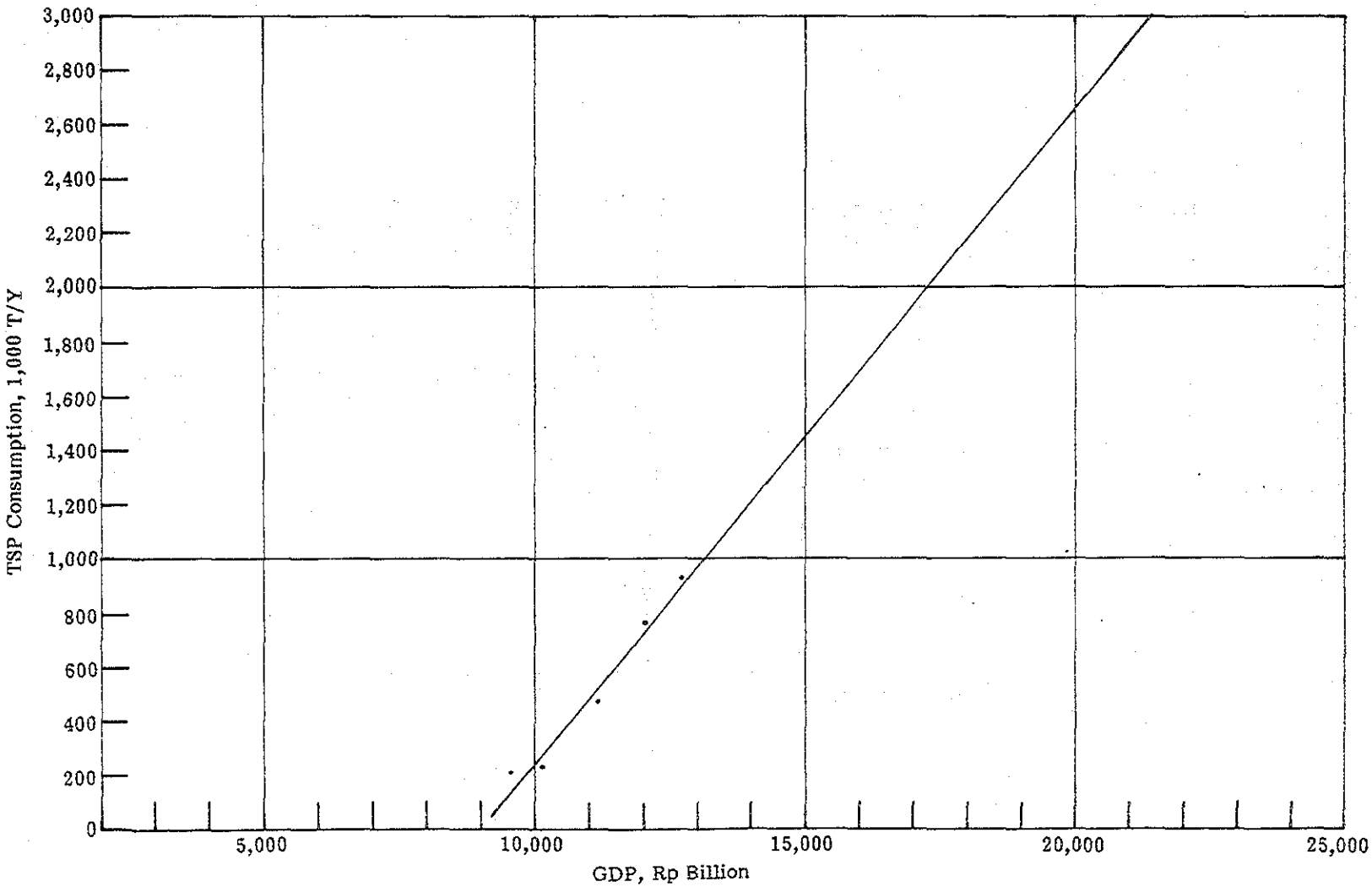

Fig. 3-6 GDP and TSP Consumption

Table 3-23 Annual Growth Rate of Consumption of Phosphate Fertilizer and TSP

	Annual Growth Rate (%)	
Year	Phosphate Fertilizer	TSP
1975	2.1	
76	-8.4	
77	0.4	
78	23.3	
79	9.6	7.2
80	52.9	120.3
81	38.7	56.4
82	n.a.	-3.9
83	n.a.	31.3
Average	10.6	36.1

Table 3-24 Consumption Ratio $N:P_2O_5:K_2O$ when N=1

	N	P_2O_5	K_2O
1975	1	0.34	0.07
76	1	0.30	0.09
77	1	0.24	0.08
78	1	0.25	0.14
79	1	0.24	0.14
80	1	0.24	0.11
81	1	0.32	0.14

Assume that the consumption ratio of phosphate fertilizer to nitrogenous fertilizer will increase to 0.5. The typical nitrogenous fertilizer and phosphate fertilizer in Indonesia are urea and TSP, respectively. If the nitrogenous fertilizer can be represented by urea and phosphate fertilizer by TSP, the consumption ratio of the TSP (converted to P_2O_5) to urea (converted to N) is 0.5. This ratio is considered as the upper limit of TSP consumption.

Therefore, the TSP consumption was first calculated according to the result of single regression analysis. When the ratio of the TSP consumption to the urea consumption exceeds 0.5, half of the urea consumption was used as the TSP consumption. Table 3-25 shows the estimate of TSP consumption. The average annual consumption rate in the period between 1983 and 1998 is 7.8%.

Table 3-25 Estimate of TSP Consumption

PELITA	Year	Consumption (1,000T)	Av. Annual Growth Rate during PELITA (%)
III	1983	965	
	84	1,049	
	85	1,210	
IV	86	1,376	10.8
	87	1,492	
	88	1,614	
	89	1,733	
	90	1,856	
V	91	1,985	7.0
	92	2,120	
	93	2,261	
	94	2,397	
	95	2,538	
VI	96	2,683	5.8
	97	2,835	
	98	2,995	

Table 3-26 compares this result with the estimates of TSP consumption made by other organizations.

Table 3-26 *Comparison of Estimates of TSP Consumption*

(Unit : 1,000T)

Year	Estimates of TSP Consumption		
	JICA	MOA	MOI
1983	965	n.a.	1,033
84	1,049	1,165	1,157
85	1,210	1,306	1,295
86	1,376	1,395	1,450
87	1,492	1,499	
88	1,614	1,587	

JICA's forecasted values are slightly smaller than those estimated by MOI and almost the same as those estimated by MOA. Therefore, they are considered to be reasonable.

3) Forecast of fertilizer production

The fertilizer production was forecasted according to the fertilizer production forecast made in 2). The construction periods and the capacity utilization were set as follows. For existing plants, the capacity utilization was set considering the past production results.

Plant	Construction Period (Y)	Capacity Utilization (%)		
		1-YR	2-YR	3-YR Onward
Urea	4	70	80	90
Ammonium Sulfate	3	70	80	90
TSP	3	70	80	90

(1) Urea fertilizer

The production capacity of urea in 1983 was about 3.3 million tons per year, and the production was about 2.26 million tons. Furthermore, PT. Kaltim II (570,000 t/y) and PT. Iskandar Muda (570,000 t/y) are planned to start operation in 1985.

Table 3-27 shows the urea production forecast assuming start of construction of a new 570,000 t/y (1,725 t/d) urea plant in each of 1984, 1986, 1989, 1992, 1995 and 1998.

Table 3-27 Urea Production Forecast

		Capacity		Production		
					Growth Rate (%/Y)	
PELITA	Year	1,000T	Cap. Utilization(%)	1,000T	Annual	Av. For 5-Yr
III	1983	2,729	82.6	2,255	3.0	
	84	3,299	83.9	2,768	22.7	
	85	4,429	84.8	3,756	35.7	
IV	86	4,429	89.9	3,982	6.0	14.8
	87	4,429	92.5	4,095	2.8	
	88	4,999	89.9	4,494	9.7	
	89	4,999	91.0	4,551	1.3	
	90	5,569	89.9	5,007	10.0	
V	91	5,569	90.9	5,064	1.1	4.2
	92	5,569	92.0	5,121	1.1	
	93	6,139	89.9	5,520	7.8	
	94	6,139	90.8	5,577	1.0	
	95	6,139	91.8	5,634	1.0	
VI	96	6,709	89.9	6,033	7.1	2.2
	97	6,709	90.8	6,090	0.9	
	98	6,709	91.6	6,147	0.9	

(2) Ammonium sulfate

The production capacity and quantity in 1983 was 150 thousand tons per year and about 200 thousand tons, respectively. The plant (250 thousand t/y) being constructed in Gresik is planned to be completed in 1984.

Table 3-28 shows the ammonium sulfate production forecast assuming the start of construction of a 200 thousand t/y ammonium sulfate plant in each of 1986, 1990, 1994 and 1998 (total 800 thousand t/y).

Table 3-28 Ammonium Sulfate Production Forecast

		Capacity		Production	Production Growth Rate (%/Y)	
PELITA	Year	1,000T	Cap. Utilization(%)	1,000T	Annual	Av. For 5-Yr
III	1983	150	139	208	-	-
	84	150	140	210	1.0	
	85	400	87.5	350	66.7	
IV	86	400	92.5	370	5.7	13.4
	87	400	97.5	390	5.4	
	88	400	97.5	390	0	
	89	600	88.3	530	35.9	
	90	600	91.7	550	3.8	
V	91	600	95.0	570	3.6	12.7
	92	600	95.0	570	0	
	93	800	88.8	710	24.6	
	94	800	91.3	730	2.8	
	95	800	93.8	750	2.7	
VI	96	800	93.8	750	0	5.1
	97	1,000	89.0	890	18.7	
	98	1,000	91.0	910	2.2	

(3) TSP

The TSP production capacity in 1983 was 1 million t/y, and the production was about 780 thousand tons.

Table 3-29 shows the TSP production forecast assuming the start of construction of a 500 thousand t/y plant in each of 1985, 1987, 1990, 1993 and 1996 (total 2.5 million t/y).

Table 3-29 TSP Production Forecast

		Capacity		Production	Production Growth Rate (%/Y)	
PELITA	Year	1,000T	Cap. Utilization(%)	1,000T	Annual	Av. For 5-Yr
III	1983	1,000	78.3	783	-	
	84	1,000	90.0	900	14.9	
	85	1,000	90.0	900	0	
IV	86	1,000	90.0	900	0	9.8
	87	1,000	90.0	900	0	
	88	1,500	83.3	1,250	38.9	
	89	1,500	86.7	1,300	4.0	
	90	2,000	85.0	1,700	30.8	
V	91	2,000	87.5	1,750	2.9	11.5
	92	2,000	90.0	1,800	2.9	
	93	2,500	86.0	2,150	19.4	
	94	2,500	88.0	2,200	2.3	
	95	2,500	90.0	2,250	2.3	
VI	96	3,000	86.7	2,600	15.6	4.7
	97	3,000	88.3	2,650	1.9	
	98	3,000	90.0	2,700	1.9	

4) Supply and demand balance forecast of fertilizer

The supply and demand balance of each fertilizer was forecasted by combining the results of forecasts made in 2) and 3) above.

(1) Urea fertilizer

Table 3-30 shows the supply and demand balance of urea. The production exceeds the consumption until 1997 to leave the margin for export. The supply and demand will almost balance in 1998.

Table 3-30 Supply and Demand Balance of Urea

PELITA	Year	Production Capacity (1,000T/Y)	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
III	1983	2,729	2,255	2,348	-93
	84	3,299	2,768	2,388	380
	85	4,429	3,756	2,605	1,151
IV	86	4,429	3,982	2,833	1,149
	87	4,429	4,095	3,072	1,023
	88	4,999	4,494	3,324	1,170
	89	4,999	4,551	3,567	984
	90	5,569	5,007	3,821	1,186
V	91	5,569	5,064	4,086	978
	92	5,569	5,121	4,364	757
	93	6,139	5,520	4,655	865
	94	6,139	5,577	4,933	644
	95	6,139	5,634	5,223	411
VI	96	6,709	6,033	5,523	510
	97	6,709	6,090	5,837	253
	98	6,709	6,147	6,165	-18

(2) Ammonium sulfate

Table 3-31 shows the supply and demand balance of ammonium sulfate. The consumption will exceed the production in the period between 1984 and 1998 to give rise to shortage of 80 to 220 thousand tons per year.

Table 3-31 Supply and Demand Balance of Ammonium Sulfate

PELITA	Year	Production Capacity (1,000T/Y)	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
III	1983	150	208	353	-145
	84	150	210	391	-181
	85	400	350	431	- 81
IV	86	400	370	473	-103
	87	400	390	517	-127
	88	400	390	563	-173
	89	600	530	608	- 78
	90	600	550	654	-104
V	91	600	570	703	-133
	92	600	570	754	-184
	93	800	710	808	- 98
	94	800	730	859	-129
	95	800	750	912	-162
VI	96	800	750	967	-217
	97	1,000	890	1,025	-135
	98	1,000	910	1,085	-175

(3) TSP

Table 3-32 shows the supply and demand balance of TSP. The consumption will exceed the production in the period between 1984 and 1998, but the shortage may be replaced with other phosphate fertilizers such as DAP.

Table 3-32 Supply and Demand Balance of TSP

PELITA	Year	Production Capacity (1,000T/Y)	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
III	1983	1,000	783	965	-182
	84	1,000	900	1,049	-149
	85	1,000	900	1,210	-310
IV	86	1,000	900	1,376	-476
	87	1,000	900	1,492	-592
	88	1,500	1,250	1,614	-364
	89	1,500	1,300	1,733	-433
	90	2,000	1,700	1,856	-156
V	91	2,000	1,750	1,985	-235
	92	2,000	1,800	2,120	-320
	93	2,500	2,150	2,261	-111
	94	2,500	2,200	2,397	-197
	95	2,500	2,250	2,538	-288
VI	96	3,000	2,600	2,683	- 83
	97	3,000	2,650	2,835	-185
	98	3,000	2,700	2,995	-295

(2) Fertilizer plant construction prospects

Table 3-33 shows the fertilizer plant construction prospects based on the above results.

Table 3-33 Fertilizer Plant Construction Prospects

Standard Capacity

-Ammonia : 1,000 T/D
-Urea : 1,725 T/D
-ZA : 200,000 T/Y
-Phosphoric Acid: 625 T P_2O_5/D
-TSP : 500,000 T/Y

PELITA	Year	No. of Plant Construction				
		Ammonia	Urea	ZA	Phosphoric Acid*	TSP
	1984	1	1			
	85					1
IV	86	1	1	1	1	
	87					1
	88					
	89	1	1			
	90			1	1	1
V	91					
	92	1	1			
	93					1
	94			1		
	95	1	1			
VI	96				1	1
	97					
	98	1	1	1		

* : One plant in each PELITA (assumption)

3.3.4 Pulp and Paper Plant

The imported pulp quantity in Indonesia is about 90,000 tons, and its ratio to the domestic pulp demand is about 40%. The forest resource in indonesia, however, is so rich as to supply the pulp material. Regarding the future construction of large paper plants, it was assumed that pulp plants are constructed with the paper plants. In preparing the pulp and paper plant construction prospects, therefore, only the demand and supply balance of paper was studied, not considering the supply and demand balance of pulp.

(1) Supply and demand balance of paper

1) Historical supply and demand balance of paper

Table 3-34 shows the historical supply and demand balance of paper in Indonesia. The paper consumption in 1983 was estimated to be 540 thousand tons. The average annual growth rate of paper in the period between 1978 and 1983 was as low as 7.3%. Especially the consumption in these few years remained almost at the same level.

The paper production in 1983 was about 400 thousand tons and more than 100 thousand tons of paper are estimated to be imported.

The per capita paper consumption in Indonesia is 3.4 kg which is low as compared with other ASEAN countries (Malaysia: 27 kg, Thailand: 11kg, Philippines: 7 kg and Singapore: 67 kg).

Table 3-34 Supply and Demand Balance of Paper

		Supply				Demand						
		Production				Consumption						
			Growth Rate(%/Y)			Growth Rate(%/Y)			Per CAPITA			
PELITA	Year	1,000T	Annual	Av. for 5-Yr	Import (1,000T)	1,000T	Annual	Av. for 5-Yr	KG/CAPITA	Growth Rate(%/Y) Annual	Growth Rate(%/Y) Av. for 5-Yr	Export (1,000T)
	1974	43.2	-									
	75	46.7	8.1									
II	76	54.4	16.5	37.7								
	77	83.5	53.5									
	78	155.2	85.9		223.8	379.0			2.7			
	79	214.2	38.0		224.5	432.3	14.1		3.0	11.1		6.4
	80	232.0	8.3		259.2	484.3	12.1		3.3	10.0		6.9
III	81	246.6	6.3	21.1	242.9	488.4	0.8	7.3	3.2	-3.0	4.7	1.1
	82	296.9	20.4		n.a.	530*	8.5		3.4	6.3		n.a.
	83	404.8	36.3		n.a.	539*	1.7		3.4	0.0		n.a.

* : Estimate

Note) (Consumption) = (Production) + (Import) - (Export)

Source:

1) Production: (1974-81), MOI(1982-83)

2) Import: BPS

3) Export: BPS

2) Paper consumption forecast

A linear correlation equation was made on the basis of the relation between the paper consumption and GDP in the past. The paper consumption was forecasted according to the projected GDP for each year.

Fig. 3-7 shows the relation between the GDP and paper consumption. Single regression analysis with the paper consumption as y (1,000 t/y) and the GDP as x (billion Rp) gives the following equation:

$$y = 0.046820x - 55.032$$

Table 3-35 shows the paper consumption forecast using this equation.

Table 3-36 compares this result with the consumption estimates by other organizations.

This forecast is lower than both of the forecasts by APKI and MOI. JICA's forecast reflects availability of paper consumption data for only six years from 1978 and slow growth of paper consumption in recent years. It is probable that the paper consumption in the future will exceed this forecast. However, since the influence on the paper and pulp plant construction prospects is considered little, this forecast is used without adjustment.

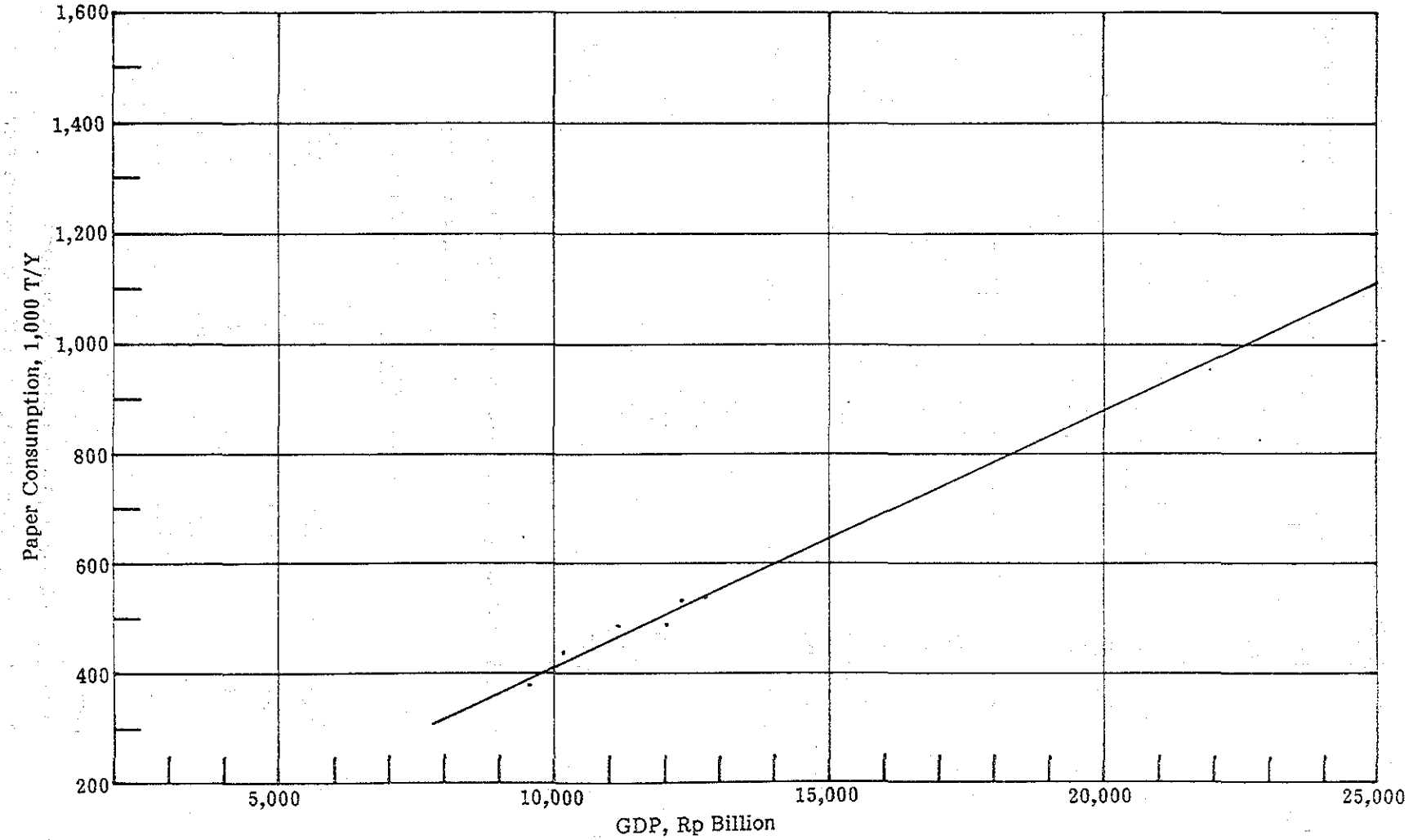

Fig. 3-7 GDP and Paper Consumption

Table 3-35 Estimate of Paper Consumption

PELITA	Year	Consumption (1,000T)	Av. Annual Growth Rate during PELITA(%)
III	1983	539	
	84	570	
	85	601	
IV	86	634	5.5
	87	668	
	88	704	
	89	739	
	90	776	
V	91	814	4.9
	92	854	
	93	896	
	94	936	
	95	977	
VI	96	1,021	4.4
	97	1,066	
	98	1,113	

Table 3-36 Comparison of Paper Consumption Estimates

(Unit: 1,000T)

Year	Estimates of Paper Consumption		
	JICA	1) APKI	2) MOI
1983	539	539	582
84	570	602	672
85	601	675	759
86	634		822

Source:

1) APKI: Indonesian Pulp & Paper Association

2) MOI : Pengembangan Kapasitas Nasional Sektor Industri (1983-1986)

3) Paper production forecast

The paper production capacity in 1983 was 537 thousand t/y, and the production was about 405 thousand tons.

Table 3-37 shows the paper production forecast assuming that the construction of 90 thousand t/y paper and pulp plant starts every two years from 1985 until 1998 (total 630 thousand t/y). The construction period was assumed to be three years so that production starts from the fourth year after the start of construction. The plant capacity utilization was assumed to be 60% in the initial year of operation, 70% in the second year, and 80% in the third year and on.

Table 3-37 Paper Production Forecast

		Capacity		Production	Growth Rate (%/Y)	
PELITA	Year	1,000T	Cap. Utilization(%)	1,000T	Annual	Av. For 5-Yr
III	1983	537.2	75.4	404.8	-	-
	84	743.8	71.1	529	30.7	
	85	886.2	71.7	635	20.0	
IV	86	886.2	75.6	670	5.5	13.5
	87	886.2	80.0	709	5.8	
	88	976.2	78.2	763	7.6	
	89	976.2	79.1	772	1.2	
	90	1,066.2	78.3	835	8.2	
V	91	1,066.2	79.2	844	1.1	3.7
	92	1,156.2	78.4	907	7.5	
	93	1,156.2	79.2	916	1.0	
	94	1,246.2	78.6	979	6.9	
	95	1,246.2	79.3	988	0.9	
VI	96	1,336.2	78.7	1,051	6.4	4.2
	97	1,336.2	79.3	1,060	0.9	
	98	1,426.2	78.7	1,123	5.9	

4) Paper supply and demand balance forecast

Table 3-38 shows the supply and demand balance forecast obtained by combining the results of forecasts in 2) and 3) above.

There will be a room for export except in 1983, 1984 and 1997.

Table 3-38 Supply and Demand Balance of Paper

PELITA	Year	Production Capacity (1,000T/Y)	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
III	1983	537.2	404.8	539	-134.2
	84	743.8	529	570	-41
	85	886.2	635	601	34
IV	86	886.2	670	634	36
	87	886.2	709	668	41
	88	976.2	763	704	59
	89	976.2	772	739	33
	90	1,066.2	835	776	59
V	91	1,066.2	844	814	30
	92	1,156.2	907	854	53
	93	1,156.2	916	896	20
	94	1,246.2	979	936	43
	95	1,246.2	988	977	11
VI	96	1,336.2	1,051	1,021	30
	97	1,336.2	1,060	1,066	-6
	98	1,426.2	1,123	1,113	10

(2) Pulp and paper plant construction prospects

Table 3-39 shows the pulp and paper plant construction prospects based on the above study result.

Table 3-39 Pulp & Paper Plant Construction Prospects

Standard Production Capacity: 90,000 T/Y

PELITA	Year	No. of Plant Construction
	1984	
	85	1
IV	86	
	87	1
	88	
	89	1
	90	
V	91	1
	92	
	93	1
	94	
	95	1
VI	96	
	97	1
	98	

3.3.5 Palm Oil Plant

Palm oil is an important non-oil export products in Indonesia. The Government lays stress on development of oil palm plantation and up-bringing of the palm oil industry.

(1) Palm oil supply and demand balance

1) Historical supply and demand balance of palm oil

Table 3-40 shows the historical supply and demand balance of the palm oil in Indonesia. The palm oil production increased steadily from 350 thousand tons in 1974 and reached 900 thousand tons in 1983. The average annual growth rate in this period was 11%.

On the other hand, the fluctuation of the consumption was great. The consumption in 1983 was about 530 thousand tons.

2) Palm oil consumption forecast

As apparent from the consumption values in Table 3-40, the year to year fluctuation of the palm oil consumption is so great that regression analysis can not be made. Therefore, the palm oil consumption until 1998 was forecasted on the basis of the consumption forecast made by MOA until 1988, taking the growth rate in that period into consideration.

Table 3-41 shows the result of the forecast.

Table 3-40 Supply and Demand Balance of Palm Oil

		Supply				Demand			
		Production				Consumption			
			Growth Rate (%/Y)		Import		Growth Rate (%/Y)		Export
PELITA	Year	1,000T	Annual	Av. for 5-Yr	(1,000T)	1,000T	Annual	Av. for 5-Yr	(1,000T)
	1974	351.1				50			301.2
	75	411.4	17.2			25	-100.0		386.5
II	76	433.9	5.5	10.6		28	12.0	22.6	405.6
	77	497.4	14.6			93	232.1		404.6
	78	525.0	5.5			113	21.5		412.2
	79	599.9	14.3			249	120.4		351.3
	80	691.0	15.2			267	7.2		502.9
III	81	751.8	8.8	11.4		646	141.9	36.0	196.4
	82	807.4	7.4			425	-34.2		259.5
	83	900.4	11.5			525	23.5		345.8

Source:
1) Production : BPS
2) Consumption : MOA (1981-83); (Consumption) = (Production) - (Export) (before 1980)
3) Export : FAO

Table 3-41 Estimate of Palm Oil Consumption

PELITA	Year	Consumption (1,000T)	Av. Annual Growth Rate during PELITA(%)
III	1983	525	
	84	621	
	85	641	
IV	86	661	6.0
	87	681	
	88	701	
	89	736	
	90	773	
V	91	811	5.0
	92	852	
	93	895	
	94	931	
	95	968	
VI	96	1,007	4.0
	97	1,047	
	98	1,089	

3) Palm oil production forecast

Palm oil is an important export product of Indonesia. Stress will be laid on expansion of the oil palm plantation and increase of palm oil production in the future.

Oil palm fruit harvesting is possible from the fourth year after the oil palm plantation. The yield gradually increases until the peak in the tenth to fifteenth years, and will decrease gradually later. The palm oil production forecast here is based on the plantation area forecast.

According to the statistics of the MOA, the oil palm plantation area was 261,000 ha in 1979 and 411,000 ha in 1983. It increased by 150,000 ha in four years. The average annual increase rate was 38,000 ha.

In PELITA IV, the plantation area is 495,000 ha in 1983 and is planned to be increased to 976,000 ha in 1988. The increment in the five year period is 481,000 ha, so the annual increase is 96,000 ha. As compared with the past growth in the plantation area, the increase is considerably great.

Supposing about 60% (58,000 ha/y) of the plantation area increase in PELITA IV, it is almost equivalent to the 50% increase of the plantation area annually in the past.

The palm oil production here was forecasted assuming an annual plantation area increment of 60,000 ha in the period from 1983 to 1988, and 40,000 ha in the period from 1989 and on. Table 3-42 shows the forecast of oil palm plantation area.

Table 3-43 shows the forecast of palm oil production assuming the yied per unit area to be 3.7 t/ha and actual oil palm harvesting to start from the fifth year after the plantation.

Table 3-42 Forecast of Oil Palm Plantation Area

PELITA	Year	Area (1,000ha)	Av. Annual Growth Rate during PELITA(%)
III	1983	411	
IV	84	471	11.6
	85	531	
	86	591	
	87	651	
	88	711	
V	89	751	5.1
	90	791	
	91	831	
	92	871	
	93	911	
VI	94	951	4.0
	95	991	
	96	1,031	
	97	1,071	
	98	1,111	

Table 3-43 Forecast of Palm Oil Production

PELITA	Year	Production (1,000T)	Av. Annual Growth Rate During PELITA(%)
III	1983	907 (actual)	
	84	1,092	
	85	1,180	
IV	86	1,221	14.0
	87	1,521	
	88	1,343	
	89	1,965	
	90	2,187	
V	91	2,409	9.8
	92	2,631	
	93	2,779	
	94	2,927	
	95	3,075	
VI	96	3,223	3.8
	97	3,371	
	98	3,519	

4) Palm oil supply and demand balance forecast

Table 3-44 shows the palm oil supply and demand balance forecasted by combining the results obtained in 2) and 3).

The margin for export of palm oil will gradually increase from 470 thousand tons in 1984 to 2.43 million tons in 1998.

Table 3-44 Supply and Demand Balance of Palm Oil

PELITA	Year	Production (1,000T)	Consumption (1,000T)	Balance (1,000T)
III	1983	907	525	382
	84	1,092	621	471
	85	1,180	641	539
IV	86	1,221	661	560
	87	1,521	681	840
	88	1,743	701	1,042
	89	1,965	736	1,229
	90	2,187	773	1,414
V	91	2,409	811	1,598
	92	2,631	852	1,779
	93	2,779	895	1,884
	94	2,927	931	1,996
	95	3,075	968	2,107
VI	96	3,223	1,007	2,216
	97	3,371	1,047	2,324
	98	3,519	1,089	2,430

(2) Palm oil plant construction prospects

Assuming the standard production capacity of the palm oil plant to be 30t FFB/h, the annual palm oil production becomes about 26,000 tons. Table 3-45 shows the palm oil plant construction prospects assuming that the palm oil plant construction starts from the next year of oil palm plantation.

Table 3-45 Palm Oil Plant Construction Prospects

Standard Production Capacity: 30 TFFB/H

PELITA	Year	No. of Plant Construction
IV	1984	11
	85	11
	86	11
	87	11
	88	11
V	89	8
	90	8
	91	8
	92	8
	93	8
VI	94	8
	95	8
	96	8
	97	8
	98	8

3.3.6 Plant Construction Prospects for Five Designated Plants (Summary)

Table 3-46 shows the summary of plant construction prospects for five designated plants.

Table 3-46 Summary of Plant Construction Prospects

Plant	PELITA IV					PELITA V					PELITA VI				
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cement Plant (1 Million T/Y)	1.5	1.5	1.5	1.5			1.5	1.5	1.5	1.5	1.5		1.5		1.5
Sugar Plant (4,000 TCD)	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5
Fertilizer Plant															
-Ammonia Plant (1,000 T/D)	1		1		1	1			1			1			1
-Urea Plant (1,700 T/D)	1		1		1	1			1			1			1
-Ammonium			1				1				1				1
Sulphate Plant (200,000 T/Y)					1										
-Phosphoric Acid			1				1						1		
Plant ($625TP_2O_5$/D)															
-TSP Plant (500,000 T/Y)		1		1			1			1			1		
Pulp & Paper Plant (90,000 T/Y)		1		1		1		1		1		1		1	
Palm Oil Plant (30 TFFB/H)	11	11	11	11	11	8	8	8	8	8	8	8	8	8	8

3.4 Selection Standards for Localization of Plant Processing Equipment

The selection standards for localization of plant processing equipment for five designated plants were established, taking the following items into consideration.

- Negative list (Daftar Barang Modal yang Dikeluarkan dari Daftar Induk Barang Impor)
- Those helpful for technological development of Indonesia
- Those which can be manufactured after five years from now when the renovation is completed and the plant commenced its operation.
- Those which do not need any special material
- Those which require much freight cost because of the weight and size

Section 3.5 describes the localization of plant processing equipment for the five designated plants using these selection standards.

3.5 Classification of Plant Processing Equipment for Five Designated Plants and Localization Quantity

The engineering Advancement Association (ENAA) of Japan has classified the plant processing equipment into Categories, Functions and Types (ENAA standard 303-82). Here, the plant processing equipment for five designated plants was classified according to the Functions specified by the ENAA, and the localizable quantity and import quantity for each item of Function were studied.

Since the ENAA's classification has been prepared to classify the chemical plant processing equipment, a part of equipment of cement, sugar, pulp and paper, and palm oil plants is difficult to classify in accordance with this classification. In this case, new items were added for major equipment. As for equipment with light weight, it was included in similar items.

3.5.1 Cement Plant

Table 3-47 shows the ENAA classification of cement plant processing equipment and the quantity of local contents and import quantity for each item of ENAA classification, assuming the standard production capacity to be 1.5 million t/y.

Table 3-47 Equipment of Cement Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	767	1,939	2,706	
-Towers				
-Vessels				
-Tanks	362	-	362	
-Heat Exchangers				
-Air Cooled Exchangers	211	367	578	incl. imported refractory
-Furnace	194	1,572	1766	incl. imported refractory
Rotating Machines	11	283	294	
-Pumps	11	-	11	
-Compressors	-	10	10	
-Turbines				
-Blowers/Fans	-	257	257	
-Speed Transmissions				
-Diesel Engines	-	16	16	
Miscellaneous Equipment	2,414	6,589	9,003	
-Agitators				
-Filters	-	251	251	
-Centrifuges				
-Decanters				
-Screens	-	26	26	
-Thickners				
-Cyclones	443	1,223	1,666	incl. imported refractory
-Dryers	119	226	345	
-Conveyors	1,636	393	2,029	excl. structure
-Feeders	96	947	1,043	
-Crushers	-	2,759	2,759	
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors				
-Weighers				
-Dust Collectors	120	726	846	
-Flares	-	18	18	
-Cooling Towers	-	20	20	
Package Units				
-Pelletizers				
-Deminelizers				
-Softners				
-Boilers				
-Air Dryer Package Units				
Piping	697	945	1,642	
-Pipe Fittings	213	71	284	
-Valves	-	18	18	
-Accessories				
-Others	484	856	1,340	incl. imported refractory and insulation material and brick
Instrumentation				
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	880	767	1,647	
-H/V Switch Board	-	79	79	
-Power Transformer	-	105	105	
-Motors	-	315	315	
-Control Source				
-Control Panel	70	51	121	
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures	36	-	36	
-Fire Alarm System				
-Paging System				
-Electrical Materials	774	217	991	
Civil and Architecture	7,606	188	7,794	
-Building Facilities	7,606	188	7,794	
Others				
-Fire Fighting System				
-Labo. & Machine Shop				
Items Not Classified by ENAA	27	542	569	
-Reclaimer	-	385	385	
-Air Blending Equip.	-	40	40	
-Overhead Crane	24	24	48	
-Hoist, Chain Block	3	-	3	
-Personnel Elevator	-	17	17	

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Air Slide	-	61	61	
-Air Lift	-	15	15	
Sub-total				
Total	12,402	11,253	23,655	

3.5.2 Sugar Plant

Table 3-48 shows the ENAA classification of sugar plant processing equipment and the quantity of local contents and import quantity for each item of ENAA classification, assuming the standard production capacity to be 4,000 TCD.

Table 3-48 Equipment of Sugar Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	2,224	171	2,395	
-Towers				
-Vessels	781	45	826	
-Tanks	1,052	33	1,085	
-Heat Exchangers	344	92	437	
-Air Cooled Exchangers				
-Furnace	47	-	47	
Rotating Machines	96	384	480	
-Pumps	-	86	86	
-Compressors	-	11	11	
-Turbines	-	103	103	
-Blowers/Fans	-	6	6	
-Speed Transmissions	96	106	202	
-Diesel Engines	-	72	72	
Miscellaneous Equipment	870	434	1,304	
-Agitators	-	1	1	
-Filters	-	52	52	
-Centrifuges	-	74	74	
-Decanters				
-Screens	6	12	18	
-Thickners				
-Cyclones				
-Dryers	15	23	38	
-Conveyors	180	47	227	
-Feeders	192	2	194	
-Crushers	473	52	525	
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors				
-Weighers	4	39	43	
-Dust Collectors				
-Flares				
-Cooling Towers	-	132	132	
Package Units	545	1,156	1.701	
-Pelletizers				
-Deminelizers				
-Softners	-	5	5	
-Boilers	530	1,149	1,679	
-Air Dryer Package Units	15	2	17	
Piping	537	158	695	
-Pipe Fittings	494	20	514	
-Valves	3	109	112	
-Accessories	-	8	8	
-Others	40	21	61	
Instrumentation				
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	191	190	381	
-H/V Switch Board				
-Power Transformer				
-Motors				
-Control Source				
-Control Panel				
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures				
-Fire Alarm System				
-Paging System				
-Electrical Material				
Civil and Architecture	2,047	38	2,085	
-Building Facilities	2,047	38	2,085	
Others	1	161	162	
-Fire Fighting System	1	1	2	
-Labo. & Machine Shop	-	160	160	
Items Not Classified by ENAA				
Total	6,511	2,692	9,203	

3.5.3 Fertilizer Plants

The standard production capacity was established for each of the following fertilizer plants, ammonia plant and phosphoric acid plant. The plant processing equipment was classified according to the ENAA's Function classification, and each item is further classified into local manufacture and import in the following tables.

Plant	Production capacity	Table number
Ammonia plant	1,000 t/d	3-49
Urea plant	1,725 t/d	3-50
Ammonium sulfate plant	200,000 t/y	3-51
Phosphoric acid plant	625 t P_2O_5/d	3-52
TSP plant	500,000 t/y	3-53

Table 3-49 Equipment of Ammonia Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	1,657.5	1,509.4	3,166.9	
-Towers	27.6	408.5	436.1	
-Vessels	488.6	841.5	1,330.1	
-Tanks	383.3	-	383.3	
-Heat Exchangers	758.0	259.4	365.4	
-Air Cooled Exchangers				
-Furnace				
Rotating Machines	38.1	497.2	535.3	
-Pumps	32.3	65.1	97.4	
-Compressors	-	266.2	266.2	
-Turbines	-	165.9	165.9	
-Blowers/Fans	5.8	-	5.8	
-Speed Transmissions				
-Diesel Engines				
Miscellaneous Equipment	-	4.8	4.8	
-Agitators				
-Filters				
-Centrifuges				
-Decanters				
-Screens				
-Thickners				
-Cyclones				
-Dryers				
-Conveyors				
-Feeders				
-Crushers				
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors	-	4.8	4.8	
-Weighers				
-Dust Collectors				
-Flares				
-Cooling Towers				
Package Units	62	195	257	
-Pelletizers				
-Deminelizers				
-Softners				
-Boilers	62	195	257	
-Air Dryer Package Units				
Piping	2,500	452	2,952	
-Pipe Fittings	1,300	-	1,300	
-Valves		42	42	
-Accessories		10	10	
-Others	1,200	400	1,600	
Instrumentation	-	300	300	
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	400	1,200	1,600	
-H/V Switch Board				
-Power Transformer				
-Mators				
-Control Source				
-Control Panel				
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures				
-Fire Alarm System				
-Paging System				
-Electrical Materials				
Civil and Architecture	3,200	100	3,300	
-Building Facilities	3,200	100	3,300	
Others	370	40	410	
-Fire Fighting System	370	40	410	
-Labo. & Machine Shop				
Items Not Classified by ENAA	1,780	2,230	4,010	
-Primary Reformer	1,600	2,230	3,830	
-Stack	180	-	180	
Total	10,007.6	6,528.4	16,536.0	

Table 3-50 Equipment of Urea Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	992.6	811.7	1,804.3	
-Towers	160.8	5.8	166.6	
-Vessels	383.8	472.3	856.1	
-Tanks	82.6	-	82.6	
-Heat Exchangers	365.4	333.6	699.0	
-Air Cooled Exchangers				
-Furnace				
Rotating Machines	16.8	328.8	345.6	
-Pumps	16.8	163.7	180.5	
-Compressors	-	116.0	116.0	
-Turbines	-	49.1	49.1	
-Blowers/Fans				
-Speed Transmissions				
-Diesel Engines				
Miscellaneous Equipment	15.5	58.5	74.0	
-Agitators	-	2.4	2.4	
-Filters				
-Centrifuges				
-Decanters				
-Screens				
-Thickners				
-Cyclones				
-Dryers				
-Conveyors	12.0	-	12.0	
-Feeders				
-Crushers				
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors	-	1.1	1.1	
-Weighers	-	15.0	15.0	
-Dust Collectors	3.5	40.0	43.5	
-Flares				
-Cooling Towers				
Package Units	35	168	203	
-Pelletizers				
-Deminelizers				
-Softners				
-Boilers	35	168	203	
-Air Dryer Package Units				
Piping	1,050	224	1,274	
-Pipe Fittings	470	-	470	
-Valves	-	28	28	
-Accessories	-	6	6	
-Others	580	190	770	
Instrumentation	-	200	200	
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	250	700	950	
-H/V Switch Board				
-Power Transformer				
-Motors				
-Control Source				
-Control Panel				
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures				
-Fire Alarm System				
-Paging System				
-Electrical Materials				
Civil and Architecture	1,200	60	1,260	
-Building Facilities	1,200	60	1,260	
Others	200	20	220	
-Fire Fighting System	200	20	220	
-Labo. & Machine Shop				
Items Not Classified by ENAA				
Total	3,759.9	2,571.0	6.330.9	

Table 3-51 Equipment of Ammonium Sulphate Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	1,563.2	-	1,563.2	
-Towers	462.2	-	462.2	
-Vessels	27.2		27.2	
-Tanks	754.8	-	754.8	
-Heat Exchangers	319.0	-	319.9	
-Air Cooled Exchangers				
-Furnace				
Rotating Machines	63.8	312.0	375.8	
-Pumps	55.2	298.8	354.0	
-Compressors	-	13.2	13.2	
-Turbines				
-Blowers/Fans	8.6	-	8.6	
-Speed Transmissions				
-Diesel Engines				
Miscellaneous Equipment	82.6	1,177.0	1,259.6	
-Agitators	42.0	-	42.0	
-Filters	-	401.6	401.6	
-Centrifuges	-	37.6	37.6	
-Decanters				
-Screens				
-Thickners				
-Cyclones				
-Dryers	-	61.2	61.2	
-Conveyors	40.6	-	40.6	
-Feeders				
-Crushers	-	642.0	642.0	
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors				
-Weighers	-	17.6	17.6	
-Dust Collectors				
-Flares				
-Cooling Towers	-	17.0	17.0	
Package Units	70	-	70	
-Pelletizers				
-Deminelizers				
-Softners				
-Boilers	70	-	70	
-Air Dryer Package Units				
Piping	410	107	517	
-Pipe Fittings	210	-	210	
-Valves	-	13	13	
-Accessories	-	4	4	
-Others	200	90	290	
Instrumentation	-	110	110	
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	120	400	520	
-H/V Switch Board				
-Power Transformer				
-Motors				
-Control Source				
-Control Panel				
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures				
-Fire Alarm System				
-Paging System				
-Electrical Materials				
Civil and Architecture	1,900	90	1,990	
-Building Facilities	1,900	90	1,990	
Others	160	20	180	
-Fire Fighting System	160	20	180	
-Labo. & Machine Shop				
Items Not Classified by ENAA				
Total	4,369.6	2,216.0	6,585.6	

Table 3-52 Equipment of Phosphoric Acid Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	451.7	-	451.7	
-Towers	9.5	-	9.5	
-Vessels	39.8	-	39.8	
-Tanks	381.2	-	381.2	
-Heat Exchangers	21.2	-	21.2	
-Air Cooled Exchangers				
-Furnace				
Rotating Machines	5.3	55.6	60.9	
-Pumps	-	55.6	55.6	
-Compressors	2.0	-	2.0	
-Turbines				
-Blowers/Fans	3.3	-	3.3	
-Speed Transmissions				
-Diesel Engines				
Miscellaneous Equipment	22.8	8.3	31.1	
-Agitators	22.8	-	22.8	
-Filters	-	7.0	7.0	
-Centrifuges				
-Decanters				
-Screens				
-Thickners				
-Cyclones				
-Dryers				
-Conveyors				
-Feeders				
-Crushers				
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors	-	1.3	1.3	
-Weighers				
-Dust Collectors				
-Flares				
-Cooling Towers				
Package Units	50	-	50	
-Pelletizers				
-Deminelizers				
-Softners				
-Boilers	50	-	50	
-Air Dryer Package Units				
Piping	168	33	201	
-Pipe Fittings	108	-	108	
-Valves	-	10	10	
-Accessories	-	3	3	
-Others	60	20	80	
Instrumentation	-	70	70	
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	80	220	300	
-H/V Switch Board				
-Power Transformer				
-Mators				
-Control Source				
-Control Panel				
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures				
-Fire Alarm System				
-Paging System				
-Electrical Materials				
Civil and Architecture	1,600	80	1,680	
-Building Facilities	1,600	80	1,680	
Others	240	30	270	
-Fire Fighting System	240	30	270	
-Labo. & Machine Shop				
Items Not Classified by ENAA				
Total	2,617.8	496.9	3,114.7	

Table 3-53 Equipment of TSP Plant by ENAA Classification

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Equipment	460.3	33.5	493.8	
-Towers	38.4	-	38.4	
-Vessels	114.4	0.4	114.8	
-Tanks	177.0	-	177.0	
-Heat Exchangers	34.4	20.4	54.8	
-Air Cooled Exchangers				
-Furnace	96.1	12.7	108.8	
Rotating Machines	43.6	16.8	60.4	
-Pumps	15.2	16.8	32.0	
-Compressors	2.0	-	2.0	
-Turbines				
-Blowers/Fans	26.4	-	26.4	
-Speed Transmissions				
-Diesel Engines				
Miscellaneous Equipment	143.7	312.3	456.0	
-Agitators	5.4	5.4	10.8	
-Filters				
-Centrifuges				
-Decanters				
-Screens				
-Thickners				
-Cyclones	4.8	-	4.8	
-Dryers				
-Conveyors	130.6	123.4	254.0	
-Feeders				
-Crushers	-	128.4	128.4	
-Granulators				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
-Ejectors	-	0.8	0.8	
-Weighers	-	21.0	21.0	
-Dust Collectors	2.9	33.3	36.2	
-Flares				
-Cooling Towers				
Package Units	90	-	90	
-Pelletizers				
-Deminelizers				
-Softners				
-Boilers	90	-	90	
-Air Dryer Package Units				
Piping	487	63	550	
-Pipe Fittings	227	-	227	
-Valves	-	18	18	
-Accessories	-	5	5	
-Others	260	40	300	
Instrumentation	-	130	130	
-Board Instruments				
-Field Instruments				
-Detectors, Gauges and Switches				
-Control Valves and Accessories				
-Instrument Panels				
-Materials for Instruments Installation Works				

(Unit: T)

Classification of ENAA	Local	Import	Total	Remarks
Electorical	100	250	350	
-H/V Switch Board				
-Power Transformer				
-Motors				
-Control Source				
-Control Panel				
-Local Equipment				
-Motor Speed Control Panel				
-Lighting Fixtures				
-Fire Alarm System				
-Paging System				
-Electrical Materials				
Civil and Architecture	2,000	100	2,100	
-Building Facilities	2,000	100	2,100	
Others	180	20	200	
-Fire Fighting System	180	20	200	
-Labo. & Machine Shop				
Items Not Classified by ENAA				
Total	3,504.6	925.6	4,430.2	