THE REPUBLIC OF INDONESIA

SURVEY REPORT ON SYNTHETIC AND RAYON FIBRE INDUSTRY DEVELOPMENT

FEBRUARY 1973

Prepared for
OVERSEAS TECHNICAL COOPERATION AGENCY
GOVERNMENT OF JAPAN
by
UNICO INTERNATIONAL CORPORATION

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PREFACE

The Government of Japan, in compliance with the request of the Government of The Republic of Indonesia for the study on the formulation of a long term plan for the synthetic fibre and rayon fibre industries, entrusted the Overseas Technical Cooperation Agency with the implementation of the survey.

The Agency, for this purpose, organized a survey team comprising eight experts, headed by Mr. Yoshikazu Nakagawa, director of UNICO International Corporation, and sent it to Indonesia for a period of 30 days from July 18 to August 16, 1972.

Together with the discussions held with the Indonesian Authority concerned — Directorate General of Chemical Industry, Directorate General of Textile Industry, Ministry of Planning and Inventorization of Forestry, BAPPENAS, MIGAS, PUTL, Ministry of Trade, Institute of Hydrology Engineering, Geological Survey of Indonesia, and Institute of Textile Technology — the team had made the field survey of general conditions for the textile industries through observations of textile mills, fertilizer plants, caustic soda plant at each city of Djakarta, Bandung, Tjilatjap, Tjirebon, Jogjakarta, Surakarta, Surabaja and Banjuwangi.

This report is a summary of the study on the development of the said industries, based on the data gathered in the field survey and on the analysis conducted in Japan.

It is my sincere desire in presenting this report that it will contribute to the development of various textile industries in Indonesia and eventually help promote the economic exchange between our two countries.

Finally, I would like to take this opportunity to express my gratitude to the officials of various authorities in The Republic of Indonesia for the assistance extended to the survey team during its stay in Indonesia.

Feb. 1973

Keiichi Tatsuke
Director General

Overseas Technical Cooperation Agency

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1. Purpose of Survey

In compliance with the request made by the Departemen Perindustrian of the Government of Indonesia, the present series of surveys were conducted under the cooperation of the Government of Japan for the purpose of compiling a proposition for the formulation of a long-term plan and the necessary policies for the establishment of synthetic fibre and rayon fibre industries in Indonesia. The scope of the survey encompasses the following subjects.

1. A long-term forecast up to the year 1980 concerning the rayon fibre and synthetic fibre demand in Indonesia.

2. Prospect of industrial scale production of various synthetic fibres and the relative raw materials.

3. Feasibility of industrial scale production of rayon staple fibre.

4. National interest in the event of the establishment of the above-mentioned industrial scale production.

5. Problems concerning the establishment of industrial scale production and the ways and means for the solution to the problems.

2. Organization of the Survey Team

Members	Title	Allocation of Responsibility
Yoshikazu Nakagawa, Team Leader	Executive Managing Director, UNICO International Corp.	General Management
Taneo Maeda	Manager, Synthetic Fibre Department, UNICO International Corp.	Synthetic fibre Industries
Ginichi Sasaki	UNICO International Corp.	Raw materials for rayon fibre
Etsutaro Honjo	UNICO International Corp.	Rayon fibre industry
Hisayuki Okada	UNICO International Corp.	Processing of man-made fibres
Fumio Taniguchi	UNICO International Corp.	Textile market survey
Ryotaro Morimoto	UNICO International Corp.	Synthetic fibre raw materials
Fumihiko Kohara	Economic Cooperation Policy Division, Ministry of International Trade and Industry	Textile market survey

3. Survey Schedule

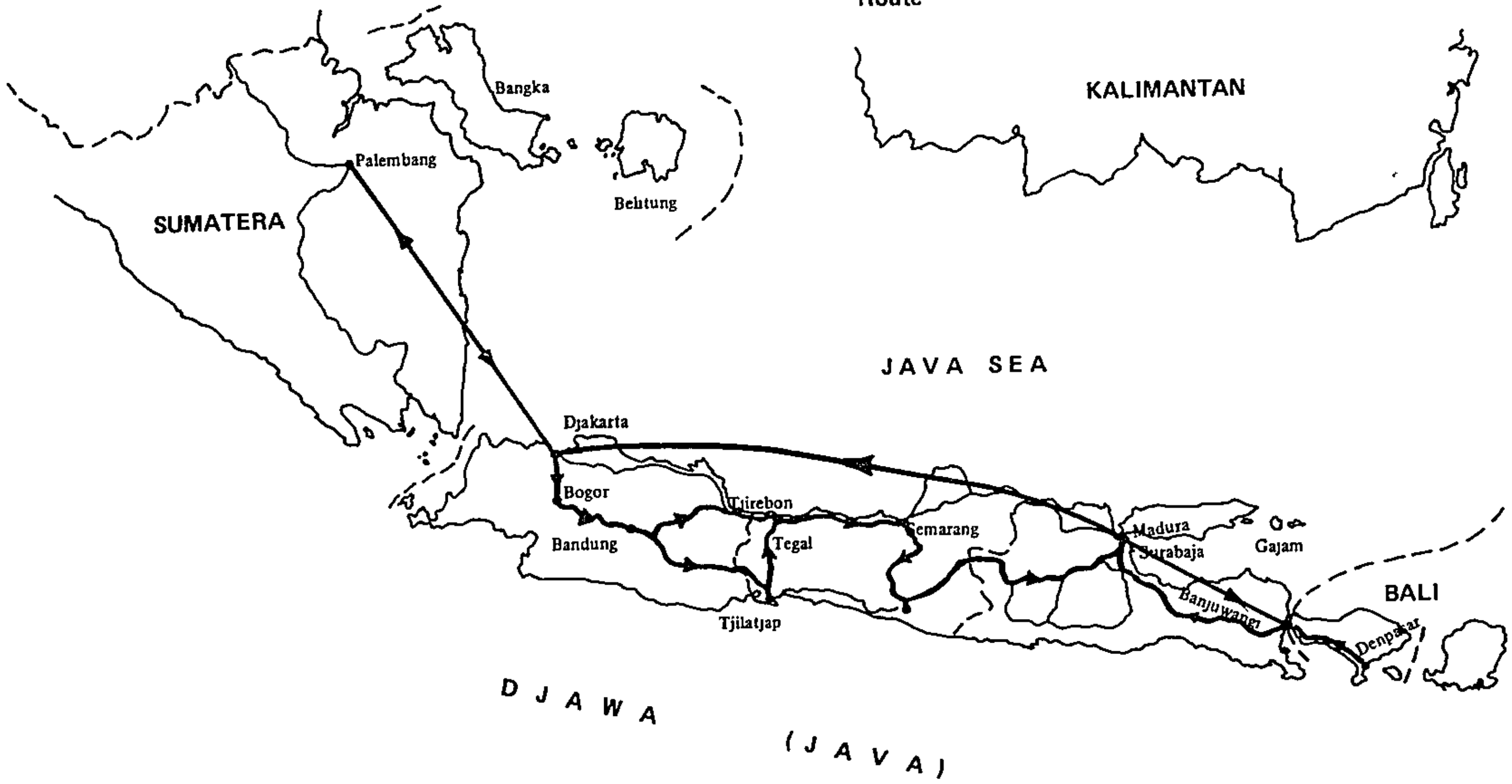
	Date	Itinerary	Activities
1.	18th July (Tues.)	Tokyo-Djakarta	Travelling
2.	19th July (Wed.)	Djakarta	Japanese Embassy, Conference with OTCA
3.	20th July (Thurs.)	Djakarta	Conference with D.G. of Chemical Ind.
4.	21st July (Fri.)	Djakarta	Visited D.G. of Chemical Ind. Textile Ind. and P.T. I.S.T.E.M.
5.	22nd July (Sat.)	Djakarta	Visited BAPPENAS, D.G. of Textile Ind., market survey
6.	23rd July (Sun.)	Djakarta	Market survey
7.	24th July (Mon.)	Djakarta	Conferred with D.G. of Chemical Ind. and BAPPENAS. Visited P.N. Senajan
8.	25th July (Tues.)	Djakarta	Visited M.P.I.F., M.I.G.A.S. and Batik Plant
9.	26th July (Wed.)	Djakarta-Bandung	(Djakarta) Visited P.U.T.L., Perkebunan (Cotton plantation office) and Ministry of Trade. Bank Indonesia. Left for Bandung
10.	27th July (Thurs.)	Bandung	Visited Padalarang paper mill, I.T.T. and P.N. Bandjalan (spinning mill)
11.	28th July (Fri.)	Bandung	Visited Institute of Hydrology Engineering and the Geological Survey of Indonesia, Perintis, BTN and Nitex (fibre processing mill)
12.	29th July (Sat.)	Bandung	Visited Padalarang paper mill, Famatex (textile mill), and C.V. Langsung (Knitting mill)

13.	30th July (Sun.)	Bandung-Tjilatjap Bandung	Material and data classification and travelling
14.	31st July (Mon.)	Tjilatjap-Tjirebon Bandung-Tjirebon Bandung-Djakarta	(Bandung) Visited L.P.S. (rayon laboratory) (Tjilatjap) Visited P.N. Tjilatjap (spinning mill), travelling
15.	1st Aug. (Tues.)	Tjirebon-Tegal-Jogjakarta Djakarta	(Tegal) Visited Texin (Spinning mill) (Djakarta) Conference with Japanese Embassy and trading companies
16.	2nd Aug. (Wed.)	Jogjakarta-Surakarta Djakarta	(Jogjakarta) Visited G.K.B.I. (BATIK), P.T. Primissima (spinning mill) (Surakarta) Visited Batik Keris (Djakarta) Conferred with D.G. of Chemical Industry and M.P.I.F.
17.	3rd Aug. (Thurs.)	Surakarta-Surabaja Djakarta-Surabaja	Travelling
18.	4th Aug. (Fri.)	Surabaja	Visited: P.N. Soda, Waru (Caustic Soda plant) P.N. Petrokimia (Fertilizer plant) P.N. Grati (Spinning mill)
19.	5th Aug. (Sat.)	Surabaja-Bali Surabaja	(Surabaja) Visited Kamadjaja (weaving mill), Inbritex (spinning mill), travelling
20.	6th Aug. (Sun.)	Surabaja-Djakarta Bali Surabaja	Travelling and classification of materials and data
21.	7th Aug. (Mon.)	Bali-Banjuwangi-Surabaja Surabaja-Djakarta. Surabaja	(Banjuwangi) Visited Banjuwangi paper mill Travelling and studies of materials and data

22.	8th Aug. (Tues.)	Surabaja-Djakarta Djakarta	(Djakarta) Visited D.G. of Textile Industry, travelling
23.	9th Aug. (Wed.)	Djakarta	Visited PERTAMINA and D.G. of Chemical Industry
24.	10th Aug. (Thurs.)	Djakarta-Palembang Djakarta	(Palembang) Visited Pusri Fertilizer Plant and P.N. Palembang (textile mill) (Djakarta) Visited D.G. of Textile Industry, travelling
25.	11th Aug. (Fri.)	Palembang- Djakarta	(Djakarta) Summarizing survey results and compilation of interim report (Palembang) Visited PERTAMINA, travelling
26.	12th Aug. (Sat.)	Djakarta	Summarizing survey results and compilation of interim report
27.	13th Aug. (Sun.)	Djakarta-Bangkok Djakarta	(Djakarta) Summarizing survey results and compilation of interim report, travelling
28.	14th Aug. (Mon.)	Djakarta Bangkok	(Djakarta) Explained interim report to D.G. of Chemical Industry (Bangkok) Visited T.T.T.M.
29.	15th Aug. (Tues.)	Djakarta Bangkok	(Djakarta) Preparation for departure and courtesy visits to parties concerned (Bangkok) Conferred with ECAFE and ECOCEN
30.	16th Aug. (Wed.)	Djakarta-Tokyo Bangkok-Tokyo	Travelling

Fig. I-1 Survey Itinerary

—— Route



4. Acknowledgement

The survey team would like to take this opportunity to express its deep appreciation for the effective assistance extended by the offices of the governmental authorities of the Republic of Indonesia, particularly for the cooperation rendered by the Directorate General of Chemical Industry, the Directorate General of Textile Industry of Departemen Perindustrian, the officers concerned of the BAPPENAS, the ministry of Agriculture, the district and local offices of the authorities, and various governmental plants, mills and factories, to whom visits were made during the course of the present survey.

The leader of the survey team, on behalf of all the team members, expresses his gratitude for the satisfactory completion of the survey which would have been impossible were it not for the cooperation and assistance of all the Indonesian parties concerned.

The team acknowledges with appreciation the collaboration of the following officers of the Government of Indonesia who acted as counterparts of the team members and, who either accompanied and guided the team members during the course of on-site surveys or assisted the members in the way of collecting data and various materials.

Mr. Nico Kansil	Officer, Directorate General of Chemical Industry, the Departemen Perindustrian
Mr. S. R. Tambunan	Officer, Directorate General of Chemical Industry, the Departemen Perindustrian
Mr. Kusmono	Officer, Directorate General of Chemical Industry, the Departemen Perindustrian
Mr. Sukirto	Officer, Directorate General of Chemical Industry, the Departemen Perindustrian
Mr. Sudito	Officer, Directorate General of Chemical Industry, the Departemen Perindustrian
Mr. Pattinama	Officer, Directorate General of Chemical Industry, the Departemen Perindustrian
Mr. Sudjaijoto	Officer, Directorate General of Textile Industry, the Departemen Perindustrian

II. Conclusions and Recommendations*

1. Demand Forecast

1) It is expected that the total demand for the fibrous and textile products (hereinafter referred to as the "total textile demand") will attain the level of approximately 370,000 tons by 1980 when the per capita consumption of the products will be 2.4 kg/person/year. This corresponds to the annual growth rate of 12%. The rate comprised by synthetic fibres in the total fibre demand will be approximately 35% which is similar to the rate achieved by other nations. The quantity of synthetic fibre consumption will therefore be approximately 130,000 tons.

2) The total fibre consumption in 1970 was 120,000 tons and the per capita consumption was 1.0 kg/person/year. The rate comprised by synthetic fibres (hereinafter referred to as the "synthetic fibre rate") was then 17%.

3) The breakdown of the forecast demand quantity in 1980 in accordance with the type of fibres is as follows.

Cotton	221,000 tons	59.4 %
Polyester staple	62,000	16.6
Nylon filament	34,000	9.2
Polyester filament	25,000	6.6
Rayon	21,000	5.6
Acrylic fibres	4,000	1.2
Others	5,000	1.4
	372,000 tons	100.0 %

4) At present, Indonesia relies entirely upon imports for the supply of fibre raw materials, however, in order to cope with the future increment in demand, certain types of fibre raw materials must be produced domestically. The items to be produced within Indonesia are synthetic fibres, rayon fibres and cotton. Of these three categories, the synthetic fibre is the item to which domestic production efforts

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* In this report, the convension rates of ¥308 to U.S. dollar and Rp 415 to U.S. dollar are employed.

are recommended to be concentrated most positively. The reason for this recommendation is that the synthetic fibre possesses conditions under which domestic production can be carried out with the highest efficiency when compared with other items.

5) The synthetic fibres, the filament and staple production of which must be scrutinized, are nylon and polyester.

6) The quantity-wise demand for cotton in 1980 will attain a level which is approximately twice as high as the present level. Thus, it is necessary to positively promote the presently undertaken domestic production studies of cotton in order to efficiently cope with a number of problems such as the demolition of the PL480, the world-wide cotton shortage and the general increase in cotton prices.

7) A demand forecast should be undertaken regularly each year and should be revised from time to time by incorporating changes in achievements accomplished since the previous forecast as well as developments in the general situations. From this viewpoint, it is desirable for regular demand forecast studies to be continued in the future.

2. Synthetic fibres

1) The machinery and equipment for the production of synthetic fibres are being extensively developed in a number of countries and from the Indonesian standpoint, the domestic production of synthetic fibres employing such machinery and equipment will inevitably call for the importation of raw materials, machinery and equipment, spare parts and components, etc. which are rather to the disadvantage of Indonesia, however, the advantage here is the posibility of employing high productivity machinery and equipment which have already been developed in the other countries. Further, the utilization of the domestic raw material resources (petroleum) is being contemplated along with the expansion of the scale of the synthetic fibre industry in Indonesia, and it is recommended that the Indonesian Government positively promote the industrialization of the production of synthetic fibre.

2) When constructing synthetic fibre plants, it is recommended that the plants for the production of polyester staple (polyester SF), polyester filament (polyester FY) and nylon filament (nylon FY) be concurrently constructed in order to carry out efficient utilization of the polymerization equipment, utility facilities, labour force, etc.

3) The economic scale of the above-mentioned plants should be 20,000 T/Y for the staples and 10,000 T/Y for the filaments. Should there by any financial problems for the concurrent construction of these plants, it is recommended that the construction be undertaken in the following order of preference.

Polyester SF plant -- Nylon FY plant -- Polyester FY plant

4) It is not recommended, in view of economic reasons that small scale plants for the production of various synthetic fibre products be scatteredly built. Therefore, it is desirable that large scale plants as mentioned above be constructed for the production of synthetic fibres. It would not be sufficient to rely solely upon the introduction of foreign funds undertaken by private enterprises for the construction of such large scale plants as above. Therefore, it is highly desirable that the Indonesian Government take part in the project as one of the partners of the Indonesian parties.

5) The construction of the plants for the production of synthetic fibre products in order to fulfil the domestic demands should be carried out as follows.

First Step:	Construction of plants in Western Java (Onstream targeted for 1976/77)
Second Step:	Construction of plants in Eastern Java (in the vicinity of Surabaja) (Onstream targeted for 1978/79)
Third Step:	Construction of plants in mid-Java (Onstream targeted for 1980/81)

6) As to the raw materials for such synthetic fibre plants, importation of monomer, rather than polymer (chips) is recommended. For the production of polyester fibres, the direct esterification method should be adopted in view of the nature of the by-products.

7) It is desirable for a 2nd step survey following upon the presently completed survey to be conducted concerning the synthetic fibre industry for the purpose of carrying out more detailed studies and scrutinizations pertaining to such points as the studies of economic assessment with higher accuracy, the selection of the most suitable sites, ways and means to be employed for the actual implementation of the study results, etc.

8) Along with the production of synthetic fibres, it is indispensable to substantiate the synthetic fibre processing systems required. It would therefore seem necessary to undertake a survey of the present situations and study the future schedule for the implementation of the synthetic fibre processing industrialization and also clarify the policies to be taken by the governmental authorities.

For this purpose, it is recommended that a survey regarding the synthetic fibre processing industries be conducted following upon the presently completed survey.

3. Synthetic Fibre Raw Materials

1) In view of the scale of production for the foreseeable future, it is recommended that the importation of cyclohexane and p-xylene be undertaken for the production of the monomer in Indonesia.

2) There is no fundamental impediment in Indonesia for the production of caprolactam and terephthalic acid. The plant for the production of terephthalic acid should be targeted for going onstream in 1978/79 with a capacity of 40,000 T/Y. The plant for caprolactam production should be onstream in 1980/81 with a scale of 30,000 to 40,000 T/Y as the optimum production capacity.

3) The terephthalic acid production has a higher extent of feasibility for industrial scale production than caprolactam in view of the demand forecast and the nature of the by-product.

4) As sub-raw materials such as ammonia, sulphuric acid, etc. are necessary and further by-products such as ammonium sulphate will be produced as a result of caprolactam production, the construction of caprolactam should be studied on the basis of, and in line with, the development of the basic chemical industries and the relative fertilizer production plant construction projects.

5) As no sub-raw material is required for the production of terephthalic acid and in view of the fact that the polyester plant is projected to be constructed in Western Java, it is recommended that the terephthalic acid production plants be built in the district of Western Java. Surabaja and Tjilatjap are recommended as the plant sites for the caprolactam production plants due to the availability of the necessary sub-raw material for the former and to the relationship with the chemical fertilizer plants for the latter.

6) We consider that the achievement of cyclohexane and p-xylene production will be difficult before 1980. For the production of these items, projects must be laid out from a general and global viewpoint and in such a manner that the very advantage that Indonesia is a petrol-producing country be fully utilized and in coordination with the advancement of plastic industries in the country.

4. Rayon Staple

1) In the so-called industrialized nations, machinery and equipment for the production of rayon staple are fully depreciated. In this connection, if the production plants are to be newly constructed, the burden of depreciation would be very heavy so that industrial production of rayon on the basis of importation of pulp materials and caustic soda seems extremely unfeasible. However, it is evident that the pulp prices will increase world-wide in the future and if the domestic production of pulp can be carried out in Indonesia, thereby making it possible to obtain low cost pulp materials, the industiral scale operation of rayon production becomes possible. It is recommended that the scrutinization regarding the domestic production of pulp be commenced in the appropriate time to be required from the circumstances of the tendency on rayon industries in the world.

2) As far as the construction of plant is concerned, this is not an urgent matter. (The profitability of a plant will be identical in the construction of a 25 T/D plant in 1976 and a 50 T/D plant in 1978.) At the present stage, the rayon industry as a whole is entering into an era of change throughout the world and therefore, it seems necessary to closely observe the trend in order to realistically undertake studies for projects in this field.

3) We consider that the capacity of the rayon plant to be constructed should be 50 T/D. Due to the increment in labour costs and the enhancement of pollution control regulations, it would not appear that the production increase in the industrialized countries will be implemented in the future within the rayon industry. Therefore if the quality of rayon produced in Indonesia is sufficiently high, the surplus rayon can be allocated for export, i.e. the surplus production capacity after fulfilling the domestic demand shall be directed to export, and thus it would seem possible to build a 50 T/D plant in Indonesia. From this viewpoint, it appears necessary to conduct a series of surveys concerning the export feasibility of the rayon products by carefully weighing the future evolution of the supply/demand behaviour of the products.

4) It seems necessary to confirm the direction of use of chlorine which is by-produced during the process of the domestic production of caustic soda. It goes without saying that the best application of such chlorine be made to the production of PVC monomer.

5) As the effect of the plant costs upon the production costs of rayon is strong, it seems necessary to conduct detailed scrutinizations regarding the plant costs in view of the specific conditions of the plant construction sites.

6) The domestic production of rayon in Indonesia will become an absolute necessity for the following reasons.

(1) After the termination of the PL480, Indonesia will be compelled to import cotton on the basis of the prevailing international cotton prices which are higher than the present PL480 prices. Further, it is being forecasted that the international market price of cotton will increase in the future.

(2) The production of rayon in the so-called industrialized countries is expected to be reduced, thereby making cotton importation increasingly more difficult.

(3) Although there is an expectation that the production of cotton in Indonesia will expand, the production cost of cotton will not become less than that of rayon.

(4) It seems necessary to consider the effective utilization of forest resources available in Northern Sumatra, Central Java, Kalimantan, etc.

In view of the above, it is considered necessary to constantly study the opportunity for possible domestic production commencement of the rayon industries in Indonesia and, as and when the opportunity arrives, immediate action seems necessary for the commencement of the industrialization. The opportune time should be determined on the basis of the international price increase trend of rayon and pulp and the future trend of the chemical industries in Indonesia. It is therefore necessary to continue the studies and scrutinizations for the implementation of the rayon industry on a regular basis in the future. It is considered that it would be more economical to carry out such studies concurrently with the demand forecast mentioned in above (1).

5. Various Policies Deemed Necessary to be Implemented in the Future

1) Statistical data

Due to the shortage of domestic data in Indonesia, we were compelled to conduct approximations on the basis of relative data obtained from other countries during the course of the present demand forecase studies. It seems imperative to substantiate the necessary data of statistics for effecting scrutinization studies for various projects. As far as the textile industries are concerned, substantiation and a further detailed classification of export/import statistics and the compilation of consumption and production seem to be the minimum requirements for the future.

2) Customs Import Duties

When the industrial scale production of synthetic fibres and chemical fibres are put onstream, it would seem necessary, as was effected by other South East Asian countries, to levy customs duties upon the importation of competitive products in order to protect the domestic industries. However, the import tariff rate of import duty becomes higher as the production scale of plants is reduced. From this viewpoint, it must be taken into consideration that the plant production scale must be set as high as possible in order to maintain as low a tariff rate as possible so that the purchasing power of the population will not be impeded. If the DCF rate is employed as the assessment basis for the economic evaluation, a tariff rate of at least 10% would be necessary in the case of taking a production capacity of 18,000 T/Y for polyester staple in order to bring the DCF rate to a level of 15%, and at least 15% tariff in the case of a 9,000 T/Y capacity for nylon filament. If the capacities are set lower than the above mentioned levels, the import duty rate would become higher than the percentage figures quoted above.

3) Textile Processing Industries

On the assumption that the above-mentioned plants for synthetic fibres are duly completed as scheduled by 1980, the following production should be achieved domestically.

Polyester SF	approx. 50,000 T/Y
Polyester FY	approx. 20,000 T/Y
Nylon FY	approx. 28,000 T/Y

On the other hand, the capacity for the synthetic fibre processing should attain the following levels in one to two years' time.

Spinning (Polyester staple consumption)	approx. 20,000 T/Y
Filament processing (Filament consumption)	" 5,000 T/Y

Therefore, by taking the domestically produced synthetic fibres alone, it would become necessary to install approximately 500,000 or more spindles of spinning facilities which correspond to the processing capacity of 30,000 T/Y of polyester staple and the expansion of the necessary facilities for processing the 43,000 T/Y of filaments. The investment to cover these expansions should be three to five times the investment amount called for in the production of staple and filament together, which is a considerably large amount of investment.

6. Projects Worthy of Future Feasibility Studies

We consider that the following projects call for feasibility studies in order to promote the future synthetic and chemical fibre industries in Indonesia.

1) Detailed and practical scrutinization for the achievement of construction for the first stage of the synthetic fibre plant projects. (Polyester SF -- 18,000 T/Y; Nylon FY -- 9,000 T/Y; Polyester FY -- 8,000 T/Y.)

2) Studies of the expansion and substantiation of the synthetic fibre processing industry.

3) Detailed and practical scrutinization of the construction of terephthalic acid production plants (raw material for polyester fibres).

4) Feasibility studies regarding the domestic production of dissolving pulp materials (raw materials for rayon).

5) Detailed scrutinizations for the industrial scale production of rayon SF (especially, practical studies concerning the plant costs required).

6) The follow up surveys to the studies conducted in this report pertaining to the demand forecast and to the rayon industry.

Of the above items, it is particularly recommended that item 1) be taken up as soon as possible, however, item 3) and 4) be taken up by considering the tendency on the rayon industries in the world.

7. Researches and Training Concerning Textile Industries

Along with the future increment in the domestic consumption of the man-made fibre products in Indonesia, the role to be played by the following laboratories and research institutes is considerably significant in view of the development of techniques and fostering of engineers and technicians. Sound coordination between the technical development and the training of specialists must be under taken.

1) LPS (Cellulose Research Institute)

Whilst it is important to continue the basic researches now being undertaken by this institute, it would also seem necessary to establish stable operation techniques on the basis of pilot plants. The pilot plants must be fully and effectively utilized for the establishment of techniques in this respect. The engineers to be trained through the operation of these pilot plants will be extremely useful for the establishment of the actual synthetic fibre production techniques.

2) ITT (Institute of Textile Technology)

It is forecasted that the Indonesian textile industry will, in the near future, see an acute increase in the rate of synthetic fibres assumed in the total textile production. It seems likely that the existing research facilities of the ITT alone are insufficient to cope effectively with the future development of the industry. If the ITT's research activities rely solely upon the existing facilities, it is evident that the institute will fall behind the development and advancement of techniques established by national and private enterprises in this field. It is therefore strongly recommended that rehabilitation of this institute be undertaken at the earliest possible opportunity.

3) Collaboration between the LPS and the ITT

The establishment of spinning techniques is integral with the achievement of fibre processing techniques so that we would like to recommend that the integration of rayon and synthetic fibre development teamwork encompassing both the ITT and LPS be established.

8. Effects upon the Indonesian National Economy

The synthetic fibre industry covers a wide range of materials from raw materials up to the finished products, i.e. clothing goods, so that the industry is obviously one of the major columns to buttress the national economy. By means of realizing the synthetic fibre production in Indonesia, the following effects upon the national economy will be exerted.

1) Improvement of the trade balance due to the substitution of so far imported items

At the present stage, the nation imports staples, filaments, spun yarn, woven fabrics, etc. Therefore, by means of industrialization, these items will be replaced by monomer importation which involves a lesser extent of the added value. It is particularly likely that synthetic fibre will become the very basic foundation of the Indonesian domestic production fibre materials and that the synthetic fibre products may be allocated not only to fulfil domestic consumption but also for exportation.

2) Expansion of employment opportunities

As mentioned above, the textile industry encompasses a wide range of activities so that the expansion of employment opportunities will be achieved covering a large number of the national industries as a whole.

3) Future correction of the district economic discrepancies

Although no immediate effect in this respect is expected, the industrialization of fibre and textile production will eventually contribute to the correction of the discrepancies among the economic conditions of various local districts.

4) Utilization of domestic resources in the future

The advancement of the industrialization of textile industries will eventually lead to the effect utilization of domestic resources such as petrol, forest resources, etc. which are to be employed as raw materials for the industry.

III. Outline of the Survey Methods and Results of the Survey

1. Survey Methods

1-1. Outline of the Survey Method and the Scope of Survey

The outline of the survey and the scope of the surveys conducted are shown in Fig. III-1. In the present survey, the estimate of the total fibre consumption in Indonesia up to 1980 and the breakdown thereof in the form of the category-wise consumption amount, were conducted (I).

Scrutinizations concerning the main raw materials (TPA, caprolactam or rayon pulp) and the sub-raw materials (caustic soda, carbon disulphide, sulphuric acid, ammonia, etc.) were then undertaken together with the studies of various conditions concerning the availability of utilities (II).

Subsequently, the present status of the fibre processing industry in Indonesia, with special emphasis upon the rayon and synthetic fibre processing, was surveyed (III), as the filaments and staples are converted into the final products after undergoing such processing as spinning, weaving and dyeing.

On the basis of the results of studies (I), (II), and (III), together with the minimum economic scale studies (IV) of the filament and staple production plants, forecasts were made regarding the scale of the production extent of various filament and staple producing plants as well as concerning the timing of the constructions thereof. Also, the investment extent in terms of monetary amount corresponding to the estimated scales of the plants was calculated (VI). On the other hand, the plant site selection scrutinization was made on the basis of the transportation conditions (VII) and the availability conditions of the utilities (V).

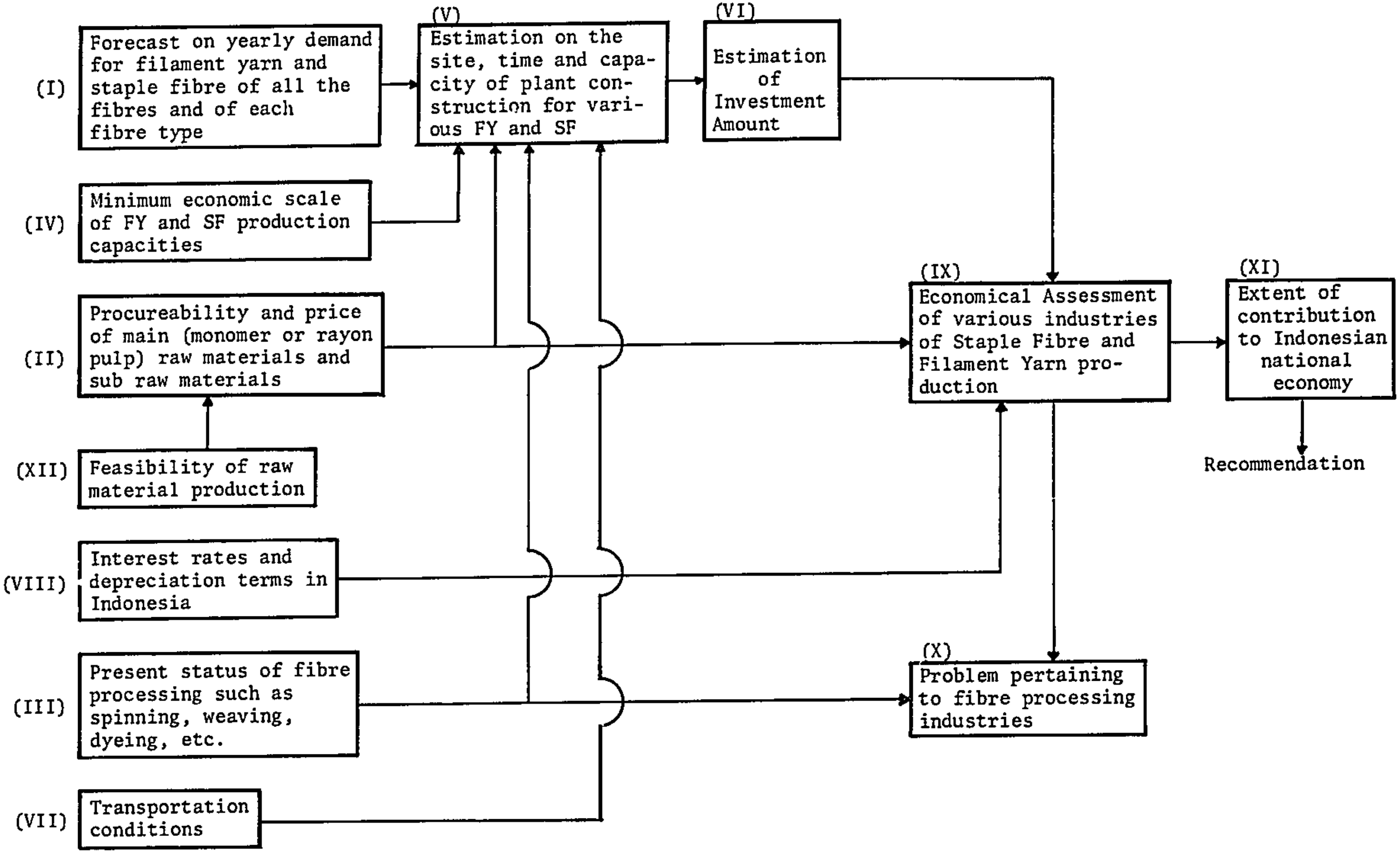
Surveys regarding the various conditions for the preliminary calculation of the production costs such as the Indonesian taxation systems were also undertaken (VIII).

On the basis of the results of the evaluations made by the above (VI), (II) and (VIII), the economic evaluation (IX)of the production plants for filament and staple was made.

In accordance with the results of the evaluations (IX) as well as on the basis of the present situation of the processing (III), a brief evaluation concerning the expansion of the processing plants was also made (X). Further, as pracicable an elaboration (XI) as possible was made on the merits of constructing various staple and filament production plants from the national point of view.

Finally, scrutinizations were made concerning the possibility of domestic production of the above-mentioned raw materials (XII).

Fig. III-1 Scope of Survey and Work



As shown by the method of scrutinizations mentioned above, the present survey method is quite dissimilar to the conventional method. In the latter, the production of the raw materials (BTX extraction, production of rayon pulp, etc.) is taken as the starting point leading up to the turning out of the final products, however, the forecast made in the present survey has been compiled concerning the demand quantity of each fibre product item and on the basis of the required capacity of the processing of such fibre product items, the required amounts of the filament and staple were estimated.

Further, an assessment was made of the economics of such staple and filament production. Studies on the possibility of domestic production of raw materials for the filament and staple were also made.

The "synthetic fibre" encompasses polyester, nylon, acrylic fibres, polyvinyl alcohol ("Vinylon") etc.

Further, these items are classified in accordance with the form, i.e. filament and staple. In view of the demand forecast, the filament and staple of polyester and the nylon filament are the items to be placed under present scrutinization as the ultimate goal of industrial scale production, and therefore studies were made concerning these three items alone. (If industrial scale productions are to be effected at the stage of fibre processing, studies should be undertaken including other types of synthetic fibres which are not included within the scope of the present survey.)

1-2. Demand Survey

The demand forecast methods employed in the present survey are shown in Fig. III-2. Generally speaking, the following are commonly available as the demand forecast methods.

(1) Time-Series Method: In this method, the past demand evolution is studied and the future trend is forecasted on the basis of the studies.

(2) Correlation Method: In this method the correlations between past demand evolution and past national achievements such as the GNP, etc., are taken as the criteria for the formulation of the forecast.

(3) Cross Section Method: In this method, the actual demand trent records achieved in other nations are taken as the bases in order to forecast the future demand pattern of a given nation.

As much material and data as possible were collected in order to apply such to the above-mentioned methods for studying the future demand forecast.

The following paragraphs shall briefly explain the contents of each of the above-mentioned methods.

The Time Series Method (1):

In order to employ this method, it is at least necessary to obtain substantial import statistics (I) of textile product items as well as production and consumption statistics (II) over several years concerning a given country. If these data are secured in accordance with the types of products, it would be possible to establish a meaningful forecast on the basis of the Time-Series Method. However, in many cases, the statistical data on the side of the importing country are insufficient, and therefore no typewise classification of the data has been compiled, or names of the exporting countries given, i.e. the origin of the imported items, are not clear often due to the international political situations or other reasons. Therefore, in order to supplement such insufficiency, it has been normally practiced to utilize the export statistics (III) obtained in the textile exporting countries or in the trade intermediating countries. Further, the information (IV) obtained from textile product distributors or textile manufacturers within the given country has been utilized.

The Correlation Method (2):

This is a method in which a textile demand forecast is made not only by means of extending the above-mentioned textile demand growth along with the time sequence, but also by means of grasping such demand growth in relation to certain factors (e.g. the GNP or the GDP in the present case) which are in correlation with the demand for textile products, as well as grasping the separately forecasted growth of the GNP.

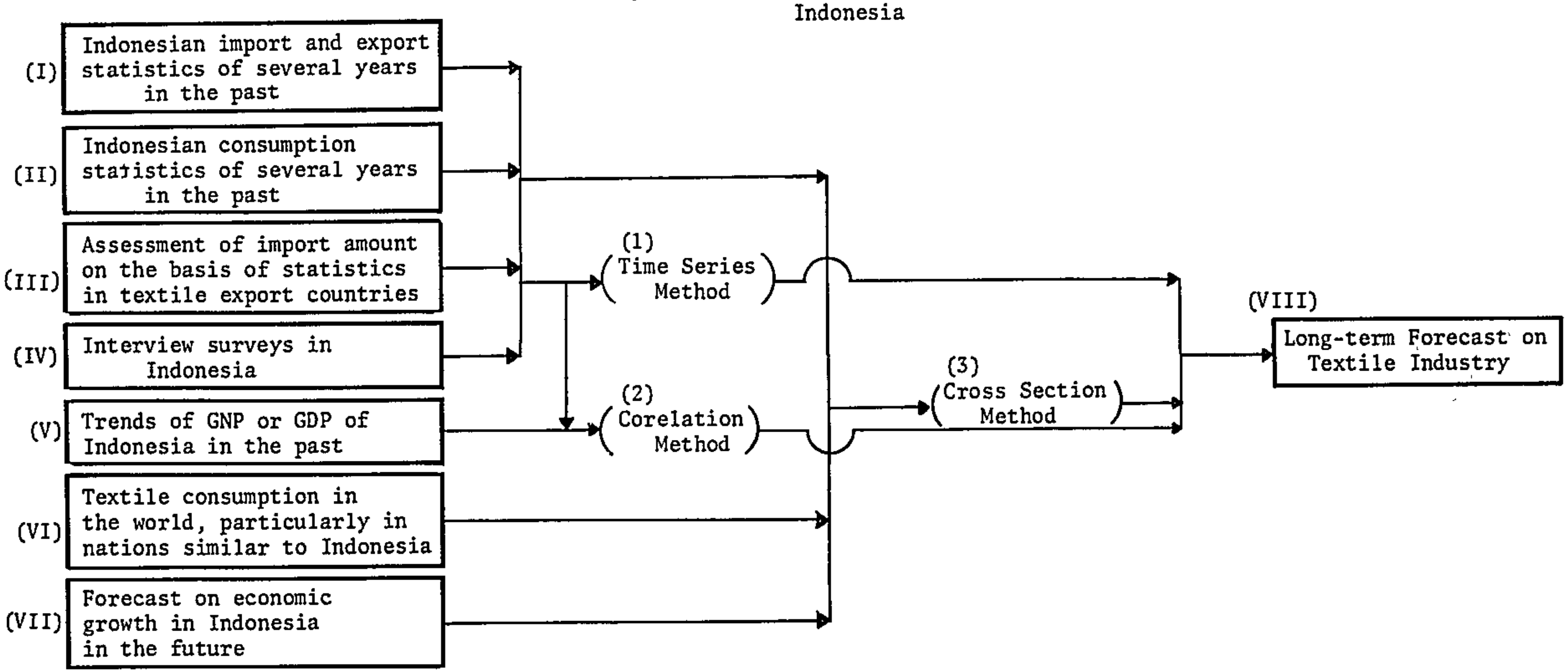
The Cross Section Method (3):

In contrast with the above (1) and (2), both of which employ the past achievement records of a given country as the basis for the forecast, this method employs the records achieved in foreign countries in order to formulate forecasts upon the demand in a given country.

In the present survey, the Cross Section Method was mainly employed due to the nature of the data made available to the survey team. It is evident that in order to fully utilize this method, it is necessary to separately formulate a forecast of the economic growth of Indonesia toward the future (i.e. the GNP growth). However, the forecast upon the growth of GNP is not the direct subject of the present survey. Therefore, the GNP growth survey results obtained through other separate surveys were utilized for the purpose of this report.

For establishing the category-wise demand forecast of textile products, there are two available methods, i.e. a method in which the total textile consumption amount is forecast at the initial stage and then the results obtained are

Fig. III-2 Forecast on Type-wise Textile Consumption in Indonesia



analysed on the basis of past achievement records in accordance with the categories as well as by referring to the examples actually achieved in other countries, and, another method in which the demand directions in accordance with the directions of use of the textile products are firstly assumed and on the basis of the thus obtained results, forecasts are made on the quantitative demand extent in each type of textile product in accordance with the directions of use, thereby obtaining the total textile consumption amount by summing up all the forecasts.

While it is desirable to enhance the accuracy of forecasts by employing more than one method, thereby making a comparison possible and screening of the results, it is often the case that suitable data are not available, thereby compelling the survey to employ a single method. Also, in the case of treating the statistics regarding textile products, the unit of the data is often expressed in terms of length (m), weight (kg), square meters, etc. Due to the fact that the calculated quantity will vary considerably depending upon how to select the criterion to indicate the "weight per unit length", the statistical data themselves are prone to vary widely depending upon the criterion employed. Another problem here was the fact that fabric products include both the so-called "double width" and "single width" products.

In the present scrutinizations, no studies have been made regarding the demand forecast pertaining to the possible exportation. The reason for discarding the export demand forecast are two-fold as follows, which pertain to the inherent nature of the textile industry in Indonesia.

(1) Regarding the synthetic fibres, the advantage that the basic raw material for the fibre, i.e. the oil is domestically and economically obtainable in Indonesia, cannot be materialized immediately.

(2) The so-called related industries such as the chemical industries are still under-developed.

Because of these existing disadvantages, it was not assumed that the fibres to be produced in Indonesia in the foreseeable future would be competitive overseas.

Fig. III-3 shows the forecast method adopted in the present survey under the Cross Section Method. In other words, the regression analysis method was employed in order to clarify the relationship between the GNP per capita of various countries of the world and the per capita textile consumption amount. The trend forecast concerning Indonesia in terms of per capita textile consumption will be obtained along with, and on the basis of, the thus obtained relationship as well as in relation to the forecast upon the Indonesian GNP per capita trend. (In this case, comparative studies were undertaken with the per capita textile consumption amount of the countries which now stand in similar environmental conditons as those of Indonesia.)

Further, the forecast on the population growth was incorporated into the thus obtained results in order to further clarify the total textile demand extent in Indonesia. In order to further investigate the direction of use of the various types of textiles included in the above-mentioned total textile demand, the trend of synthetic fibre rate in various countries of the world were firstly obtained and the rate comprised by synthetic fibres as against the total man-made fibres were also obtained regarding such countries, so that, by taking the above-mentioned total textile consumption amount, the forecast was made on the demand trend regarding cotton, synthetic fibres and rayon fibres in Indonesia.

The demand figures concerning these three categories of fibres were also confirmed by deriving the same figures employing completely different methods, i.e. on the basis of the GNP per capita of the various countries world-wide, the trend in the synthetic consumption amount per capita, and the forecast upon the GNP growth trend in Indonesia. A comparison with the thus obtained results and the Indonesian synthetic fibre demand was made, and, a further comparison was made with the FY/SF rate (filament vs. staple rate) forecast compiled in 1970 as well as with the forecast upon the product-wise demand, thereby finally obtaining the forecast upon the demand for synthetic fibres in Indonesia in accordance with the raw materials employed.

1-3. Economic Evaluation

Economic evaluations were conducted in accordance with the methods illustrated in Fig. III-4 and III-5.

1-3-1. Cost Calculations

In accordance with Fig. III-4, the explanations regarding each item in the figure shall be made in the following paragraphs.

(1) The Total Sales were computed on the basis of the CIF prices forecast as well as on the production capacity of the pre-selected plants.

(2) The Total Fixed Assets were computed on the basis of the machinery and equipment materials, on-site construction expenses, building construction expenses, engineering fees, preparatory funds for operation, and the interest incurred during the period of construction of the plants to be built.

(3) The Working Capital was determined by the nature of the plants, the methods of procuring the raw materials, and the sales methods of the products.

(4) The Total Capital Investment was computed on the basis of (2) and (3) above.

Fig. III-3 Demand Forecast by the Cross Section Method

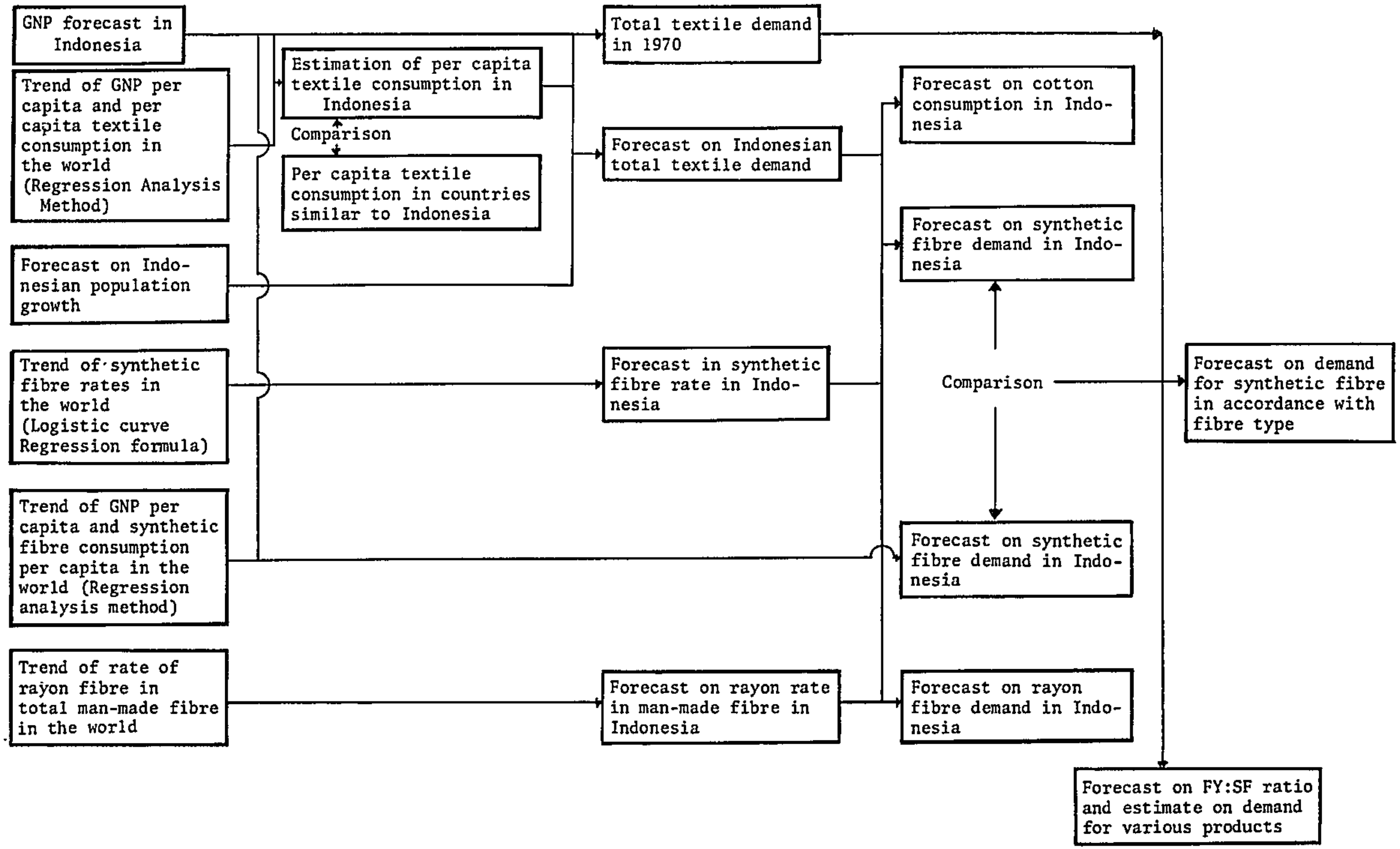


Fig. III-4 Cost Calculation Methods

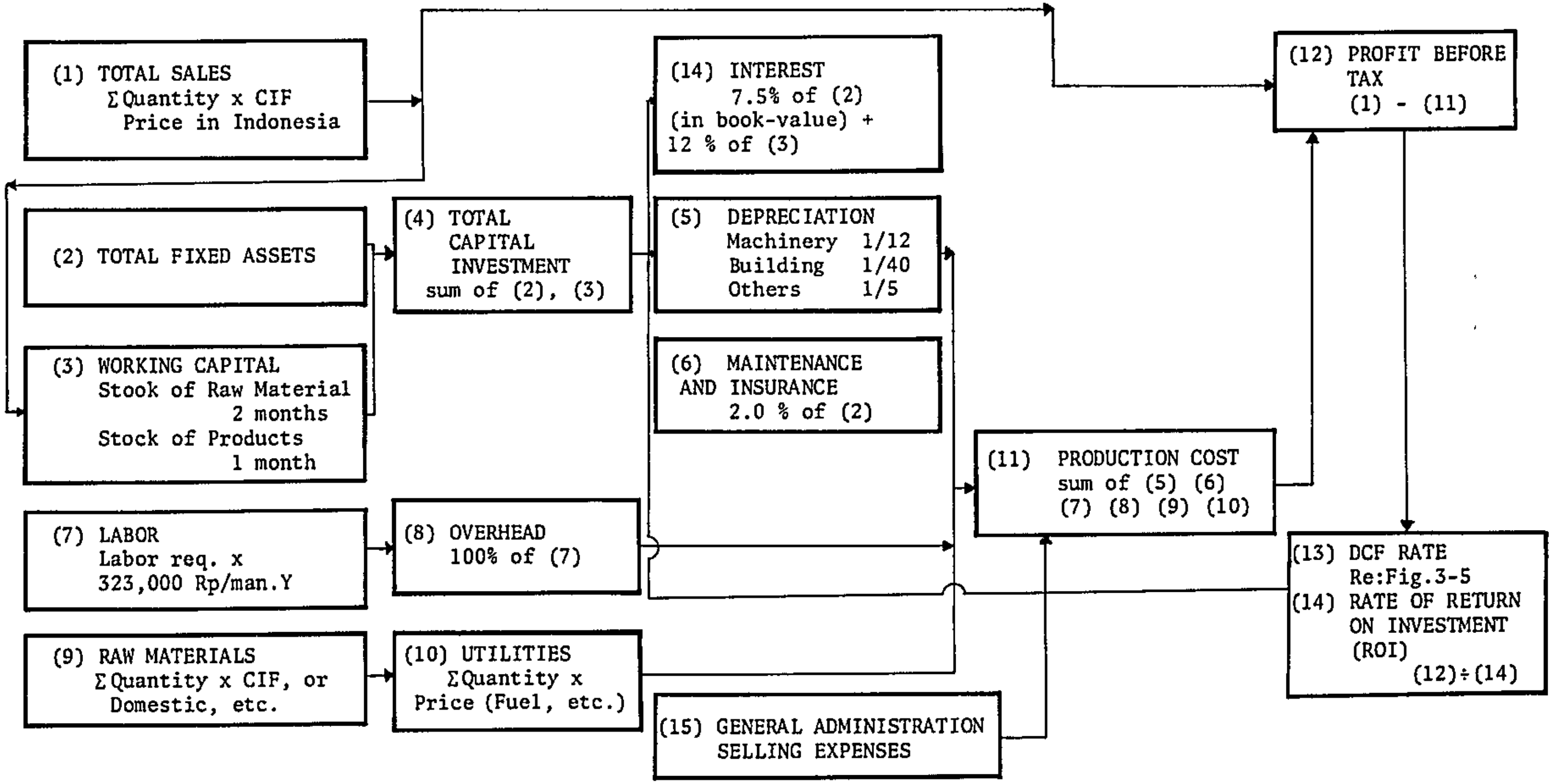
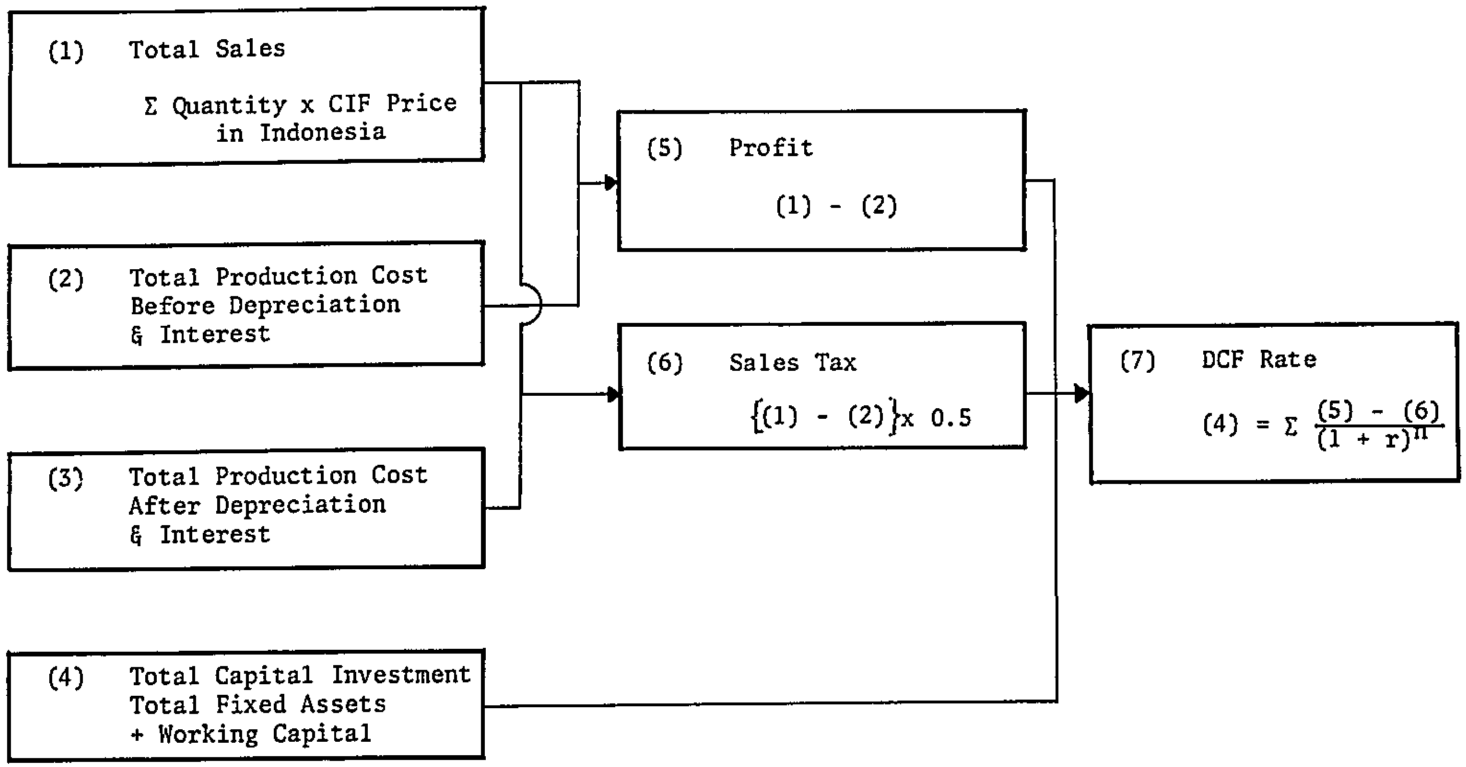


Fig. III-5 The Discount Cash Flow Method



(5) The Depreciation was adjusted to the practice actually prevailing in Indonesia.

(6) The Maintenance and Insurance were assumed preliminarily on the basis of the nature of the plants to be built.

(7) The Labour was cumulatively computed by taking into consideration the required extent of labour on the basis of the wage scale prevailing in Indonesia.

(8) The Overheads were calculated on the assumption of being 100% of (7) above.

(9) The Raw Material figures were determined in accordance with the prices obtained through the surveys conducted concerning the raw materials as well as on the basic units.

(10) The Utilities were also determined in the same way as (9) above.

(11) The Production Costs were computed by adding (5) through (10) above.

(12) The Profit before Tax was computed by subtracting the production costs computed in above (11) from the total sales amount obtained in (1) above.

(13) The scrutinization concerning the payability of the operation was made by employing the DCF rate of the Discount Cash Flow Method, however, as a simplified method, the partial adoption of the Rate of Return on Investment (ROI: obtained by dividing the profit before tax by the total investment) was also simultaneously and partially employed.

In the above calculation, no taxation was taken into consideration. The reason for discarding the taxation factor was that it is not necessary to incorporate this factor at the stage of arriving at the rate of return (ROI).

1-3-2. Discount Cash Flow Method

Fig. III-5 explains the Discount Cash Flow method which was employed for the economic evaluation of the operation. The following paragraphs explain the various conditions pertaining thereto.

(1) The Total Sales are the same as in the case of Fig. I-3

(2) The Production Cost before Depreciation and Interest is obtained by subtracting the Depreciation from the Production Cost in Fig. III-4.

(3) The Production Cost after Depreciation and Interest is obtained by adding the Interest to the Production Cost of Fig. III-4.

(4) Total Capital Investment is the same as in the case of Fig. III-4.

(5) Profit was obtained by subtracting (2) from (1).

(6) Although the Sales Tax was obtained by subtracting (3) from (1), the so-called Tax Holiday shall be applied for a period of five years after the commencement of the operation. In this case, the tax rate was taken at 50%.

(7) The Rate of Return on Investment (hereinafter called the DCF rate) can be obtained from (4), (5) and (6). However, in the present scrutinization, the Pay Out Period was taken for 10 years.

1-3-3. Economic Evaluation Indices for Indonesia

In accordance with the results of the present survey, the following were taken as the conditions for cost calculations. (Ref. Fig. III-4)

(1)	Working capital (3)	Stock of materials Stock of Products	2 months 1 month
(2)	Depreciation (5)	Machinery Buildings Others	12 years 40 years 5 years
(3)	Maintenance and Insurance (6)	2% of the facility costs	
(4)	Labour (7)	323,000 Rp/man/year	
(5)	Overhead (8)	100% of the total labour costs	
(6)	Interest (13)	7.5% against Total Fixed Assets 12% against Working Capital	
(7)	Others		
	Preparatory fund for operation:	Test operation period Machinery and equipment operation rate Defect rate	2 months 50 % 50 %

Interest incurred during construction	Period for interest incurrence	16 months
General administration costs	10% of production costs	

2. Outline of Survey Results

We conducted a series of surveys in accordance with the methods already explained. On the basis of the surveys' results, scrutinizations of the data were also undertaken.

2-1. Demand Forecast for the Total Textile and Category-wise Textile Products

Fig. III-6 shows the import and domestic consumption statistics of the textile items over the past several years for Indonesia and the past evolution of the export statistics destined to Indonesia from Japan, the U.S.A. and Singapore. Further, these figures accompany data obtained from the FAO and from the Bank-Indonesia. This table implies the following.

1) In Indonesia there was a large shift in the consumption amount in the past (during the confused period under the Soekarno Administration) and the data obtained covering this period cannot be utilized as one of the basis of forecast studies.

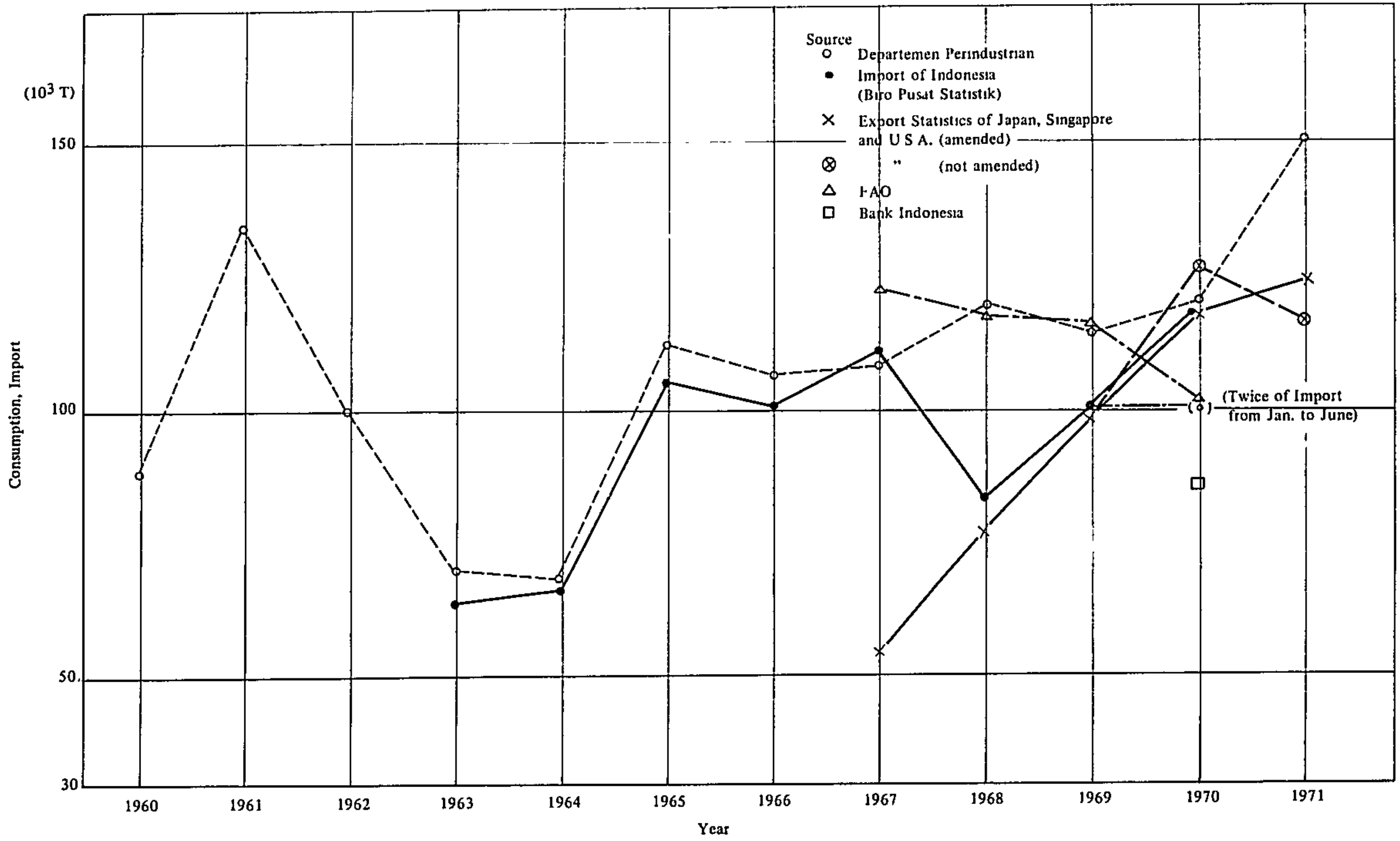
2) Comparatively stable conditions were restored for the period from 1965 onward, however, in 1968, there was a discrepancy between the import statistics and consumption statistics.

3) From 1968 onward, there is a correlation between the statistics compiled on the side of the exporting nations and the statistics made by the Indonesian authorities.

4) In 1970, there is an approximation between the consumption statistics data and the Indonesian import statistics data compiled by the Departemen Perindustrian and the import statistics of Japan, Singapore and the U.S.A.

5) In 1971, the consumption shows an acute increment. (It would seem that the figures for 1971, were based upon the forecast figures derived from the context of the 5-Year Plan.)

Figure III-6 Consumption and Import of Fibres in Indonesia



The date shown in Fig. III-6 needs modifying slightly in view of inventory problems, etc., however, generally speaking, the data obtained are rather insufficient to be used for the basis for a 10-year long term forecast by means of the Time-Series Method or the Correlation Method. Therefore, to our regret, neither or these methods could be applied for analysis of the presently obtained outcome of the surveys. Consequently, the Cross Section Method was employed in which comparative studies with data obtained from other nations were effected. As the original point for the forecast, the year 1970 was selected in view of the compatibility of the data obtained for this period. As a result, the forecast data obtained for the textile consumption in 1980 are as follows.

Forecast Figures for the Textile Consumption in Indonesia in 1980 (Population: 154 million)

	Per capita textile consumption (kg/yr)	Total textile consumption (ton)	Average annual growth rate (%)	Per capita textile consumption (m)*
Minimum	2.2	340,000	11.0	16.4
Average	2.4	370,000	12.0	17.8
Maximum	2.7	410,000	13.0	19.2

* 140g per meter

In the case of a 12% annual growth (average rate), the forecast figures for the demand in accordance with the category-wise textile products for the years from 1970 to 1980 are shown in Table III-1. Table III-2 shows the demand

Table III-1 Demand of Fiber in Indonesia 1970 - 1980

Growth Rate 12%

	Cotton	Rayon FY	Rayon SF	Nylon FY	PET. FY	PET. SF	Acrylic SF	Others	Total
1970	94,900	800	4,100	5,800	3,200	8,500	1,000	1,700	120,000
1971	99,800	900	5,100	7,900	4,900	12,700	1,200	1,900	134,400
1972	105,000	1,100	6,200	10,400	6,800	17,400	1,500	2,100	150,500
1973	111,500	1,200	7,400	13,000	8,900	22,500	1,800	2,400	168,700
1974	119,700	1,300	8,700	15,700	11,000	27,700	2,100	2,600	188,800
1975	130,200	1,500	10,000	18,500	13,100	32,900	2,400	3,000	211,600
1976	143,000	1,700	11,400	21,300	15,200	38,200	2,800	3,300	236,900
1977	157,600	1,900	13,000	24,400	17,500	44,000	3,200	3,700	265,300
1978	176,500	2,100	14,600	27,300	19,600	49,300	3,600	4,200	297,200
1979	197,700	2,300	16,300	30,600	22,000	55,200	4,000	4,700	332,800
1980	221,400	2,600	18,300	34,300	24,600	61,900	4,500	5,200	372,800

Table III-2 Demand forecast based on knowledge obtained through on-site surveys

	Demand forecast based on knowledge obtained through on-site surveys		Demand forecast of fibres in Indonesia*	
	%	t/Y 1)	%	t/Y 1)
Cotton	59	219,900	59.4	221,400
Rayon	6	22,400	5.6	20,900
Nylon FY	6	22,400	9.2	34,300
Polyester FY	4	14,900	6.6	24,600
Polyester SF	22	82,000	16.6	61,900
Acrylic SF	1.5	5,600	1.2	4,500
Ohters	1.5	5,600	1.4	5,200
Total	100	372.800	100	372,800
Synthetic fibre total	35	130,500	35	130,500

* Final forecast figure of the team

forecast for the year 1980 compiled on the basis of knowledge obtained from on-site surveys in comparison with the forecast figures already shown in Table III-1.

Concerning the actual data obtained from various nations which have been incorporated as the basis for the demand forecast, these included a certain degree of irregularity, particularly in nations where the textile consumption total amount is low. This seems to be attributable to the fact that the effect of the GNP or economic factors other than GDP exerted a great effect on the statistics. However, along with the development of the national economies of these nations, the forecast data will increase their compatibility accordingly.

Although the above demand forecast figures imply a comparatively high extent of per capita textile consumption amount, the consumption amounts stipulated are less than the present level achieved by Thailand and it is possible that Indonesia will be able to attain this level in 10 years' time. Concerning the various categories of textile product items included in the total textile production, there would be irregularities in the growth rates of these items depending upon the future trends of investment to be carried out into various taxtile processing sectors as well as on the likes and dislikes of the national population regarding the types and nature of clothing. (The likes and dislikes in this respect are variable depending greatly upon the promotion method of the market development.) However, the increment in the synthetic fibre rate up to a certain percentage level is a world-wide tendency and it is highly likely that in Indonesia also, the pattern which has been forecasted will eventually be attained. From this point of view, it is considered that the presently forecasted figures will be absolutely attainable on the condition that sound investments into the textile processing sectors be made and the development of the market is properly undertaken as scheduled. In particular, the construction programe stipulated in this report concerning the synthetic fibre producing plants are not fulfilling the forecast demand so that, even if there is a certain discrepancy between the actual demand realized and the figures forecasted, caused by difficulties in achieving accurate forecasts, the production achieved by the programmed plant will be fully covered by the consumption in view of the marketability of the items to be produced.

2-2. Main Raw Materials, Sub Raw Materials, By-products, Utilities and Product Prices

Table III-3 and 4 show the procurement methods and prices of the products and raw materials which were employed as the basis for the economic evaluation regarding the synthetic fibre and rayon industries. Regarding the utilities, the domestic prices of fuel were employed. Concerning the electrical power, the domestic price is approximately 6 Rp/KWH and it was confirmed that the procurement of electricity from outside sources is also possible. As a high quality electrical power supply is required for textile industries, the in-plant power generation was taken as the basis. (Denier irregularity will be caused due to the voltage fluctuation.) The unit price for electrical power shown in Table III-3 pertains to the proportional expenditure only. The production of caustic soda can be made at a much lower cost, if there is any suitable outlet for the utilization of the by-produced chlorine. As to the direction of use of such by-produced chlorine, the production of PVC monomer is the most desirable, however, for reference purposes, Table III-5 shows an enumeration of various industries in which chlorine can be utilized.

Regarding rayon, it is expected that a future price fluctuation will be considerable and therefore, the forecast of the prices for each year has been incorporated. However, concerning synthetic fibres, there is a comparatively small extent of price fluctuation factors involved in the future so that as far as the synthetic fibre forecast is concerned, the price factors have been taken on a fixed basis. Regarding the pulp materials, even specialists in this field opine that the forecast is extremely difficult so that even an estimate for the coming year is not practicable. This is due to the fact that the present prices of pulp materials are unreasonably low and also to the fact that the problems pertaining to pollution have become acutely evident so that many pulp producing enterprises are suffering from a deterioration of the payability of production operation. Such being the circumstance, except in the socialist countries, most pulp producing enterprises are tending to reduce their scales of production. (It is expected that the pulp prices will show an uptrend for some time to come reflecting the efforts to recover the payability of the so-far deteriorated operations and also due to the replacement of the production facilities and the implementation of pollution prevention devices.)

As mentioned above, the present situation of the textile raw material industry is unstable so that the entrepreneurs in this field are in a state of

Table III-3 Price of utilities, fibres, raw materials and sub raw materials thereof

Product	Raw material, Sub raw material, By-product	Price: Purchased from Foreign maker	Price: Purchased from Domestic maker	Price: Produced by own plant
Rayon SF	Pulp	104.6	90[1]	-
	Caustic soda	82	75	40 - 49[2]
	Sulphuric acid	-	11	-
	Carbon disulphide	-	-	72 - 95[3]
	Sodium sulphate (by-product)			4.2
Nylon FY	Caprolactam	225		
Polyester FY	Terephthalic acid	194	-	-
Polyester SF	Ethylene glycol	120	-	-
Caprolactam	Cyclohexane	50	-	-
	Ammonia	-	38	-
	Sulphuric acid	-	11	
	Ammonium sulphate (by-product)			
Terephthalic acid	p-Xylene	67	-	-
Fuel			7 Rp/Kg	
Electric power				2.8 Rp/KWH

1) Estimate figure

2) Price of caustic soda will be changed by the price of by-produced chlorine.

3) Price of carbon disulphide will be changed by the capacity of plant.

Table III-4 Price of fibres (C.I.F. Indonesia) (Rp/kg)

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Rayon SF	269	281	291	301	310	320	324	328	332
Nylon FY					659				
Polyester FY					769				
Polyester SF					408				

Table III-5 IMPORTANT CHLORINE DERIVED CHEMICALS, THEIR CLASSIFICATIONS AND RELATED INDUSTRIES

Classification	Name of chemicals	Main raw material	Usage	Consumer's industry	Required investment and plant scale	Notes
	Benzene Hexachloride (BHC)	Benzene	Agricultural Insecticide	Agriculture	Medium-small	Polution problem
	Diphenyldichlorotrichloroethane (DDT)	Chlorobenzene, Chloral	Insecticide	Public welfare	"	"
Agricultural chemical, Pesticides and other chemicals for public health	Pentachlorophenol (PCP)	Phenol	Lumber antiseptics	Lumber industry	"	"
	2,4 Dichlorophenoxyacetic Acid (2,4D)	Phenol, monochlor acetic acid	Weed killer	Agriculture	"	"
	Chloropycrin	Ca-pycrate	Fumigant for cereal storage	Crop and cereal dealers	"	"
	Aldrin	Dicylopentadience	Insecticide	Agriculture	"	Use and manufacture-patent are limiting the production
	p-Dichlorobenzene	Benzene	Worm killers	House use and public health	"	
	Perchlor-ethylene	Trichlor-ethylene	Loundry, metal cleaning	Loundry service		
	Trichlor-ethylene	Ethylene	" "	Metal and mechanical Industry		
Solvents and Heat transfer mediums and intermediates.	Chloroform	Ethylene	Refregerant	Refregirators industry	Plant scale and investment are medium.	
	Carbon tetrachloride	CS_2 or methane	"			
	Methylene chloride	Methyl-chloride	Refregerant			
	Chloral	Ethanol or Acetaldehyde	DDT's raw material	DDT Manufacturing		
	Chlorinated diphenyl	Diphenyl	Thermal transfer medium Dielectric fluid	Power transmission, etc.		In some case polution prob
Gasoline Blender	Tetraethyl lead	Ethyl chloride	Anti-knock agent	Petroleum refinery	Large scale	Polution problem.
	Ethylene dichloride	Ethylene	Vinylchloride monomer	Petrochemical Industries and Plastics.		Plastics and petrochemical industries of the world are in severe competition. Accordingly, the large plant scale and cheap raw materials are required in order to keep the production cost as low as possible.
	Vinylchloride	Ethylene, Acetylene	" Polymer			
	Ethylidene-chloride	Vinylchloride	Polyvinylidene chloride (Dow's "Saran")		Big scale and investment	
Monomer for plastics and their intermediates, Elastomers.	Chloroprene-monomer	Butadiene	Chloroprene Rubber	Elastomer and Rubber Industries.		
	Phosgene and TDI	Carbon-mono-oxide	Toluilene-di-isocyanate to urethane			
	Propylene chlorhydrin and PO	Propylene	Propylene Glycol to urethane			
	Allylchloride for epichlorhydrin	Propylene	Epoxy Resin	Paint, varnish, plastics.		
	Chlorobenzene	Benzene	Sulphur-dyes, phermaceuticals and organic chemicals (incl. DDT)	Fine chemical industries.	Each product is small scale, but combination of various production is profitable	Skillful organic chemists and laboratories must be arranged.
Intermediates for dye and phermaceuticals.	Chlorophenols	Phenols				
	Monochloro-acetic acid	Acetic acid	2,4D, Indigo, Phenyl glycine and others.	Textile finishing, dyeing Industries.		
	Hydrochloric acid	Hydrogen	Various industrial use	Steel, metal, food and MSG, etc.	Medium to small	Bleaching powder, hydrochloric acid and liquid chlorine plant are usually installed with electrolysis unit for the emergency absorber of chlorine
	Bleaching powder or solution	Calcium hydroxides, NaOCL	Desinfectants, Bleach for pulp	Textile and paper	"	
Miscellaneous Inorganic Chemicals for industrial use	Bromine	NaBr (Sea water origin)	Methylbromide, Tetraethyl lead	Agricult chemical, Anti knock industries.	Scale is large, but investment is rather small.	
	Ferric chloride	Iron				
	Chlorine-dioxide	——	Bleaching			
	Titanium tetrachloride	Titanium oxide or Titanium ore	Metal titanium	Metal smelter	Large scale	
Plastisizers and intermediates for detergents.	Chlorinated paraffine	Paraffine	Blender of plastisizers. / Synthetic detergent	Soap industries. / Plastic industries	Medium to small.	

uncertainty. This situation makes the price forecast for the raw materials extremely difficult. Therefore, an assumption is made here that concerning the synthetic fibres, the fluctuation in the raw material prices will directly reflect upon the fluctuation of the price of the synthetic fibres themselves. Concerning rayon, another assumption is made that the increase in the price of pulp materials will directly reflect upon the increment of the rayon prices themselves, the economic evaluation of this sector of industry has been made on these basis.

In this report, scrutinizations were made on the prices of own-produced caustic soda, etc. the sub-raw materials for rayon. Theoretically speaking, the results of surveys on the basic chemical industries should be incorporated as the basis of such scrutinizations, however, due to the lack of time, we undertook to preliminarily calculate the costs on an assumption basis. If there should be a large discrepancy between the calculation results and the forthcoming scrutinization results to be compiled by the O.T.C.A. Survey Team on the basic chemical industries, due modifications shall be made at a later stage.

2-3. Construction Schedule for the Rayon and Synthetic Fibre Production Plants and the Raw Material Production Plants

The investment amounts taken as the basis for the present scrutinizations are the so-called outline data which are normally incorporated into this type of study.

Therefore, no cost calculation concerning the construction costs on the basis of the actual on-site conditions has been undertaken. Thus, as in the case of the rayon industry where most of the production facilities in the industrialized countries, i.e. the rayon supplying countries, have already been depreciated and where the extent of the depreciation cost directly affects the competitiveness of each enterprise and further where such depreciation cost factors play an important role in forming such competitiveness, it would be necessary to effect detailed estimates of such factors when carrying out full scale feasibility studies in this field.

Tables III-6 and 7 show the schedules for the plant constructions and the minimum economic scales regarding each process of production.

Table III-6 Minimum economic size of plant

Process	Capacity	
P-TPA - Polyester FY	10,000	t/y
P-TPA - Polyester SF	20,000	〃
Caprolactam - Nylon FY	10,000	〃
Pulp - Rayon	20,000	〃
P-Xylene - P-TPA	30,000	〃
Benzene - Caprolactam	30,000	〃
Naphtha - P-Xylene, Benzene (Naphtha feed)	10,000	B/SD
Dissolving pulp	30,000	t/y

Table III-7 Capacity, Investment, Date of completion and Candidate site of the Plants

Plant	Capacity	Total Capital Investment (million Rp) Total fixed capital: Foreign currency	Total fixed capital: Local currency	Working capital	Date of Completion	Candidate Site	Date of commencing feasibility study
Polyester SF							
1st	15,000 - 20,000 t/y	6,700	1,800	800	1976/77	West Java	1973
2nd	15,000 t/y	5,700	1,500	700	1978/79	East Java (Surabaja)	1975
3rd	15,000 t/y	5,700	1,500	700	1980/81	Central Java	1977
Polyester FY							
1st	5,000 - 8,000 t/y	7,400	2,500	400	1976/77	West Java	1973
2nd	5,000 - 7,000 t/y	7,400	2,500	400	1978/79	East Java (Surabaja)	1975
3rd	5,000 - 7,000 t/y	7.400	2,500	400	1980/81	Central Java	1977
Nylon FY							
1st	10,000 t/y	8,800	3,000	700	1976/77	West Java	1973
2nd	7,000 - 9,000 t/y	7,200	2,500	600	1978/79	East Java (Surabaja)	1975
3rd	7,000 - 9,000 t/y	7,200	2,500	600	1980/81	Central Java	1977
Rayon SF	18,000 t/y	7,200 (1,800) 2)	3,400 (400) 2)	840	3)	Surabaja or Tjilatjap	1973 1)
Caprolactam	30,000 - 40,000 t/y	9,600	1,000	600	1980	Surabaja or Tjilatjap	1977
Pure Terephthalic acid	40,000 t/y	7,400	800	600	1978	West Java, Surabaja	1975

1) Date of commencing feasibility study concerning production of D.P. in Indonesia.

2) Investment in caustic soda and carbon disulphide plant.

3) The construction of rayon SF plant should be decided after making feasibility study concerning production of D.P. in Indonesia.

2-4. Present Status of Fibre Processing

At present in Indonesia, all the raw materials for the textile products are being imported. Studies concerning these imports revealed that one-third each of the total imports is comprised by three items, i.e. filaments and staples as one category, yarn, and woven fabrics. There is an evident shortage in the fibre processing facilities in Indonesia. In particular, the synthetic fibre ratio being still at a low level, it is expected that the needs for synthetic fibre processing facilities will see an acute increase in the near future. Table III-8 shows the survey results of the forecast upon the processing capacities which will be required in two to three years.

Table III-8 Textile Processing Capacity

		Capacity		Remarks
		Present	After 2-3 years	
Spinning	Total	67,000 t/Y ($510x10^3$ spindles)	100,000 t/y ($800x10^3$ spindles)	Expansion and increase in productivity are required
	Synthetic fibre blending	5,000 t/y	30,000 t/y	
Texturi-zing	Synthetic fibre	2,000 t/y	8,000 t/y (80-90 sets)	
Weaving Knitting	Total	177,000 t/y1)	250,000 t/y1)	Excluding hand loom, the capa-city will be 200,000 t/y
Industri-al Use, Interior Use		Few	Expected to increase in Capac-ity	

1) Source : Departemen Perindustrian

Regarding the synthetic fibres, the present capacity for processing filaments and spinning is extremely short so that a substantial enhancement in the capacity in this aspect is desirable.

2-5. Customs Import Duties

When undertaking industrial scale production of synthetic and rayon fibre products, it would not be possible during the initial stage of operation to compete price-wise with others on the international market. Therefore, in order for the Government of Indonesia to positively foster such an industry, it would be neces-sary to provide a protection by establishing the so-called import duty barrier. In accordance with our scrutinizations, the tariff rates in such a case would be as follows.

It would be necessary to levy a tariff of more than 10% in order to bring the DCF rate of the initial domestic production of the polyester SF up to the 15% level (in the case of a plant with a capacity of 18,000 T/Y). Also, in the case of nylon FY which is scheduled for industrial scale operation after polyester SF, the tariff rate required would be more than 15% in order to bring the DCF rate to 15%, (in the case of a plant with a capacity of 9,000 T/Y). The effect of the extent of the facility scale upon the production costs would be considerably high in the case of a plant with a capacity of below 18,000 T/Y, so that, if a smaller scale plant is to be implemented in compliance with a future demand evolution forecast, the required import duty rate would become even higher. In the case of Indonesia it is expected that the actual plant operation will be commenced after the thorough training of plant operations has been completed by technicians invited from industrialized nations and after the technical level of such operators has been sufficiently improved. However, the production of fibrous products is a type of operation for which no substantial experience has been achieved in Indonesia.

Due to this fact, there is a possibility that the quality of the products turned out during the initial period of operation will not be high enough to compete internationally. From this point of view, an assumption must be made that price competition with other internationally accepted products is not practicable for the initial period. Therefore, the actually levied import duty would have to be slightly higher than the theoretically derived level. (For example, in Fig. III-7, approximately 20% duty would be levied theoretically for a DCF rate of 15% at approximately 4,000 T/Y, however, taking the above factor into consideration, the actual tariff rate would have to be in the vicinity of 25% to 30%.)

Fig. III-7 shows the relationship among the production scale, import duty tariff rates, and the DCF rates taking the polyester SF as an example.

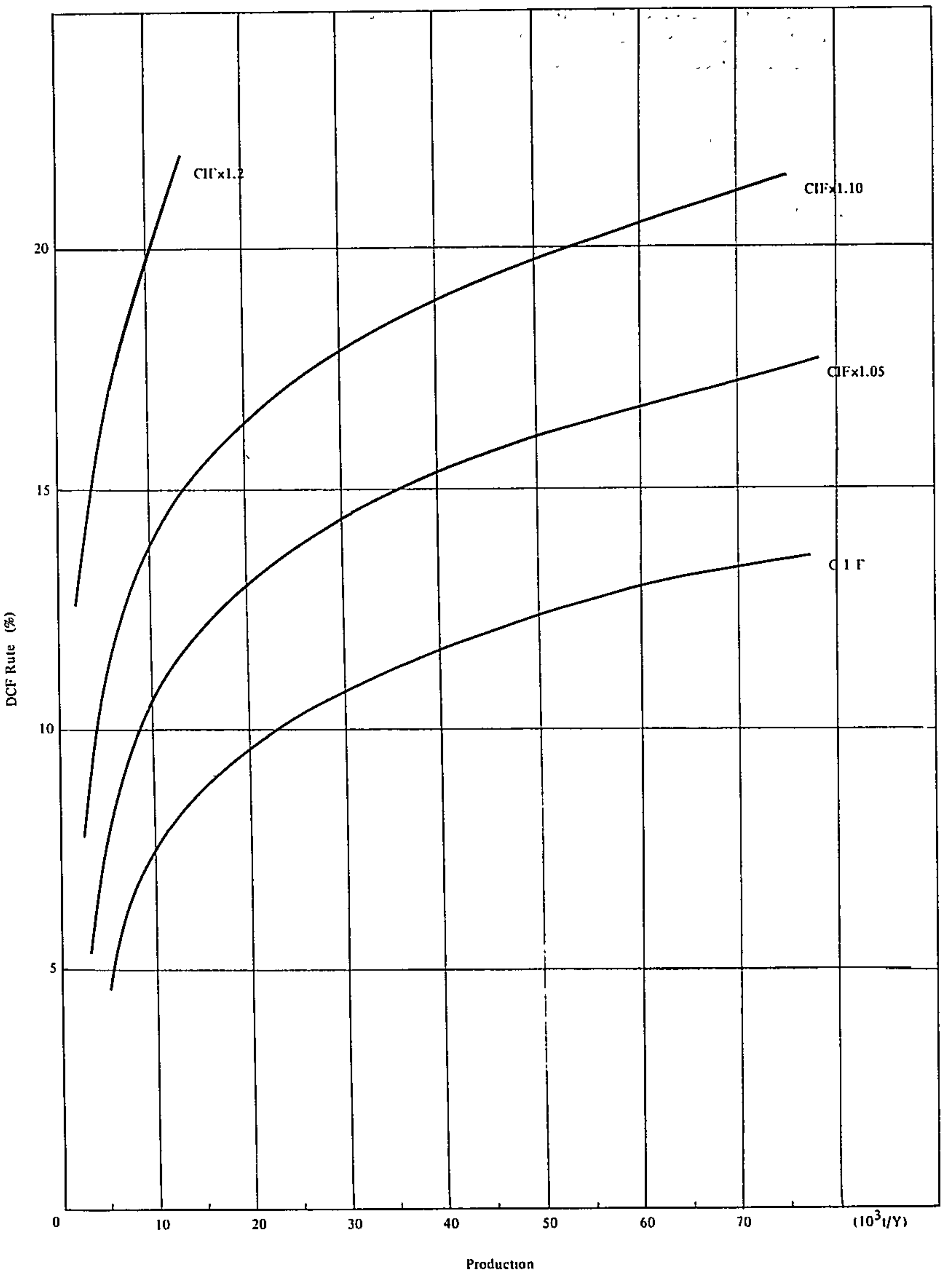
If an excessively high level of import duty is levied for the purpose of protecting the domestic industry, an adverse effect may arise by taking away from the entrepreneurs the incentives toward cost reductions. Therefore, it goes without saying that the above-mentioned protective tariff barrier should be decreased gradually along with the decrease in the production costs realized as the production scale is gradually enhanced. As long as the production of rayon SF is to be carried out on the basis of imported pulp materials, an import duty tariff barrier of as much as 50% would be necessary and therefore, studies concerning the domestic production of rayon SF should be undertaken after detailed scrutinizations regarding the domestic production feasibilities of pulp materials and the various required production facilities are duly completed.

2-6. Contribution to the Indonesian National Economy.

The following categories of industries are incorporated as the major sectors in the First 5-year Plan for the development of the Indonesian national economy.

1) Industries for the manufacture of agricultural machinery and for agricultural products processing machinery in order to support and supplement the development of agriculture.

Figure III-7 Capacity and Profitability of Polyester SF



2) Industries where the promotion of which will enable the saving of foreign exchange reserves by producing commodities to substitute presently imported items.

3) Industries in which large quantities of domestic resources can be processed.

4) Labour intensive industries.

5) Industries where the promotion of which will enhance local development incentives by means of the accumulative effects thereof.

The textile industries as being one of the industries within the scope of the above categories, have been gradually substantiated on the basis of strong supports by the Government of Indonesia. As to the rayon and synthetic fibre production projects for which the present scrutinizations were carried out, the following studies were made in order to assess as to what extent the promotion of such industry would contribute to the advancement of the national economy of Indonesia. Such studies as mentioned hereunder were carried out along with the policy laid out by the Indonesian Government as mentioned above.

The main aims of the above governmental policies may be restated as follows.

1) Improvement of trade balance by means of substituting imports.

2) Utilization of national resources.

3) Expansion of employment opportunities.

4) Correction of local economic discrepancies by means of district developments.

On the basis of these points, the extent of the contribution of the development of the textile industry will be studied in the following paragraphs.

Promotion in one particular industry will cause the advancement of relative industries as well, thereby exerting various effects upon many types of industries. Therefore, the effects of the promotion of any particular industry, must also be studied, in view of the contribution to the national economy. The textile industry also has various related industries and the interrelationship in this respect must be fully taken into consideration. In order to carry out such scrutinizations, it seems advantageous to utilize the so-called industry inter-relationship models. As to the macro models for the Indonesian national economy, there are several models available for this purpose, e.g. the Models No. 1 and 2 of the ECAFE, the model formulated by the Asian Economy Research Institute of the Japanese Government, Models No. 1 and 2 of the International Christian University, the model of the International Development Centre which is being formulated in cooperation with the Government of Indonesia, the model made by the Kyoto University, Indonesia Research Institute, etc. However, there are certain difficulties in directly applying any one of these models in practical scrutinizations undertaken for the present purpose to make any meaningful forecast concerning the consequential effects of the rayon and synthetic fibre industries to the Indonesian economy as a hole. Consequently, either quantitative or qualitative scrutinizations were conducted for the effects of the rayon and synthetic fibre industry alone on the national economy. For reference, the payability stipulations are attached to this report concerning the enterprises in this sector of industry from the global Indonesian point of view, rather than the payability of the synthetic and rayon fibre industry perse. The stipulations made in this respect seem to be of the most important criteria for the selection of the priority of various industrialization projects from the national point of view.

1) Expansion of employment opportunities and import substitution. Table III-9 shows the effects of the industry in these aspects. The figures shown in this table represent the effects in the case of the actual implementation of the first stage plans concerning each sector of the industry.

Table III-9 Effects on National Economy

			Synthetic fibres industry					Rayon Industry
			Synthetic fibres			Raw materials		
			Polyester SF	Polyester FY	Nylon FY	Terephthalic Acid	Caprolactam	Rayon SF
Capacity		t/y	18,000	8,000	9,000	40,000	30,000	18,000
Expansion of employment opportunities	Operators	(men)		630		76	70	272
	Others	(men)[1]		315		38	35	136
	Total	(men)		945		114	105	408
Saving of foreign currency exchange	CIF price of fibre	(Rp/kg)	408	769	659	172	199	346
	Price of raw materials	(Rp/kg)	235	246	284	67	58	12[2]
	Interest on total fixed capital	(Rp/kg)	30	65	54	10	16	11
	Balance	(Rp/kg)	143	458	321	95	125	323
		(10^8 Rp/kg)	24	37	29	38	38	58[3]

1) 50% of operating labor
2) This is the case of producing D.P. in Indonesia
3) If pulp and caustic soda are imported the balance will be 21 x 10^8 Rp/Y'Y

2) Utilization of the national resources

The basic raw materials, i.e. benzene and p-xylene, for the production of synthetic fibres are derived from oil as their raw material. Therefore, the synthetic fibre industry seems to be one of the most important industries to be fostered in Indonesia where the potential for utilizing domestically available resources, i.e. the Indonesian oil, is great. However, during the initial stage of industrialization, the scope of the fibre production would still be on a small scale and thus it would not be practicable to establish facilities covering the whole range from the processing of oil up to the production of the synthetic fibre materials. Therefore, while it is not practicable to receive directly the benefits from the advantage of domestically available resources, the effects of oil utilization will eventually be materialized along with the expansion of the synthetic fibre industry.

Regarding rayon, the needle-leaved trees presently available within Indonesia can be utilized and therefore, the rayon industry is one of the most highly desirable enterprises to be fostered together with the pulp material production industries, in view of the effective utilization of domestically available resources. The situation would be further improved if the level of technique is advanced to such an extent that the abundantly available Indonesian tropical woods can be industrially utilized.

3) Correction of local economic discrepancies by means of district development

The textile material production industries is the so-called market-oriented industry. Therefore, the production sites must be selected in or around the centres of fibre processing industries. This being the case, the textile industry cannot be regarded as a readily contributing industry for the correction of the local discrepancy in the economic status. However, along with the expansion of the textile processing industry as one of the ways of development the local economy, it is evident that the textile industry itself will eventually contribute to the desired correction.

4) Export Possibilities

In addition to the contributions mentioned above, such possibilities as under-mentioned are existent in the case of Indonesia.

The contribution to the national economy realized in view of the under-mentioned aspect is by no means insignificant. The quality of the processed textile products of Indonesia has already attained, in the case of certain manufacturers, the level at which the products can effectively compete with others on the international market. Further, the advancement in processing techniques, together with the inherent skills and dexterity of the Indonesian people, there is a high possibility of future improvements.

Also, it should not be disregarded that the advantageous recruitment of abundant labour forces is possible in Indonesia more so than in the case of other already industrialized nations. These factors that although the rayon and synthetic fibre products to be turned out in Indonesia during the initial stage of production may not be internationally competitive in the form of staple or filament, the quality-wise and price-wise competitiveness can be given to the processed textile materials. During the initial period when the self-sufficiency rate of textile materials is not high, the major role to be played by such products would be the substitution of the presently imported items. However, in view of the fact that Indonesia is one of the oil producing countries, it is by no means unreasonable to expect the above-mentioned effects particularly in the case of the synthetic fibre industry.

5) Profitability of the Project in View of National Economy

Table III-10 shows the profitability of the project in view of the national economy regarding each project placed under the present studies covered in this report. The pre-requisite conditions in arriving at the results shown in this table are as follows.

Table III-10 DCF rate calculated from National Economic Point of View

	DCF rate (%)
Polyester SF	14
Polyester FY	23
Nylon FY	14
Rayon SF	15

(1) All the direct labour forces and one-half of the indirect labour forces consist of individuals who obtained employment opportunities by means of the achievement of textile industrialization.

(2) From the viewpoint of the national economy, the import duties and other taxes are not counted as cost items for the production.

The figures in Table III-10 concerning rayon have been obtained on the assumption that the domestic production of pulp materials is deemed to be practicable so that a 50 T/D plant would have been constructed by 1978. Further, from Table III-10, it is implied that the polyester FY has the greatest advantage, however, in view of the demand forecast, the industrial scale production of the polyester SF would be the first operation to be undertaken.

IV. Demand Forecast

1. Introduction

The following problems presented themselves during the course of the present survey of the demand forecast.

(1) Insufficient statistical data

No adequate data were available to the survey team in Indonesia concerning the present situation on, for example, the total textile consumption amount, the consumption amount in accordance with the fibre types of the textile products, etc. Although all the textile fibre types are being imported into Indonesia, the import statistics are far from being substantial.

(2) The extremely low level of the present textile consumption

The present textile consumption in Indonesia is approximately 1.0 kg/year/person which is extremely low. In comparison, in Thailand it is approximately 3 kg/year/person approximately 15 kg/year/person in the case of Japan. Also, the synthetic fibre ratio is considerably low. Therefore, it is expected that in the near future, an acute increment in the textile consumption and the advancement of the synthetic fibre ratio are expected and, along with such substantial changes in consumption, the Indonesian textile consumption pattern will inevitably change.

Therefore, as the first step in the demand forecast formulation work, it was decided that the grasping of the present situation be made by means of thoroughly investigating the presently available textile related statistical data in Indonesia. As the method of such investigations, separate classifications were made regarding the data obtained from past surveys conducted in Indonesia and data collected and compiled in countries other than Indonesia. For instance, the export amounts to Indonesia from Japan, the U.S.A. and Singapore were checked. The comparison of these two categories of data were conducted in order to assess the present situation of the textile industries in Indonesia. The present textile industry situation was forecasted on the basis of the above-mentioned method and the total textile consumption amount in Indonesia was derived while taking into consideration the present circumstances prevailing in other nations, especially the South East Asian countries as well as the forecast upon the future growth of the Indonesian GNP. Further, the changing trend in the synthetic fibre rate in various other countries was assessed in order to scrutinize the trend forecast of the rate in Indonesia in the future. The relationship data obtained in the other countries between the GNP trend and the advancement trend of the synthetic fibre rate were utilized for the forecast formulation of the demand forecast in Indonesia, so that the total fibre consumption in Indonesia in the year 1980 was forecasted.

Then, the future textile demand quantity in Indonesia was estimated in accordance with the materials employed by referring to the textile industry environment in South East Asian nations. The extent of demand obtained in accordance with the above-mentioned method of forecast was the consumption amount of all the textile products in Indonesia so that it must be noted that this amount is not equivalent to the amount replaceable by domestic production. The factors which must be taken into consideration are the present situations of the fibre processing facilities, the scope of production facility expansion and new installation, and the demand quantity of staples and filaments. The filaments and staples are the subjects of the future domestic production in Indonesia.

2. Surveys Conducted concerning the Textile Consumption Amount, and the Rates of Consumed Textile Items in accordance with the Types of Fibre

2-1. Indonesian Data

2-1-1. Textile Bureau, Departemen Perindustrian of Indonesian Government:

Table IV-1 shows the data covering the period from 1960 to 1971 regarding the production of yarns and fabrics, the imported textile products and the total textile consumption, etc. publicized by the Textile Bureau of the Departemen Perindustrian. The data shown in this table imply the following.

(1) During the period from 1965 to 1970, the total consumption amount or the supply amount (concerning the period from 1969 to 1971, the figures stipulated cannot be distinguished as being the supply amount or the imported amount) were 100,000 to 120,000 tons and the variation during the period is extremely slight.

(2) However, in 1971, the figure attains 150,000 tons, thereby attaining a growth rate of 26% as against the year 1970. The reason for this high rate of growth during 1971 seems to be attributable to the fact that the importation amount of fabrics and yarns increased quite considerably compared with period from 1969 to 1970. The production increment in spun yarn in Indonesia during the year was 9.4%, thereby showing a low extent of contribution to such an overall increment.

(3) The criterion for the fabrics was taken at 140 to 145 g/m so that no change is noted during the period from 1960 to 1971. From the above data, it is felt that there was an increase in the textile consumption from the year 1971 onward, however, as the indicated increment is excessively acute, it seems impracticable to employ these data as the basis for demand forecast studies. Table IV-2 shows the import-

Table IV-1 Production, Importation and Consumption of Textiles in Indonesia

	1960	61	62	63	64	65	66	67	68	69	70	71
Domestic Spun Yarn Production (ton)	8,231	7,749	8,661	10,248	7,410	13,466	7,986	16,158	22,519	33,077	39,500	43,221
Yarn Import (ton)	56,256	54,134	28,457	22,194	26,262	43,690	22,412	9,110	(20,476)	41,237	44,600	55,950
Yarn Supply Total (ton)	64,487	61,883	37,118	32,442	33,672	57,156	30,398	25,268	42,995	74,314	84,100	99,171
Stock (ton)	P.M.	26,457	36,701	30,916	25,887	26,728	20,278	15,671	10,243	-	-	-
Consumption (ton)	40,924	54,420	44,570	38,928	34,344	66,175	36,371	31,832	45,940	-	-	-
Domestic Fabric Production (10^6 m)	282	374	307.1	268.3	236.6	456	250	225	316.5	449.8	598.3	731
Average (g/m)	145	146	145	145	145	145	145	141	145	165	140	136
Fabric Import (10^6m)	340	567	393.6	218.6	240	326.4	497.3	543.7	523.8	283.2	258.7	363.8
Fabric Supply Total (10^6m)	622	941.5	700.7	486.9	476.6	782.4	747.3	768.7	(840.3)	733	8,517	1,094.8
Fabric Consumption Total **	87,080	131,810	98,140	68,180	66,780	109,480	104,580	107,660	117,600	102,620	120,000	153,270
Fabric Supply Total **	88,524	133,800	99,730	69,588	67,944	111,815	105,951	107,992	119,300	103,661	-	-
*m/man	6.5	9.6	7.0	4.7	4.6	7.3	6.8	6.8	7.3	6.2(7.6)	7.0(8.2)	8.8(8.8)

Source : Departemen Perindustrian "Datas about the textile industry in Indonesia 1970" and others.

* () Target

** Fabric Consumption Total

A : Computed from fabric consumption total by using conversion factor 140 g/m

B : "Yarn Consumption Total" + Fabric Import (Conversion factor 140g/m)

Table IV-2 Importation and Consumption of Raw Cotton in Indonesia

(ton)

Year	Stock of 1 st Jan.	Import	Total	Consumption
1960	8,539	12,175	20,714	9,413
61	11,301	11,077	22,378	8,909
62	13,469	10,578	24,047	9,957
63	14,089	7,043	22,133	11,782
64	9,351	4,392	13,743	8,520
65	5,223	12,933	18,156	15,482
66	2,675	7,979	10,654	9,182
67	1,472	35,927	37,399	18,756
68	18,643	15,117	33,760	25,941
69	7,818	36,432	44,250	32,218
70	(12,032)	-	-	-

Source : Departemen Perindustrian

ation amount and the consumption amount of cotton and raw cotton taken from the publications made by the Textile Bureau. From the data shown in Table IV-1, the rates of domestically produced spun yarn, imported yarn and imported fabrics into the Indonesian textile consumption were re-arranged as shown in Fig. IV-1 and 2 and Table IV-3. The trend from 1960 onward implies that the production rate of the domestically produced spun yarn assumed in the textile consumption in Indonesia has rapidly increased and, along with this increment, the rate of the imported fabrics has shown a commensurate decrease. As a result, although up to 1965 approximately one-half of the total textile consumed was imported, during the period 1969-1971, one-third each of the total consumption has been taken up by three major items, i.e., the domestically produced spun yarn, the imported spun yarn and the imported fabrics.

2-1-2. Indonesian Textile Import Statistics

Table IV-4 shows the re-arranged import statistics of the textiles (filaments, staples and woven fabrics) made public by the Statistics Bureau of the Indonesian Government. The re-arrangements have been made on the basis of the fibre types and the forms, i.e., whether in the form of fibre or fabric. The importation amount has been approximately 100,000 T/Y from 1965 onward. The man-made fibre ratio in the total is approximately 25%, however, a considerable extent of mixed-woven natural fibres are also included in this percentage so that the actual rate of man-made fibres should be less than the 25% rate.

Table IV-3 Textile Production and Importation in Indonesia and Rates against the Total Consumption

(ton)

Year	1960	61	62	63	64	65	66	67	68	69	70	71
Domestic Spun Yarn Production	5,223 (6.0)	6,814 (5.1)	10,400 (10.4)	12,297 (17.7)	7,558 (11.1)	15,591 (13.9)	9,555 (9.0)	20,356 (18.9)	24,062 (20.2)	33,077 (29.0)	39,500 (32.8)	43,221 (28.8)
Imported Spun Yarn	35,700 (40.3)	47,605 (35.6)	34,171 (34.3)	26,631 (38.3)	26,787 (39.4)	50,584 (45.2)	26,816 (25.3)	11,476 (10.6)	21,879 (18.3)	41,237 (36.2)	44,600 (37.1)	55,950 (37.3)
Imported Fabric	47,600 (53.8)	79,380 (59.3)	55,104 (55.3)	30,604 (44.0)	33,600 (49.5)	45,696 (40.9)	69,622 (65.7)	76,118 (70.5)	73,332 (61.5)	39,648 (34.7)	36,218 (30.1)	50,932 (33.9)
Total Fibre Consumption	88,523	133,800	99,675	69,531	67,945	111,871	105,993	107,[illegible]	119,272	113,962	120,318	150,103

( ) ... Percentage on Total Fibre Consumption

* Estimated by using conversion figure 140 g/m²

Source : Departemen Perindustrian

Table IV-4 Textile Importation into Indonesia (1963 to 1970 January-June)

(ton)

Type.Form	Year	1963	1964	1965	1966	1967	1968	1969	1970*
Cotton	Raw Cotton	7,070	4,414	12,973	8,013	16,731	13,455	21,131	8,396
	Spun Yarn	23,257	26,808	43,739	20,511	11,724	22,095	31,363	19,785
	Fabric	26,417	22,588	25,676	41,035	52,252	27,988	23,775	8,807
	Sub-Total	56,744 (89.9)	53,810 (81.7)	82,388 (78.7)	69,559 (69.2)	80,707 (73 1)	63,538 (76)	76,269 (75.8)	36,988 (73.6)
Man-Made	Staple	243	856	2,052	,836	2,290	3,929	3,822	859
	Spun Yarn	67	733	655	798	1,514	2,133	1,489	1,619
	Fabric	4,549	8,118	12,130	23,988	23,237	11,336	9,233	5,186
	Sub-Total	4,859 (7.7)	9,707 (14.7)	14,837 (14.2)	26,622 (26.5)	27,041 (24.5)	17,398 (20.8)	14,544 (14.5)	7,664 (15.3)
Natural (excl. Cotton)	Raw Fibre	140	278	622	2,404	644	268	149	181
	Spun Yarn	5	12	85	5	6	12	19	7
	Fabric	733	1,318	5,779	268	571	898	219	139
	Sub-Total	878 (1.4)	1,608 (2.4)	6,486 (6.2)	2,677 (2.7)	1,221 (1.1)	1,178 (1.4)	387 (0.4)	327 (0 7)
Others (Man-Made)	Staple	43	53	83	69	24	794	8,244	4,490
	Spun Yarn	607	693	830	1,545	1,458	739	1,203	756
	Fabric								
	Sub-Total	650 (1)	746 (1.1)	913 (0.9)	1,614 (1.6)	1,482 (1.3)	1,533 (1.8)	9,447 (9.4)	5,246 (10.4)
	Total	63,131	65,871	104,624	100,472	110,451	83,647	100,647	50,225

Source . Indonesia Imports Statistics

( ) ... %

*From January to June

Fig. IV-1 Importation of Textiles into Indonesia according to Fibre Form

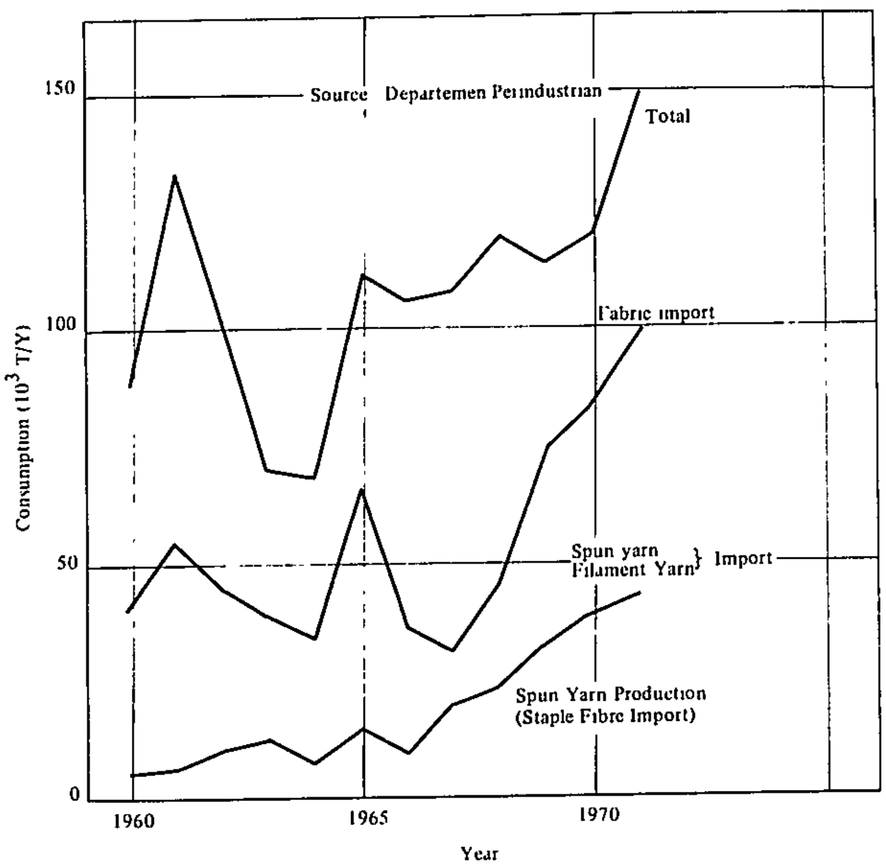
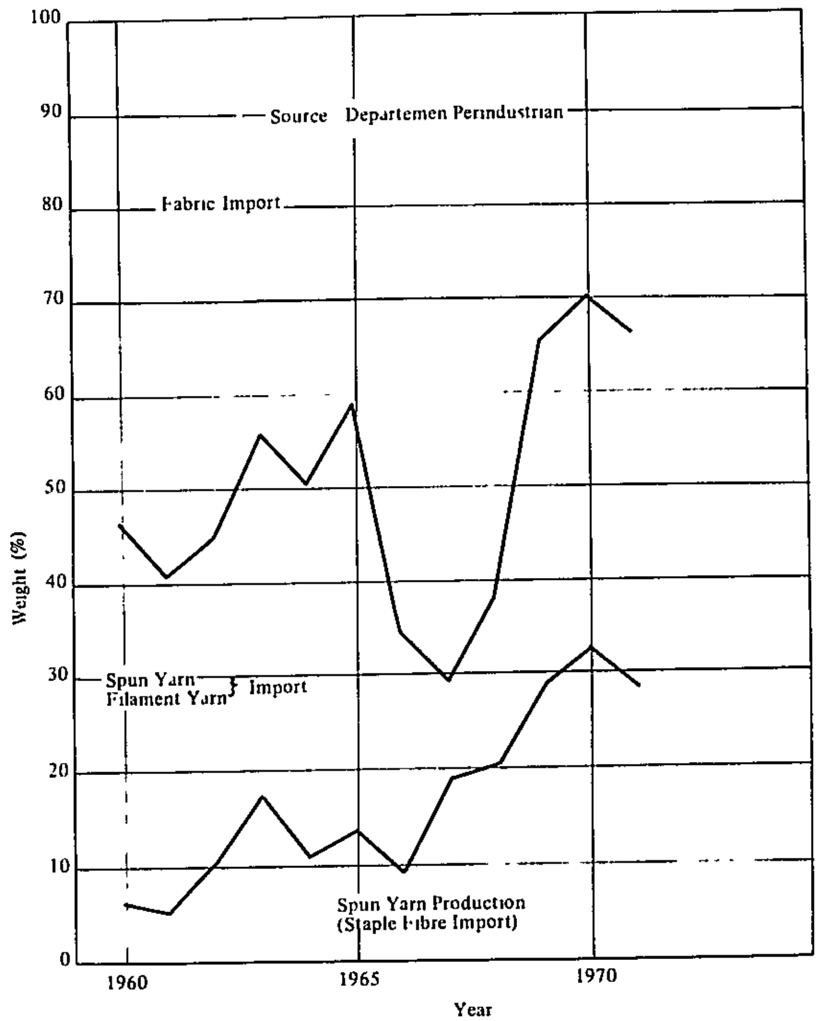


Fig. IV-2 Rates of Fibre Importation into Indonesia according to Fibre Form



Concerning the man-made fibres, no detailed description of the fibre types thereof was given. Therefore, it was impossible to learn the fibre-type-wise ratio of the man-made fibres. The conversion from the area-wise amount of fabric into weight was based on the same method as in the case of Singapore and an assumption was made separately concerning this point on the basis of the Japanese export statistics.

2-1-3. The Bank Indonesia (Data Processing Department of The Bank Indonesia)

In accordance with the statistical data, the importation amount (i.e., the total supply amount) of the textile materials and the textile products in 1970 was as shown in Table IV-5. In accordance with these data, the textile supply amount in 1970 was approximately 86,000 tons. If this figure is taken as the supply amount, the per capita textile consumption amount per year would be 5.0m assuming that the population was 121 million and the average conversion criterion for the fabrics is taken as 140 g/m. This figures is considerably less than the figure of 7.0m announced by the Textile Bureau.

Table IV-5 Importation into Indonesia, Textile Materials and Textile Products (Supply Amount)

Type. Form		Import (ton)
Cotton	Raw Cotton	40,401
	Spun Yarn	13,429
	Textile	12,833
	Sub-Total	66,663 (78%)
Others	Yarn	11,555
	Textile	7,537
	Sub-Total	19,092 (22%)
Total		85,755

Source : Bank Indonesia, Data Processing Department

2-1-4. The Fibre Type Ratio of the Man-made Fibres (Interdepartmental Commission)

The Inter-departmental Commission Concerning Man-made Fibres extracted various types of fabrics in the markets of Djakarta and Bandung area in order to investigate the fibre type ratio. In accordance with their findings, the ratio of the man-made fibres was as shown in Table IV-6.

Table IV-6 Utilization Rates of Man-made Fibre as Fibre Types (Survey Results obtained from Djakarta and Bandung Markets)

Type	%
Polyester	44
Rayon	25
Nylon	16
Acrylic	10
Acetate	5

Source : Interdepartmental commission concerning man-made fibers

These data imply that the rate between the synthetic fibre and rayon fibre is 7:3. Polyester comprises the largest portion of the synthetic fibre group, the nylon being approximately one-half of the polyester and acrylic fibres being approximately one-half of the nylon.

2-1-5. Forecast for 1975 Compiled by the UNIDO Textile Industry Advisor:

Table IV-7 shows the forecast upon 1975 concerning the production amount and the fibre-type-wise forecast compiled by Mr. H.J. Blydenstein, the UNIDO Textile Industry Advisor. He forecasts that the man-made fibre ratio taken by 1975 in the total textile consumption in Indonesia will be 40%.

Table IV-7 Forecast on Domestic Yarn Production in 1975

	Production (ton)	(%)
Cotton	93,070	60.6
Art. (Cellulosic)	22,930	14.9
Synthetic	37,680	24.5
Total	153,680	100

Source : H.J. BLYDENSTEIN (UNIDO Textile Industry adviser.) "INDUSTRIAL AND AGRICULTURAL ASPECTS OF COTTON GROWING IN INDONESIA".

2-2. Statistics by the FAO

In accordance with the textile statistics compiled by the FAO, the textile consumption amount in Indonesia for the period 1968 to 1970 was as shown in Table IV-8. According to these statistics, the textile consumption amount showed a slight decrease during the period 1967 to 1970. (Practically, this phenomenon should never take place and seems highly unrealistic.) The ratio taken up by the synthetic fibre was approximately 10% and that by rayon fibre was approximately 6%, thereby no increase in the synthetic fibre rate was noted.

Table IV-8 Textile Consumption in Indonesia

(10^3 Ton)

	1967	1968	1969	1970
Natural	99.4 (81.2)	99.3 (84.7)	98.6 (86.0)	84.1 (83.2)
Rayon & Art.	8.0 (6.5)	6.7 (5.7)	5.8 (5.1)	5.4 (5.3)
Synthetic	15.0 (12.3)	11.2 (9.6)	10.2 (8.9)	11.6 (11.5)
Total	122.4	117.2	114.6	101.1

( ) ... %

Source : FAO

2-3. Survey of Export Statistics of Various Countries.

Indonesia imports all the textile raw materials. Therefore, surveys were made on the exported statistics of the U.S.A., Japan and Singapore in order to assess the consumption amount of textile materials in Indonesia. While it is true that importation has been and is being made from countries other than the above, it was assumed that such imports are comparatively small and insignificant. Therefore, the data regarding the other countries were deleted. The reason for selecting the three countries are as follows.

(1) The U.S.A. has been exporting to Indonesia a large quantity of cotton under the PL-480.

(2) Japan has been exporting to Indonesia a considerable amount of man-made fibres.

(3) Singapore, with its geographical proximity to Indonesia, seems to have been exporting a considerable amount of textile materials to Indonesia.

The export statistics of Singapore do not stipulate the export amount of textile materials to Indonesia. Further, as will be discussed later, only approximately 30% of imports to Singapore has been exported from Singapore in accordance with the Singapore data.

2-3-1. Export Statistics of Japan

Table IV-9 and 10 show the Japanese export amount to Indonesia and Singapore arranged in accordance with the fibre types employed. These data have been compiled on the basis of the figures given in the "Japan Exports & Imports"

Table IV-9 Textile Export from Japan to Indonesia in accordance with Fibre Types Employed

	ton					(%)				
	1967	1968	1969	1970	1971	1967	1968	1969	1970	1971
Nylon FY	1,252	440	3,634	2,032	3,731	7.3	4.2	35.5	18.3	22.5
Polyester FY	687	224	390	724	1,116	4.0	2.2	3.8	6.5	6.7
Polyester SF	3,071	1,375	586	2,867	4,725	17.9	13.3	5.7	25.8	28.5
Acrylic SF	41	126	157	300	1,175	0.2	1.2	1.5	2.7	7.1
Rayon FY	470	211	225	313	684	2.7	2.1	2.2	2.8	4.1
Rayon SF	2,307	2,053	1,892	1,635	1,966	13.5	19.8	18.5	14.7	11.8
Others (Man-Made)	920	373	414	344	857	5.4	3.6	4.1	3.1	5.2
Industrial, Tyre Cord	484	166	167	315	443	2.8	1.6	1.6	2.8	2.7
Man-Made Total	9,232	4,968	7,465	8,530	14,697	53.8	48.0	72.9	76.7	88.6
Cotton	7,669	5,307	2,720	2,370	1,813	44.7	51.2	26.6	21.3	10.9
Other Natural	247	86	49	222	84	1.5	0.8	0.5	2.0	0.5
Natural Total	7,916	5,393	2,769	2,592	1,897	46.2	52.0	27.1	23.3	11.4
Total	17,148	10,361	10,234	11,122	16,594	100.0	100.0	100.0	100.0	100.0

Source : Japan Exports & Imports

Table IV-10 Textile Export from Japan to Singapore, in accordance with Fibre Types Employed

	ton					%				
	1967	1968	1969	1970	1971	1967	1968	1969	1970	1971
Nylon FY	1,603	2,384	3,131	4,102	5,569	11.7	12.8	11.9	13.9	15.1
Polyester FY	408	801	1,655	2,664	5,990	3.0	4.3	6.3	9.0	16.3
Polyester SF	2,493	5,176	8,576	9,243	10,175	18.2	27.7	32.6	31.2	27.6
Acrylic SF	438	498	806	632	599	3.2	2.7	3.1	2.1	1.6
Rayon FY	339	390	323	384	1,054	2.5	2.1	1.2	1.3	2.9
Rayon SF	2,432	3,178	4,331	4,542	4,764	17.7	17.0	16.5	15.3	12.9
Others (Man-Made)	1,014	1,088	1,444	1,447	2,797	7.4	5.8	5.5	4.9	7.6
Industrial, Tyre Cord	371	404	550	585	672	2.7	2.2	2.1	2.0	1.8
Man-Made Total	9,098	13,919	20,816	23,599	31,620	66.4	74.6	79.2	79.7	85.8
Cotton	4,235	4,156	4,452	5,082	4,053	30.9	22.2	17.0	17.2	11.0
Other Natural	369	604	1,005	928	1,166	2.7	3.2	3.8	3.1	3.2
Natural Total	4,604	4,760	5,457	6,010	5,219	33.6	25.4	20.8	20.3	14.2
Total	13,702	18,679	26,273	29,609	36,839	100.0	100.0	100.0	100.0	100.0

Source : Japan Exports & Imports

(expressed in terms of weight) as the basis and further classification in accordance with the fibre types were made by taking into consideration the estimated blending ratio of man-made fibres and natural fibres. The textile export amount destined for Indonesia from Japan was in the vicinity of 10,000 T/Y to 17,000 T/Y in 1970 and 1971, approximately 80 to 90% of which being taken up by man-made fibres. Textile exports from Japan to Singapore have been showing considerable annual increases and in 1970 and 1971 the amount attained 30,000 T/Y to 37,000 T/Y including approximately 80 to 86% of the man-made fibres in the total.

2-3-2. Import Statistics of Singapore

In accordance with an arrangement made between Singapore and Indonesia, the export and import statistics of Singapore do not describe the export amount to Indonesia. However, it is believed that a considerable amount of exports has been realized from Singapore to Indonesia. The problem which took place at the time of studying the Singaporean export and import statistics was the fact that although the yarns are stipulated in terms of weight, the woven fabrics are expressed in terms of square yards only. Therefore, in order to convert the stipulations in terms of weight only, the Japanese export statistics were utilized due to the fact that in these statistics both the weight and square yardage are made regarding woven fabrics. Table IV-11 shows the amount of fabrics exported from Japan to Singapore as well as the average conversion criterion figure in terms of g/m^2. By using this criterion figure, the Singaporean import and export statistics were rearranged in terms of weight as shown in Table IV-12. Further, Table IV-13 shows the amount of ready-to-be-exported fibres as against the importation by subtracting Singaporean exports from the imports, as the domestic consumption is small. Most of the man-made fibres being imported by Singapore are shipped from Japan, so that as far as the man-made fibres are concerned, we see no fundamental problem in employing this method of conversion. Concerning the cotton fabrics, due to the fact that the ratio of imports from Japan is quite low, there would be some problems if the same conversion method was to be employed, however, the actually calculated average conversion criterion figures were 120 to 150 g/m^2, thereby implying a considerably low degree of error even if the conversion method is adopted. As is evident from Tables IV-12 and IV-13, Singapore imported 109,000 tons of textiles in 1971, however, the exports of textiles from Singapore in the same year were only 36,000 tons, thereby seeming to imply that 67% of the total imports was allocated for domestic consumption in Singapore. Obviously, this amount is too high for the domestic consumption and therefore, it is assumed that a significant portion of such textile materials were allocated for export to Indonesia. (Ref. Fig. IV-3 and IV-4.) Table IV-14 shows the total imports of textiles from Japan and the rate of import from Japan as against the total importation of textiles into Singapore. In 1971, the import rates from Japan were 83%(30,000 tons) for synthetic fibres, and 58%(5,000 tons) for rayon fibres, thus showing considerably high rates. (Ref. Fig. IV-5 and IV-6.) Therefore, the ratio in accordance with the raw materials employed or the forms assumed regarding the man-made fibres in the Singaporean market, particularly synthetic fibres, would be clarified if Japan - Singapore export statistics were scrutinized. Such scrutinizations were utilized extremely effectively at the time of compiling the forecast according to the fibre types as will be discussed later.

Table IV-11 Textile Fabric Export from Japan to Singapore and Conversion Criteria

Type	Quantity (10^3m^2) 1967	1968	1969	1970	1971	Quantity Ton 1967	1968	1969	1970	1971	g/m^2 1967	1968	1969	1970	1971
Cotton	25,508	18,861	11,970	15,647	8,640	3,029	2,364	1,668	2,221	1,283	119	125	139	142	149
Synthetic FY	19,314	31,587	61,221	82,850	109,027	1,375	2,297	4,188	5,939	8,888	71	73	68	72	82
Synthetic SF	33,951	63,548	103,128	103,871	105,180	4,393	8,604	13,625	13,567	14,108	129	135	132	131	134
Rayon FY	3,345	3,753	4,254	3,699	5,709	415	435	465	393	572	124	116	109	106	100
Rayon SF	10,061	6,611	5,900	4,411	2,874	1,109	806	793	725	484	110	122	134	164	168
Total	92,179	124,360	186,473	210,478	231,430	10,321	14,506	20,739	22,845	25,335	-	-	-	-	-

Source : Japan Exports & Imports

Table IV-12 Textile Import/Export Statistics of Singapore

(ton)

Type	Form	Imports 1967	1968	1969	1970	1971	Exports 1967	1968	1969	1970	1971	Imports - Exports 1967	1968	1969	1970	1971
Cotton	Raw Cotton	5,035	5,479	7,477	11,308	16,039	4,963	4,324	4,765	3,739	7,509	72	1,155	2,712	7,569	8,530
	Spun Yarn	4,949	11,595	16,326	16,634	15,702	1,300	1,999	2,129	2,054	4,693	3,649	9,596	14,197	14,580	11,009
	Fabric	26,809	37,931	45,125	40,262	31,980	9,133	10,304	13,961	12,293	13,880	17,676	27,627	31,164	27,969	18,100
	Cotton Total	36,793	55,005	68,928	68,704	63,721	15,396	16,627	20,855	18,086	26,082	21,397	38,378	48,073	50,118	37,639
Rayon, Artificial (Cellulosic)	FY	676	1,265	595	1,059	788	18	28	11	1	8	658	1,237	584	1,058	780
	FY Fabric	2,513	2,833	2,185	1,880	1,810	684	579	424	318	386	1,829	2,254	1,761	1,562	1,424
	FY Total	3,189	4,098	2,780	2,939	2,598	702	607	435	319	394	2,487	3,491	2,345	2,620	2,204
	SF	909	673	1,539	1,786	2,594	182	1,011	1,782	860	2,058	727	-338	-243	926	536
	Spun Yarn	832	1,286	1,003	1,034	951	854	737	899	927	951	-22	549	104	107	0
	SF Fabric	439	535	612	895	2,152	651	125	102	175	534	-212	410	510	720	1,618
	SF Total	2,180	2,494	3,154	3,715	5,697	1,687	1,873	2,783	1,962	3,543	493	621	371	1,753	2,154
	Other Fabric	3	2	1	12	151	9	0	3	2	4	-6	2	-2	10	147
	Rayon, Art. Total	5,372	6,594	5,935	6,666	8,446	2,398	2,480	3,221	2,283	3,941	2,974	4,114	2,714	4,383	4,505
Synthetic	FY	167	298	984	2,109	3,079	27	32	47	58	179	140	266	937	2,051	2,900
	FY Fabric	3,114	6,730	7,816	9,260	14,004	973	1,046	1,655	1,817	2,623	2,141	5,684	6,161	7,443	11,381
	FY Total	3,281	7,028	8,800	11,369	17,083	1,000	1,078	1,702	1,875	2,802	2,281	5,950	7,098	9,494	14,281
	SF	2	109	165	553	1,275	36	21	173	0	0	-34	88	-8	553	1,275
	Spun Yarn	37	199	280	252	285	16	21	43	35	151	21	178	237	217	134
	SF Fabric	5,097	9,215	14,629	17,166	16,988	492	1,759	2,797	2,559	3,098	4,605	7,456	11,832	14,607	13,890
	SF Total	5,136	9,523	15,074	17,971	18,548	544	1,801	3,013	2,594	3,249	4,592	7,722	12,061	15,377	15,299
	Other Fabric	3	2	9	104	212	21	0	0	0	3	-18	2	9	104	209
	Synthetic Total	8,420	16,553	23,883	29,444	35,843	1,565	2,879	4,715	4,469	6,054	6,855	13,674	19,168	24,975	29,789
	Man-Made Knitted	111	378	497	378	617	238	88	123	82	282	-127	290	374	296	335
	Man-Made Total	13,903	23,525	30,315	36,488	44,906	4,201	5,447	8,059	6,834	10,277	9,702	18,078	22,256	29,654	34,629
	Total	50,696	78,530	99,243	104,692	108,627	19,597	22,074	28,914	24,920	36,359	31,099	56,456	70,329	79,772	72,268

Source : Songapore External Trade Statistics

Table IV-13 Rate of Ready-to-be exported Textiles against Textile Importation into Singapore.

(%)

Type	Form	1967	1968	1969	1970	1971
Cotton	Raw Cotton	1.4	21.1	36.3	66.9	53.2
	Spun Yarn	73.3	82.8	87.0	87.7	70.1
	Fabric	65.9	72.8	69.1	69.5	56.6
	Cotton Total	58.2	69.8	69.7	73.5	59.1
Rayon, Artificial (Cellulosic)	FY	97.3	97.8	98.2	99.9	99.0
	FY Fabric	72.8	79.6	80.6	83.1	78.7
	FY Total	78.0	85.2	84.4	89.1	84.8
	SF	80.0	-50.2	-15.8	51.8	20.7
	Spun Yarn	-2.6	42.7	10.4	10.3	0
	SF Fabric	-48.3	76.6	83.3	80.4	75.2
	SF Total	22.6	24.9	11.8	47.2	37.8
	Other Fabric	-200.0	100.0	-200.0	83.3	97.4
	Rayon, Art.Total	55.4	62.4	45.7	65.8	53.3
Synthetic	FY	83.8	89.3	95.2	97.2	94.2
	FY Fabric	68.8	84.5	78.8	80.4	81.3
	FY Total	69.5	84.7	80.7	83.5	83.6
	SF	-1,700.0	80.7	-4.8	100.0	100.0
	Spun Yarn	56.8	89.4	84.6	86.1	47.0
	SF Fabric	90.3	80.9	80.9	85.1	81.8
	SF Total	89.4	81.1	80.0	85.6	82.5
	Other Fabric	-600.0	100.0	100.0	100.0	98.6
	Synthetic Total	81.4	82.	80.3	84.8	83.1
	Man-Made Knitted	114.4	76.7	75.3	78.3	54.3
	Man-Made Total	69.8	76.8	73.4	81.3	77.1
	Total	61.3	71.9	70.9	76.2	66.5

Source : Singapore External Trade Statistics

Table IV-14 Rate of Textile Imports from Japan to Singapore against the Singaporean Total Textile Imports

Type	Form	Imports from Japan (Ton)					Ratio of Imports from Japan to Imports Total (%)				
		1967	1968	1969	1970	1971	1967	1968	1969	1970	1971
Cotton	Raw Cotton	126	67	160	64	27	2.5	1.2	2.1	0.6	0.2
	Spun Yarn	43	76	116	95	81	0.9	0.7	0.7	0.6	0.5
	Fabric	3,846	2,579	2,197	2,580	1,175	14.3	6.8	4.9	6.4	5.5
	Cotton Total	4,015	2,722	2,473	2,739	1,863	10.9	4.9	3.6	4.0	2.9
Rayon & Other Artificial (Cellulosic)	FY	102	296	76	517	212	15.1	23.4	12.8	48.8	26.9
	FY Fabric	1,273	884	709	657	561	50.7	31.2	32.4	34.9	31.0
	FY Total	1,375	1,180	785	1,174	773	43.1	28.8	28.2	39.9	29.8
	SF	882	673	1,494	1,689	2,323	97.0	100.0	97.1	94.6	90.0
	Spun Yarn	15	240	17	7	44	1.8	18.7	1.7	0.7	4.6
	SF Fabric	296	390	409	708	1,850	67.4	72.8	66.9	79.1	86.0
	SF Total	1,193	1,303	1,920	2,404	4,217	54.7	52.2	60.9	64.7	74.0
	Other Fabric	0	0	1	4	135	0	0	100.0	33.3	89.4
	Rayon, Art. Total	2,568	2,483	2,706	3,582	5,125	47.8	37.7	45.6	53.7	60.7
Synthetic	FY	94	189	768	1,405	2,317	56.3	63.4	78.0	66.6	75.3
	FY Fabric	1,985	3,165	4,728	6,424	11,211	63.7	47.0	60.5	69.4	80.1
	FY Total	2,079	3,354	5,496	7,829	13,528	63.4	47.7	62.5	68.9	79.2
	SF	0	85	165	550	1,237	0	48.0	100.0	99.5	97.0
	Spun Yarn	25	109	237	180	141	67.6	54.8	84.6	71.4	49.5
	SF Fabric	4,360	7,975	12,814	15,455	15,168	85.5	86.5	87.6	90.0	89.3
	SF Total	4,385	8,169	13,216	16,185	16,546	85.4	85.8	87.7	90.1	89.2
	Other Fabric	1	0	0	6	67	33.3	0	0	5.8	31.6
	Synthetic Total	6,465	11,523	18,712	24,020	30,141	76.8	69.6	78.4	81.6	84.1
	Man-Made Knitted	31	48	143	197	194	27.9	12.7	28.8	52.1	31.4
	Man-Made Total	9,064	14,054	21,561	27,799	35,460	65.2	59.7	71.1	76.2	79.0
	Total	13,079	16,776	24,034	30,538	37,323	25.8	21.4	24.2	29.2	34,4

Source : Singapore External Trade Statistics

Fig. IV-3 Amount of Rayon Fibre Exportation and Importation of Singapore

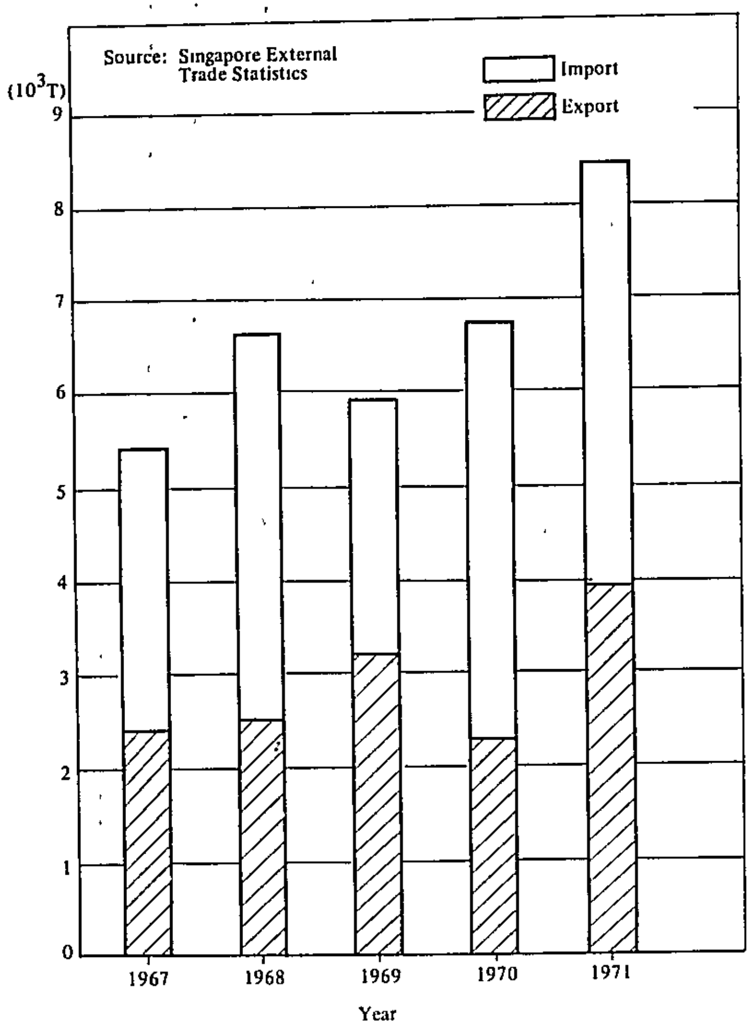


Fig. IV-4 Amount of Syntetic Fibre Exportation and Importation of Singapore

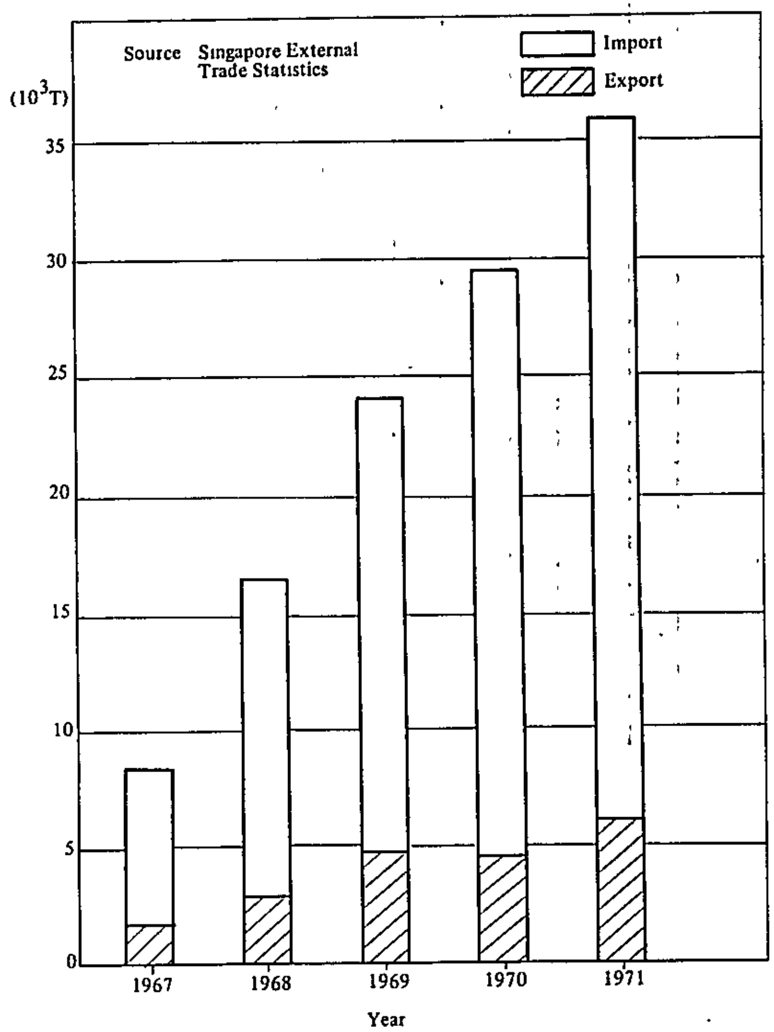


Fig. IV-5 Japanese Rayon Fibre Importation into Singapore vs. Singaporean Total Rayon Fibre Importation

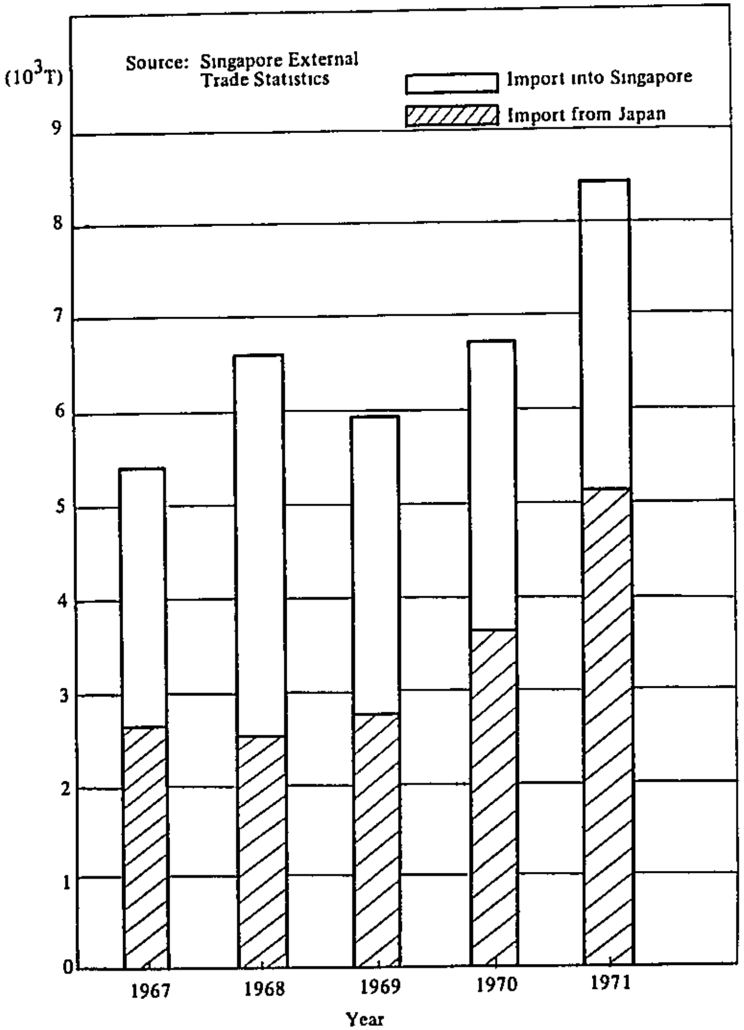
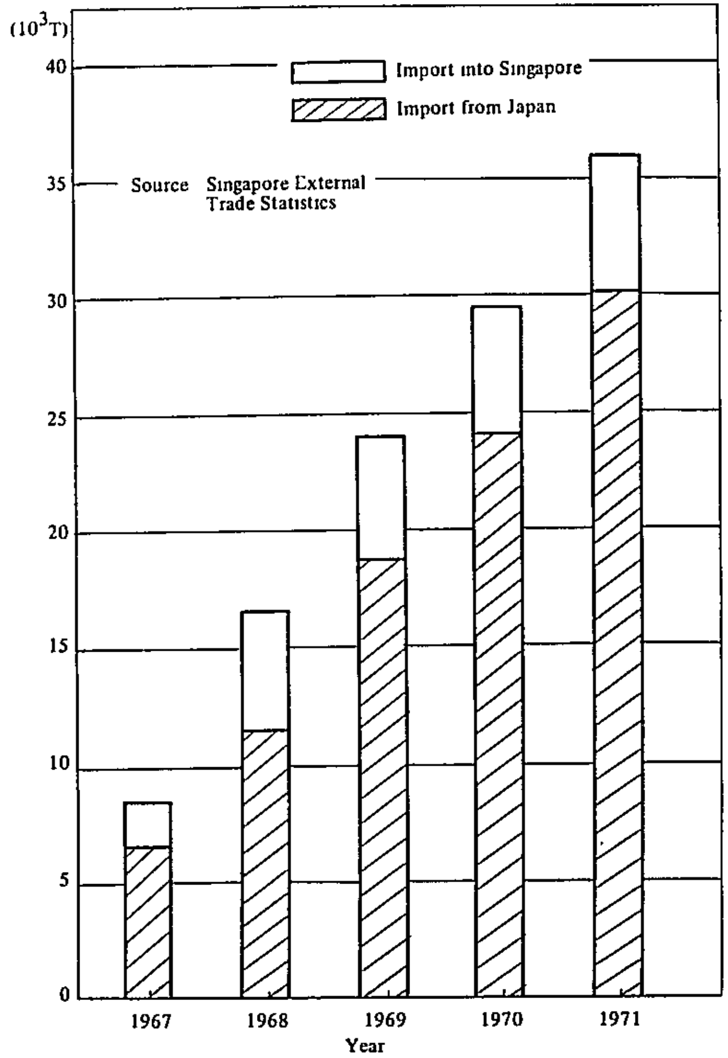


Fig. IV-6 Japanese Synthetic Fibre Importation into Singapore vs. Singaporean Total Synthetic Fibre Importation



2-3-3. Export Statistics of the U.S.A.

Table IV-15 shows the export statistics from the U.S. to Indonesia, rearranged according to the fibre types employed. Although Indonesia imported a total 50,000 to 60,000 tons of textile materials from the U.S. during the two years 1970 and 1971, more than 98% of this total consisted of cotton, and for the most part the thus imported cotton consisted in turn of raw cotton. Therefore, the amount of man-made fibre imports from the U.S. to Indonesia is quite small.

Table IV-15 Textile Exportation from the U.S.A. to Indonesia. (ton)

Type	Form	1967	1968	1969	1970	1971
Cotton	Raw Cotton	16,329	26,535	28,066	56,018	44,535
	Spun Yarn	-	118	10,200	3,268	2,984
	Fabric	123	192	60	4	135
	Cotton Total	16,452	26,845	38,326	(51,067)* 59,290	(55,877)* 47,654
Rayon Artificial (Cellulosic)	SF	-	-	-	-	79
	Spun Yarn. FY	25	194	-	-	-
	Fabric	28	10	6	4	-
	Rayon, Art. Total	53	204	6	4	79
Synthetic	SF	-	-	-	-	829
	Spun Yarn, FY	22	-	62	-	-
	Fabric	-	64	3	-	-
	Synthetic Total	22	64	65	-	829
Others (Spun Yarn, FY)		-	-	1,643	27	86
Total		16,527	27,113	40,040	(51,098)* 59,321	(56,871)* 48,648

Source : U.S. Foreign Trade

* As the export amount for the year 1970 is too excessive, proportional allotment was effected on the basis of the spun yarn production figures of 1970 and 1971. The alloted figures are shown in the ( ).

These figures were used for estimating the actual consumption amount in Indonesia.

Table IV-2 shows the amount of raw cotton exported from the U.S. in accordance with the export statistical data for America. When comparing the U.S. raw cotton exports to Indonesia with the raw cotton imports as announced by the Textile Bureau of the Departemen Perindustrian, there is a slight discrepancy, however, approximate correspondence is noted when comparing the amount with the domestic production amount of spun yarn in Indonesia.

Table IV-15 shows an acute increment in the amount of raw cotton imports into Indonesia between the years 1969 and 1970 and a decrease is also noted between 1970 and 1971. Considering the spinning capacities available in Indonesia, it does not seem likely that the total amount of 56,018 tons in 1970 was entirely consumed during 1970. Therefore, it is assumed that a considerably large part of this amount was carried over to 1971 in the form of inventory stocks.

2-3-4. Integration of the Export Statistics of Japan, Singapore and the U.S.A.

When the statistical data pertaining to exports to Indonesia from the above-mentioned three countries were integrated, it becomes possible to approximate the total textile imports into Indonesia. In this case, the import data from Japan and the U.S.A. can be utilized directly however, as imports from Singapore are not clear, an assumption had to be made as to what percentage of discrepancy between the Singaporean import and export amounts was destined for export to Indonesia. If it is assumed that the population of Singapore is two million and the annual textile consumption per person is 6 kg. (in the case of Taiwan, the 1970 figure was 6 kg.), the annual consumption in Singapore becomes 12,000 tons as a whole. Table IV-16 shows the import and export amounts into and out of Singapore concerning clothing materials. For the years 1967 and 1968, the import amount exceeds the export amount, however, since 1969, the situation has been inverted. This implies that the imports made into Singapore in the forms of filaments, staples or fabrics were processed into clothing and then allocated for export.

Table IV-16 Clothing Exportation and Importation by Singapore

	Imports	Exports	Exports-Imports	
			Value (10^3 US $)	Weight* (Ton)
1967	29,527	17,391	-12,136	-674
1968	32,969	22,648	-10,321	-573
1969	26,560	30,215	3,655	203
1970	25,145	33,593	8,448	469
1971	30,254	49,159	18,905	1,050

Source : Singapore External Trade Statistics

* The rough conversion criterion of US $ 18/Kg is employed

In order to convert the amount of clothing in terms of weight, a rough conversion criterion of US$18/kg was employed and the results thus obtained are shown in Table IV-16. The above-mentioned conversion criterion was obtained in the following way.

If the average price per kilogram is obtained on the basis of the "Japan Exports & Imports", the filament fabric made of synthetic fibre is US$6/kg (¥1,800/kg) and the staple fabric made of synthetic fibre is also US$6/kg (¥1,800/kg) so that three times this price figure was adopted as the average price per kilogram in the case of Singapore. Here, the total sum of textile material consumed in Singapore and the amount obtained by subtracting the clothing export amount from the clothing import amount was obtained, and further, the thus obtained figure was divided by the figure calculated by subtracting the export of the staples, filaments and fabrics (other than clothing) from the total imports thereof in order to obtain the rate. The results obtained are shown in Table IV-17. In this case, it was discovered that the rate thus obtained was in the range of 15 to 20%. Therefore, approximately 70% of the amount calculated

Table IV-17 Textile Domestic Consumption and Clothing Exportation by Singapore

	Textile Fibre & Fabric Imports - Exports (A) (ton)	Domestic Consumption (B) (ton)	Clothing Exports - Imports (C) (ton)	*1 B + C (ton)	B + C / A *2 %
1967	31,099	12,000	-674	11,326	36.4
1968	56,456	"	-573	11,427	20.2
1969	70,329	"	203	12,203	17.4
1970	79,772	"	469	12,469	15.6
1971	72,268	"	1,050	13,050	18.1

Source : Singapore External Trade Statistics

*1. The total of the (Singaporean domestic consumption) and the (amount obtained by subtracting exports from the clothing imports).

*2. The rate of domestic consumption and exportation as clothing vs. the amount obtained by the subtraction of exports from imports (excluding clothing).

by subtracting the export of the filaments, staples and fabrics (other than clothing) from the imports thereof in the case of Singapore can be estimated as having been exported to Indonesia. Table IV-18 shows the imports from the three countries in accordance with the origin and the raw materials employed. In Table IV-14, the total amount was calculated on the assumption that the above-mentioned rate was 70%. For reference, figures on the basis of 60% and 100% were also indicated. Table IV-19 displays the rearranged data stipulated in Table IV-18 according to the employed fibre types and the form of the fibres. As shown in Table IV-18, if an assumption is made that imports into Indonesia from Singapore (imports minus exports) is taken at 60 to 100%, the imports from the three countries in the case of 1970 would total 110,000 to 140,000 tons. This range of figures roughly coincide with the consumption amount announced by the Indonesian Statistics Bureau, thereby implying that no fundamental error took place in adopting the method of amalgamating the export statistics of the three countries as employed in this report. Further, in 1970, the rate of imports by Indonesia from the three countries were 43% from the U.S.A., 47% from Singapore and 10% from Japan, however, in view of the fact that most of the synthetic fibres imported from Singapore into Indonesia were originally exported from Japan to Singapore, the actual rate of exports from Japan to Indonesia should be much higher than 10%. When obtaining the total textile consumption amount in Indonesia by means of totalling the amounts of imports from these three countries, the marginal allowance should be taken into consideration when summing up the amounts in the case of raw cotton. However, due to the fact that in practice imports from countries other than the three have also materialized, the allowances have been provided for such third-country imports and no consideration was made to the above-mentioned marginal allowance factor.

3. Actual Status of Textile Consumption Amount and the Rate in accordance with the Raw Materials Employed

By coordinating the various statistics and data mentioned above, the assumption was made concerning the actual status of the textile consumption amount in Indonesia and the fibre type rates thereof.

Table IV-18 Textile Exportation Amount from the U.S.A., Singapore and Japan

Singapore: (Imports - Exports) x 70%

(ton)

	Exports from	1967	1968	1969	1970	1971
Cotton	U.S.A.	16,452	26,845	38,326	51,067*1) (59,290)	55,877*1) (47,654)
	Singapore	14,978	26,865	33,651	35,083	26,347
	Japan	7,669	5,307	2,720	2,370	1,813
	Sub-Total	39,099	59,017	74,697	88,520	84,037
Rayon & Art.	U.S.A.	53	204	6	4	79
	Singapore	2,082	2,880	1,900	3,068	3,154
	Japan	2,777	2,264	2,117	1,948	2,650
	Sub-Total	4,912	5,348	4,023	5,020	5,883
Synthetic	U.S.A.	22	64	65	-	829
	Singapore	4,799	9,572	13,418	17,483	20,852
	Japan	5,535	2,331	4,934	6,238	11,190
	Sub-Total	10,356	11,967	18,417	23,721	32,871
Others	U.S.A.	-	-	1,643	27	86
	Singapore	-89	203	262	207	235
	Japan	1,167	459	463	566	941
	Sub-Total	1,078	662	2,368	800	1,262
Total by Country	U.S.A.	16,527	27,113	40,040	51,098	56,871
	Singapore	21,770	39,520	49,231	55,841	50,588
	Japan	17,148	10,361	10,234	11,122	16,594
Total		55,445	76,994	99,505	118,061	124,053
Total *2	60%	52,334	71,348	92,471	110,083	116,826
	80%	58,554	82,639	106,537	126,038	131,279
	90%	61,664	88,284	113,570	134,015	138,506
	100%	64,774	93,930	120,603	141,992	145,733

Source : Japan Exports & Imports, U.S. Foreign Trade
Singapore External Trade Statistics

*1. The export of cotton from the U.S.A. are stipulated in ( ), however, due to an excessive extent of the figure for 1970, as mentioned earlier, proportional allotment was made on the basis of the spun yarn production for 1970 and 1971 (figures by Departemen Perindustrian)

*2. The total figures obtained by assuming the imports from Singapore as having been 60, 80, 90 and 100% of (Imports - Exports)

Note : Tire cord woven fabrics are included in FY.

Table IV-19 Exportation Amount of Types and Forms of Fibre to Indonesia from Japan, Singapore and the U.S.A.

(Export from Singapore : (Imports - Exports) x 70%)

(ton)

		1967	1968	1969	1970	1971
Cotton	Raw Cotton	16,418	27,439	30,082	53,622	58,284
	Spun Yarn	2,554	6,901	20,272	13,511	12,265
	Fabric	20,126	24,677	24,343	21,386	13,488
	Sub-Total	39,098	59,017	74,697	(96,843)* 88,519	(75,814)* 84,037
Rayon, Artificial (Cellulosic)	FY	555.5	1,062	608	1,034	1,131
	FY Fabric	1,682	1,695	1,262	1,115	1,096
	FY Total	2,237.5	2,757	1,870	2,149	2,227
	SF	509	Δ 237	2	734	1,068
	Spun Yarn	522.5	1,987	1,638	1,409	955
	SF Fabric	1,648	839	515	721	1,530
	SF Total	2,679.5	2,589	2,155	2,864	3,553
	Rayon, Art. Total	4,917	5,346	4,025	5,013	5,780
Synthetic	FY	145	505	4,146	2,980	5,214
	FY Fabric	3,886	4,522	4,955	6,499	9,747
	FY Total	4,031	5,027	9,101	9,479	14,961
	SF	Δ 24	62	Δ 7	387	1,828
	Spun Yarn	26	239	719	1,661	3,797
	SF Fabric	6,340	6,651	8,616	11,908	11,828
	SF Total	6,342	6,952	9,328	13,956	17,453
	Synthetic Total	10,373	11,979	18,429	23,435	32,414
Others	Natural Fibre	247	86	49	222	84
	Man-Made Fibre	810	566	661	844	1,653
	Others	-	-	1,643	27	86
	Sub-Total	1,057	652	2,353	1,093	1,823
Man-Made Total		15,290	17,325	22,454	28,448	38,194
Total		55,445	76,994	99,504	118,060	124,054

Notes : Tyre Cord Fabrics are included in FY Fabric.

( )* signifies actual import amount
All other figures obtained after allocating the spun yarn production ratio

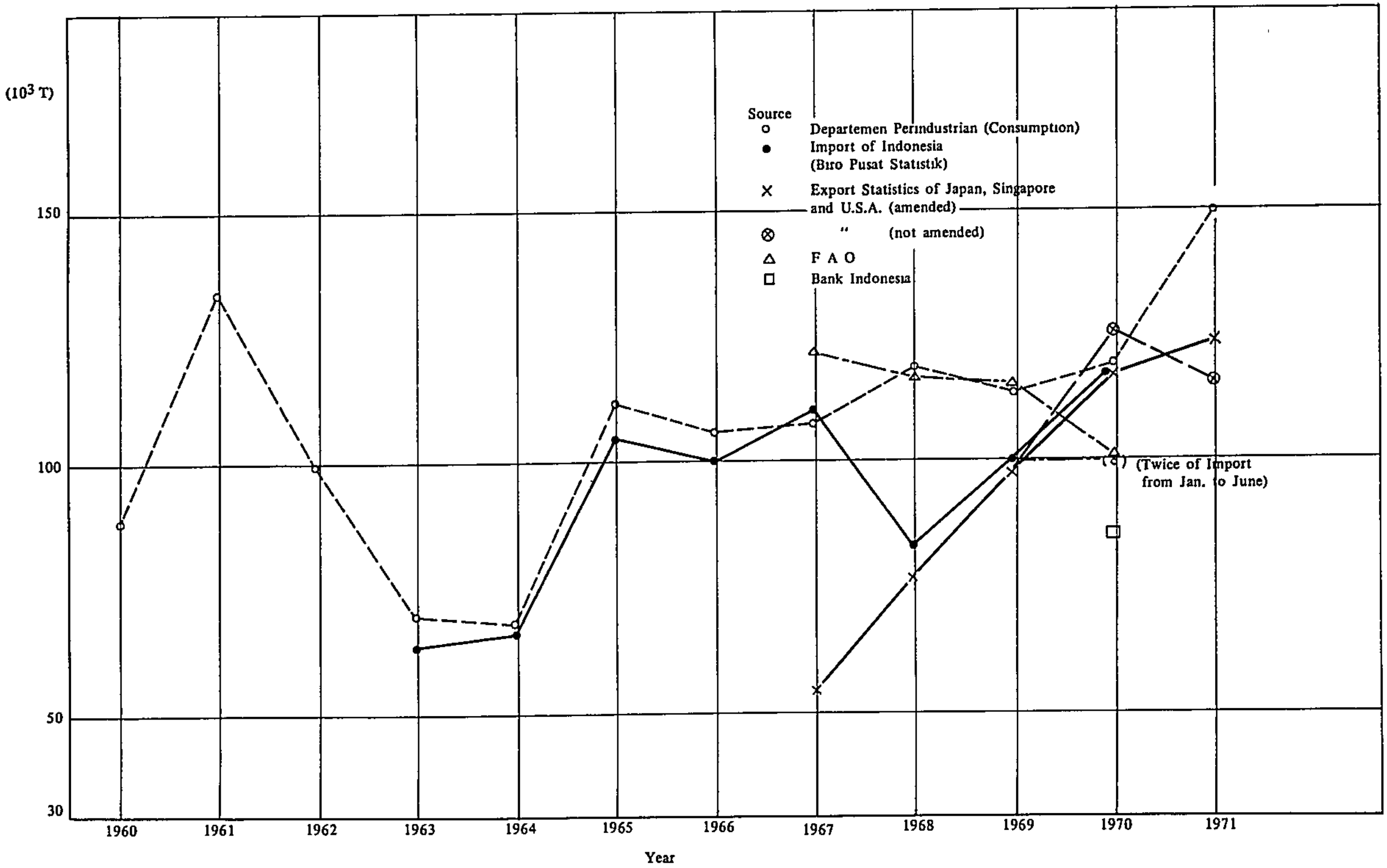
3-1. Total Textile Consumption Amount

Concerning the total consumption amount of textiles, there are five separate data available, the data compiled by the Indonesian Textile Bureau (Table IV-1), the Indonesian import statistics (Table IV-4), the Bank Indonesia statistical data (Table IV-5), the FAO data (Table IV-8) and the aggregate of export statistics of Japan, Singapore and the U.S.A. These groups of data are shown together in Fig. IV-7. Of these groups, the ones compiled by the Bank Indonesia stipulates that the consumption amount in the year 1970 was 86,000 tons which is rather lower than the others which stipulate the amounts at the level of 100,000 to 120,000 tons. If the consumption amount is estimated at 86,000 tons per year and while adopting the conversion criterion of 140 g/m, the per capita consumption should then be approximately 5m (approximately 700g) which is obviously too low an estimate. Concerning the data compiled by the FAO, it is likely that the Textile Bureau data were utilized during the process of compilation so that it is not practicable that this group's data possess independence. Also, there is a good correlation between the data obtained by the Indonesian Textile Bureau and the Indonesian official import statistics as far as the period from 1963 to 1967 is concerned, however, from 1969 onward, the data announced by the Bureau have given figures of approximately 10,000 to 30,000 tons higher, thereby showing a certain degree of discrepancy between these two groups. Therefore, the groups of data which can be deemed independent and separate are the remaining three, the aggregate of the export statistics of the U.S.A., Japan and Singapore, the Indonesian import statistics and the data compiled by the Textile Bureau. The comparison among these three groups of data revealed the following.

1) When a comparison was made between the export amounts of the three countries with the Indonesian import statistics and with the Textile Bureau data, there was an extremely high extent of discrepancy in both cases, i.e. in the case of the Indonesian import statistics, the figure is 55,000 tons and in the case of the Bureau data, the amount is 110,000 tons. However, for the period 1968 to 1971, the Indonesian import statistic figures and the figures of the export statistics of the three countries showed a high extent of correlation so that an analysis was made as to the cause for the above-mentioned wide discrepancy noted for the year 1967. In accordance with the Indonesian import statistics, the import amount from Japan is stipulated as having been 28,000 tons, however, the Japanese corresponding export statistics stipulate 17,000 tons so that the Indonesian import statistics exceed the Japanese export statistics by 11,000 tons.

   Regarding the U.S. statistics, there is no discrepancy noted and both Indonesian and American data stipulate 17,000 tons. Concerning the imports from Singapore, the Indonesian import statistics stipulate 1,800 tons which is extremely low. Therefore, the above-mentioned discrepancy cannot be explained by simply comparing the data from these three countries alone. Thus, another comparison was made between the Indonesian import statistics themselves for the year 1967 and the year 1968. According to the results, during 1967, as compared with 1968, imports from China and Hong Kong of cotton fabrics increased by 10,000 tons each, totalling 20,000 tons and imports of cotton, yarn and fabrics from the U.S.A. and Taiwan

Fig. IV-7 Consumption and Import of Fibres in Indonesia



increased by 10,000 tons. Further, synthetic fibre imports from Japan rose by 10,000 tons. On the other hand, the imports from Pakistan decreased by 8,000 tons. No satisfactory explanation can therefore be derived from the above scrutinizations however, considering the fact that there is a good correlation between the abovementioned two statistical data groups embodied for the year 1968, it is probable that, for the year 1967, imports from countries other than the three mentioned could have been exceptionally high. However, again referring to the good correlation between the two groups of statistical data from 1968 onward, we see no fundamental problem in formulating estimates on the basis of the export statistical data of the three countries as far as the period from 1968 is concerned.

2) In 1971, in accordance with the Textile Bureau data, a 28% acute increase was realized when compared with the preceding year, however, according to the export statistics of the three countries, the increment rate for the period is only 5%, thereby showing a discrepancy of 26,000 tons.

3) For the year 1970, approximately 120,000 tons was the figure stipulated for the aggregate of the export statistics of the three countries, the Textile Bureau data and in the Indonesian import statistics so that good correlation and correspondence is noted.

4) For the years 1969 and 1968, the data compiled by the Textile Bureau are as compared with the other statistics, on a higher level by 15,000 to 30,000 tons.

On the basis of the above comparisons among the data groups and taking into consideration the following factors, it would be reasonable to estimate the consumption amount for the year 1970 as having been 120,000 tons.

1) For the year 1970, the 120,000 figure is stipulated in the aggregate of the export statistics of the three countries and also in the Indonesian import statistics as well as in the Textile Bureau data, so that a good correlation is noted here as mentioned above and in this case, the conversion to the per capita consumption reveals a figure of 7m per person per year.

2) The exports from the three countries have shown a constant growth by 20,000 tons annually for the period from 1967 to 1970, thereby attaining in 1970 the figure of 120,000 tons. For the years 1970 and 1971, the annual export amount attained was also approximately 120,000 tons so that it seems reasonable to estimate that the figure 120,000 tons was almost positively and actually consumed in the year 1970.

3) The figure 150,000 tons stipulated by the Textile Bureau for the year 1971 is the data obtained during the period after the "rapid growth" was materialized so that it is not practicable to employ this figure as the basis for future forecasts.

As a result of the above scrutinizations, the figure 120,000 tons was therefore taken as the estimate figure for the total textile consumption in Indonesia in the year 1970 and this figure is hereby taken as the basis for the demand forecast.

3-2. Synthetic Fibre Rate and Rates according to Fibre Types Employed

The major problem took place at the time of investigating the rates of fibres in accordance with the fibre types used and the rate of man-made fibres taken up in the total textile consumption in Indonesia was that substantially prepared statistical data were not obtainable to enable a clear classification of the fibre types. The import statistics of Indonesia and the import/export statistics of Singapore do carry out classifications under the headings of natural fibres, rayon fibres, and synthetic fibres, and in some cases, further detailed categorizations are made. However, in many cases, even with these classifications, the names of the fibres are not clearly described. In the case of materials made through blend spinning processes, no clear description of the component fibre types were disclosed and therefore, it was not possible to derive the man-made fibre rates, or the rate of fibres in accordance with the raw materials employed from these data.

The data compiled by the Indonesian Textile Bureau and by the Bank Indonesia are also insufficient in this respect. However, the data collected by the Interdepartmental Commission, as shown in Table IV-6, stipulate the fibre type rates of the man-made fibres on the basis of the market surveys conducted and therefore, these data are of particular interest. Nevertheless, the rates are not stipulated concerning the man-made fibres so that it is not certain even from these data as to what extent the man-made fibres are being consumed in the total textile consumption. Thus, it was decided that the fibre type rates were to be surveyed promptly in Indonesia on the basis of the Japanese export statistics. In other words, of the three countries which export textile materials to Indonesia in bulk, the U.S.A. exports to Indonesia consist mostly of cotton. On the other hand, concerning the years 1970 and 1971, approximately 80% (20,000 to 30,000 tons) of the synthetic fibres and 55% (4,000 to 5,000 tons) of the rayon fibres imported by Singapore were shipped from Japan to Singapore. The Japanese export statistics have clear demarkation and classification of the fibre type employed and concerning the fabric materials, the weight factors are also clearly stipulated. Therefore, it was deemed reasonable to assume that a certain extent of accuracy will be ensured if the Japanese export statistics are studied in order to investigate the rates of the textile materials in Indonesia in accordance with the fibre type employed and the rates of the man-made fibres comprised in the total textile consumption of the nation.

Firstly, an assumption was made concerning the mixed spun ratio regarding each item of Japan's export statistics for the years 1967 through 1971 (this assumption was made rather easily due to the fact that the fibre types were clearly described), in order to analyse the exports made to Indonesia and Singapore in view of the type of fibre used to form such exports. The results of this screening are given in Table IV-9 and IV-10.

Largely, the exports for Singapore would be, as explained earlier, exported to Indonesia eventually, so that the amount thus exported to Indonesia was estimated in accordance with the following.

By averaging the data for the years 1970 and 1971, it was revealed that 83.0% of Singapore's imports of synthetic fibres were shipped from Japan. At the same time, 83.9% of the total imported amount into Singapore was not exported. This 70% of such ready-to-be-exported amount is to be destined for Indonesia and such amount will be obtained in the following way.

$$\frac{\text{Exports from Japan to Singapore}}{0.830} \times 0.839 \times 0.7 = (\text{Exports from Japan to Singapore}) \times 0.7$$

As to the rayon fibres, 57.6% of Singapore's total imports originated in Japan and, at the same time, 58.8% of the total amount of imports was not exported. If the 70% of such ready-to-be exported amount was to be exported to Indonesia, such amount shall be estimated in accordance with the following formula.

$$\frac{\text{Exports from Japan to Singapore}}{0.576} \times 0.588 \times 0.7 = (\text{Exports from Japan to Singapore}) \times 0.7$$

By utilizing the results obtained from the above two formulae, the preliminary calculation of the man-made fibre rates in Indonesia was undertaken. By adding the 70% of exports destined for Singapore (Ref. Table IV-10) and the exports destined for Indonesia (Table IV-9) together, the figures were obtained regarding the man-made fibres along as shown in Table IV-20 and 21. The imported amount

Table IV-20 Exportation Amount of Types and Forms of Man-made Fibres from Japan to Indonesia (average for 1970, 1971)

		Average for the years 1970 & 1971	Man-Made Fibre (%)	Synthetic Fibre (%)
Type. Form	Nylon FY	7,086	22.9	31.1
	Polyester FY	3,950	12.8	17.3
	Polyester SF	10,592	34.2	46.5
	Acrylic SF	1,170	3.8	5.1
	Rayon FY	1,002	3.2	-
	Rayon SF	5,058	16.3	-
	Others	2,090	6.8	-
	Total	30,948	100.0	100.0
Type	Nylon	7,086	22.9	31.1
	Polyester	14,542	47.0	63.8
	Acrylic	1,170	3.8	5.1
	(Synthetic Fibre)	(22,798)	(73.7)*	-
	Rayon	6,060	19.5	-
	Others	2,090	6.8	-
	Total	30,948	100.0	100.0

Source : Japan Exports & Imports

* The share of synthetic fibres including others is 80.5% (Rayon 19.5%)

Table IV-21 Exportation Amount of Types of Man-made Fibre from Japan to Indonesia and Singapore

	Ton					%				
	1967	1968	1969	1970	1971	1967	1968	1969	1970	1971
Nylon FY	2,373	2,109	5,826	4,904	7,629	15.2	14.3	26.4	19.6	20.7
Polyester FY	973	785	1,548	2,589	5,310	6.2	5.3	7.0	10.3	14.4
Polyester SF	4,816	4,999	6,589	9,337	11,847	30.9	34.0	29.9	37.3	32.1
Acrylic SF	348	475	722	746	1,594	2.2	3.2	3.3	3.0	4.3
Rayon FY	707	485	452	582	1,422	4.5	3.3	2.1	2.3	3.9
Rayon SF	4,009	4,278	4,925	4,815	5,300	25.7	29.1	22.3	19.2	14.4
Others (Man-Made)	1,629	1,135	1,426	1,357	2,823	10.5	7.7	6.5	5.4	7.7
Industrial Tyre Cord	744	449	552	724	913	4.8	3.1	2.5	2.9	2.5
Total Synthetic Fibre*	9,254	8,817	15,237	18,300	27,293	59.3(66.2)	59.9(64.9)	69.1(73.9)	73.0(77.2)	74.1(80.2)
Natural + Man-Made	15,599	14,715	22,040	25,054	36,838	100.0	100.0	100.0	100.0	100.0

Source : Japan Exports & Imports

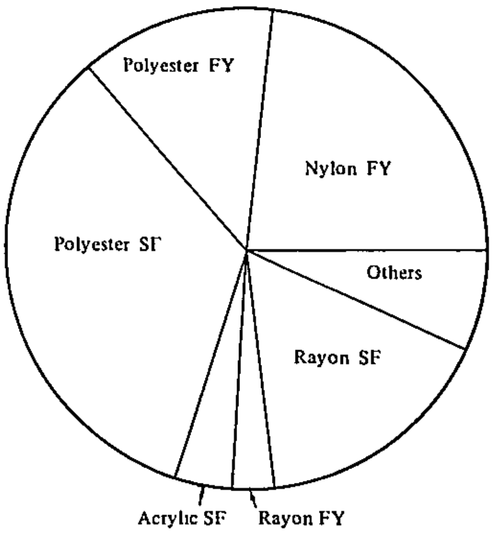
* Total Synthetic Fibre includes Tyre Cord

( ) ... $\frac{\text{Synthetic Total-Others (Man-Made)}}{\text{Natural + Man-Made}}$

of man-made fibres in the year 1970 was 25,000 tons, consisting of 77% synthetic fibres and 23% rayon fibres. The rate comprised by the synthetic fibres was 66% in 1967, however, in 1971, the rate increased to 80%, thereby implying an annual increment in the rate of synthetic fibres. On the contrary, the rate taken up by rayon fibre has been decreasing year by year, however, the absolute quantity of the rayon fibres has been increasing annually, although only slightly. If the figures of Table IV-12 (obtained solely from the "Japan Exports & Imports") obtained through the other method, i.e., by adding the Japanese export statistics to the Singaporean export statistics (i.e., reassessment of the Table IV-21 figures by using the data in Table IV-19 and IV-12), the import amounts of the man-made fibres in 1970 become 31,800 tons, thereby showing a slightly higher value than the ones shown in Table IV-21. This is due to the fact that, as mentioned earlier, no constituting component stipulation is made in the Singaporean export statistics concerning the mixed spun items so that if a certain amount of natural fibres are blended during the manufacturing process into man-made fibres, such blended natural fibres are automatically included within the scope of the man-made fibres.

Then, the rates in accordance with the raw materials employed were obtained. Regarding these rates, the year to year fluctuation was too large if the data for the year 1970 only were used, and therefore it was deemed impractica-ble to do so. Thus, the average mean value was obtained from the 1970 and 1971 fibures in a similar manner as in the case of obtaining the man-made fibre rates. The Japanese export statistics were again utilized for this purpose. The average values for the years 1970 and 1971 are shown in Table IV-20 and Fig. IV-8. Of the synthetic fibres, the rate taken up by the polyester SF is the highest, comprising approximately one-half of the total. The remaining half is taken up almost entirely by nylon FY and polyester FY. Acrylic fibres accounted for only 5% of the total synthetic fibres.

Fig. IV-8 Type-wise and Form-wise Exportation of Man-made Fibres from Japan to Indonesia (Average of 1970, 1971)



(30,948 ton)

Further, Table IV-22 stipulates the breakdown of the demand quantities in accordance with the raw materials employed on the assumption that the total

Table IV-22 Breakdown of Fibre Type in Indonesia in 1970

Basic data for forecast

	%	ton
Cotton	79.1	94,920
Nylon FY	4.8	5,740
Polyester FY	2.7	3,240
Polyester SF	7.1	8,520
Acrylic SF	0.8	960
Rayon FY	0.7	840
Rayon SF	3.4	4,080
Others	1.4	1,700
Total	100.0	120,000
Nylon	4.8	5,740
Polyester	9.8	11,760
Acrylic	0.8	960
(Synthetic Fibre Total)	(15.4)	(18,460)
Cotton	79.1	94,920
Rayon	4.1	4,920
Others	1.4	1,700
Total	100.0	120,000

Note : Nylon FY includes tyre cord

textile consumption amount for the year 1970 taken at 120,000 tons. This figure was taken as the consumption amount of the total textile materials in accordance with the raw materials employed for the year 1970 and the demand forecast was formulated on the basis of this data. The man-made fibre rates were made in accordance with the following. The figure 120,000 tons was taken as the total textile consumption amount for the year 1970 and, on the assumption that the man-made fibre consumption amount is 25,054 (Ref. Table IV-21), the following will ensue.

Man-made fibre rate = 25,054/120,000 = 20.1%

Then, when the ratio of the synthetic fibres and the rayon fibres taken up in the total man-made fibre amount is obtained from Table IV-20, the synthetic fibres (including others) is 80.5% and the rate for the rayon is 19.5%. Therefore, the following will ensue:

Synthetic fibre rate = 25,000 x 0.805/120,000 = 16.8%

Rayon rate = 25,054 x 0.195/120,000 = 4.1%

4. Demand Forecast

The basic forecast figures for the population and the GNP which are to be employed as the basic data for the demand forecast are shown in Table IV-23. The population data were obtained from the Departemen Perindustrian the GNP per capita figures were based on a report compiled by the World Bank. It must be noted that the GNP per capita data obtained for Indonesia have been extracted from the same source from which the GNP per capita data of all the other nations were also acquired and that the growth rate figures stipulated in the World Bank's report were the only data utilized from the report. The GNP per capita of Indonesia in 1970 was US$108 (in constant 1969 prices, source: AID) and in accordance with the World Bank's report, the average GNP growth rate up to 1980 will be 7.9% and the per capita average annual growth rate will be 5.4% (on the assumption that the population increase rate will be 2.4%). The GNP per capita for 1980 in Indonesia can therefore be calculated as US$183 for 1980.

Table IV-23 Forecast on Population and GNP Per Capita in Indonesia

	1970	71	72	73	74	75	76	77	78	79	1980
Population(10^6men)	121	124.4	127.5	130.9	134	137.1	140.3	143.5	146.8	150.2	153.6
GNP per Capita (US$)	108	114	120	127	133	141	148	156	165	173	183

Notes : 1. GNP per capita in 1970 was US$89, the growth rate was 5.4% p.a. in accordance with the World Bank's report

2. 1970 GNP per capita in 1969 constant price was US$108. (Source : A.I.D.)

There are several methods which can be employed for carrying out the textile demand forecast. However, as has already been discussed, the fluctuation and deviation of the data are considerable and due to the fact that the data themselves are often insufficient, it was not possible to employ the Time-Series Method in which the future trend is to be forecasted in the framework of a time sequence on the basis of the past trend of textile consumption, nor was it possible to employ the Correlation Method in which the future trend is forecasted on the basis of the correlation between causes and results regarding the trends and phenomena which took place in the past. Therefore, the Cross Section Method was employed by means of which the future trend was forecasted on the basis of the actual achievements made in various countries as well as on the basis of the present status of Indonesia.

The major problem in the course of carrying out the demand forecast on Indonesia was the fact that the textile consumption amount per capita was 1.0 kg./Y in 1970 which is on an extremely low level. In accordance with the statistics compiled by the FAO, in 1970, out of 154 countries, 30 countries (19.5%) showed the per capita textile consumption of less than 2 kg. per year (excluding countries of less than 1 million population). Of these 30 nations, 11 (7.1%) had less than 1 kg. figure. Of the above 30 countries where the figure was less than 2 kg. 17 were African countries. The remaining 13 non-African countries were:

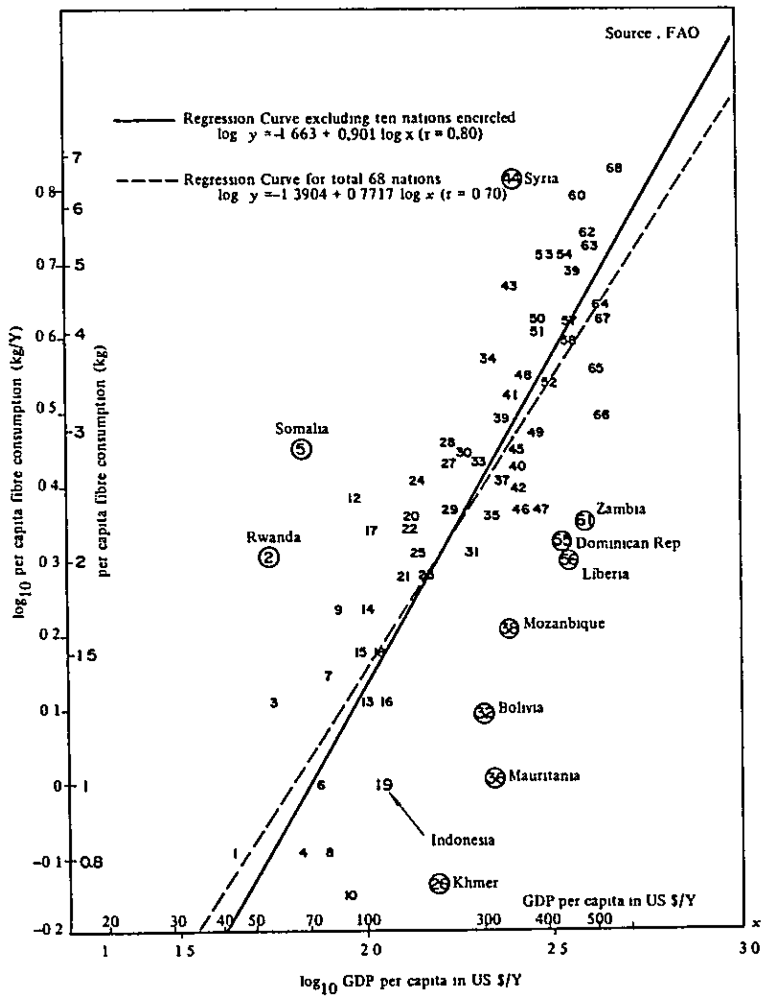
(Laos), (Khmer), South Vietnam, (North Vietnam), (Indonesia),
Sri Lanka, (Nepal), China, North Korea, (New Guinea), (Papua), Bolivia.

Note: Countries shown in brackets are those having less than 1 kg. per person per year consumption.

As explained above, the nations where the per capita consumption is 1 kg. are rather exceptional and therefore the trends and phenomena which took place in such countries pertaining to the GNP per capita, etc. are often remote from those achieved in other nations where the consumption figures are comparatively higher. (Ref. Fig. IV-9)

Fig. IV-9 Relationship between Textile Consumption Per Capita and GDP Per Capita in Developing Countries (1970)

(GDP Per capita less than 500 US $)



1.	Upper Volta	35	Senegal
2.	Rwanda	36	Mauritania
3.	Malawi	37.	Rhodesia
4	Chad	38	Mozambique
5	Somalia	39	Morocco
6	Ethiopia	40.	Philippines
7	Tanzania	41	Tunisia
8	Mali	42	Mauritius
9	Dahomey	43	Korea, Rep. of
10	Nepal	44	Syria
11	Niger	45	Ecuador
12.	Afganistan	46	Paraguay
13	Burma	47	Sarawak
14	Uganda	48	Ghana
15	Nigeria	49	Honduras
16	Zaire, Rep of	50	Algeria
17	India	51	Ivory Cost
18.	Madagascar	52	El Salvador
19	Indonesia	53	Sabah
20.	Central African Republic	54	Jordan
21	Viet-Nam, Rep of	55	Dominican Rep
22.	Pakistan	56	Liberia
23.	Kenya	57.	Colombia
24	Sudan	58	Guatemala
25	Togo	59	Guyana
26	Khmer	60	Taiwan
27.	Cameroon	61.	Zambia
28	Sierra Leona	62.	Iraq
29	Congo, People's Rep.	63.	Iran
30	Thailand	64	West Malaysia
31	Ceylon	65.	Nicaraqua
32.	Bolivia	66.	Peru
33.	Angola	67.	Brazil
34.	Egypt	68.	Turkey

4-1. Total Textile Consumption Amount

Fig. IV-9 shows the relationship between the GDP per capita and the per capita textile consumption amount in the so-called developing nations where the

GDP per capita level is less than US$500. Fig. IV-9 was compiled by extracting and plotting the data obtained from the FAO. In accordance with the FAO data, the per capita textile consumption in Indonesia was 0.8 kg., however, in accordance with the present survey, the figure was 1.0 kg. Therefore, the survey result figure was employed in this report.

The regression formula covering all the 68 countries will be as follows.

$$\log y = -1.390 + 0.772 \log x \ (r = 0.696) \ \ldots \ (1)$$

The regression formula after eliminating 10 countries* showing a considerable extent of deviation from the others is as follows.

$$\log y = -1.663 + 0.901 \log x \ (r = 0.798) \ \ldots \ (2)$$

Where,

y = per capita textile consumption amount (kg/person/Y)

x = GDP per capita (US$/person/Y)

* The eliminated 10 countries are:
Rwanda, Somalia, Khmer, Bolivia, Mauritania, Mozambique, Zambia, Syria, Dominica and Liberia.

Also, Fig. IV-10 shows the plotted results of the data concerning other South East Asian countries which are geographically close to Indonesia or where the synthetic fibre rates are comparatively high. The plotting for Fig. IV-10 was made in a similar manner as was employed for the compilation of Fig. IV-9. Fig. IV-10 data were re-illustrated in time sequence as shown in Fig. IV-11.

Considering the possibility of the future rapid growth in the GNP, the per capita consumption amount of textiles in Indonesia will most likely be 2 to 3 kg/person/Y in the foreseeable future.

The main point in the demand forecast is to assess how many years will be necessary for Indonesia to attain the actually achieved amount of the other nations concerning the per capita GNP levels and the per capita textile consumption amounts as illustrated in Fig. IV-9 and IV-10.

The consumption amount level in Indonesia is found below the regression line shown in Fig. IV-9 and IV-10 and this has been due to the results of unavoidable circumstances. However, since the commencement of the Indonesian 5-year Economy Rehabilitation Plan, remarkable advances have been achieved as the result of appropriate policies undertaken by the government and because of the enthusiasm displayed by both official and private sectors, as well as by the economical and technical assistances provided by various foreign nations concerned. This having been the circumstances, it is forecasted that the future GNP growth rate will be approximately 8% p.a. Of all the rehabilitated industries in Indonesia, the textile industries have displayed particularly conspicuous improvements and this point has been made in the parliamentary address by President Soehart on the eve of Independence Day in August 1972. It is expected that the level of textile consumption in Indonesia will attain the standards of the other nations in the

Fig. IV-10 Relationship between Textile Consumption Per Capita and GDP Per Capita in South East Asian Countries

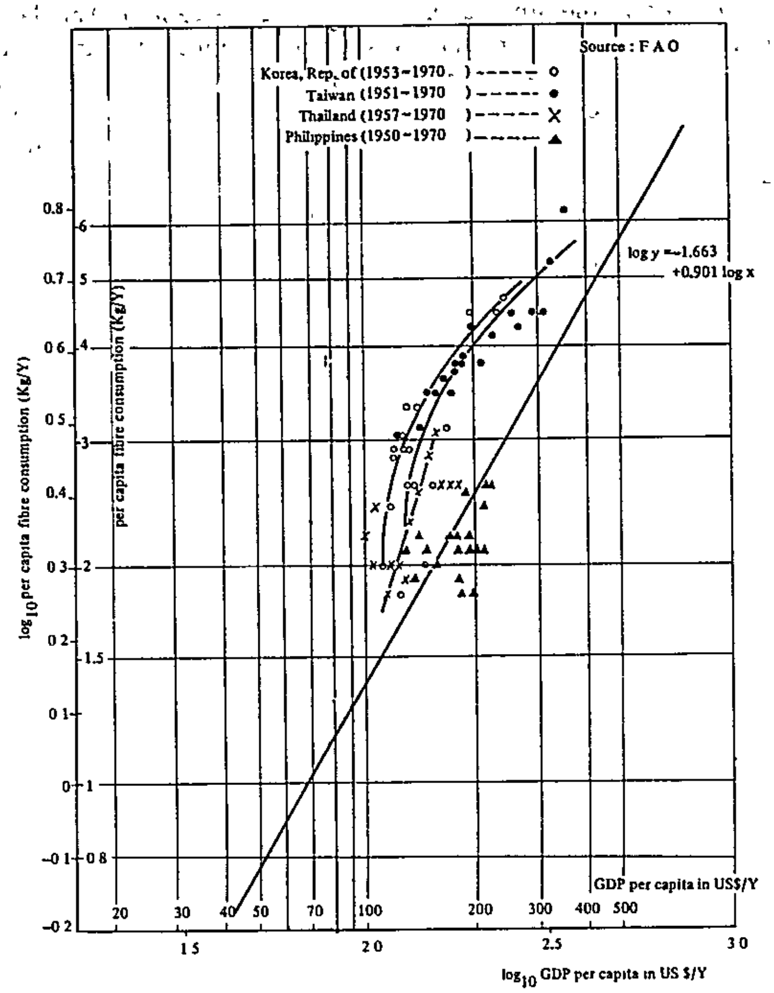
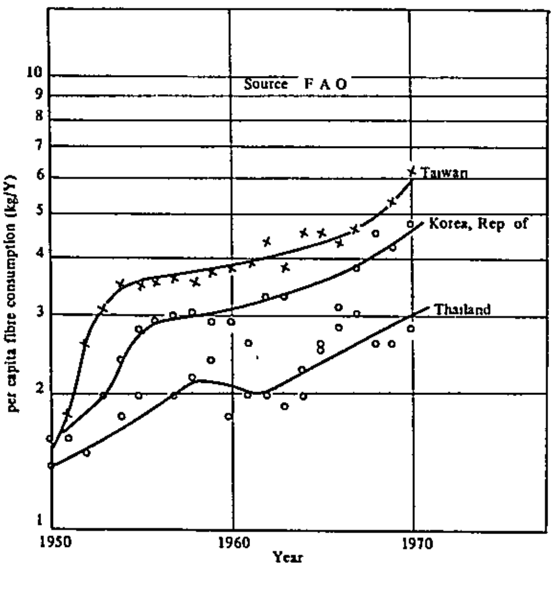
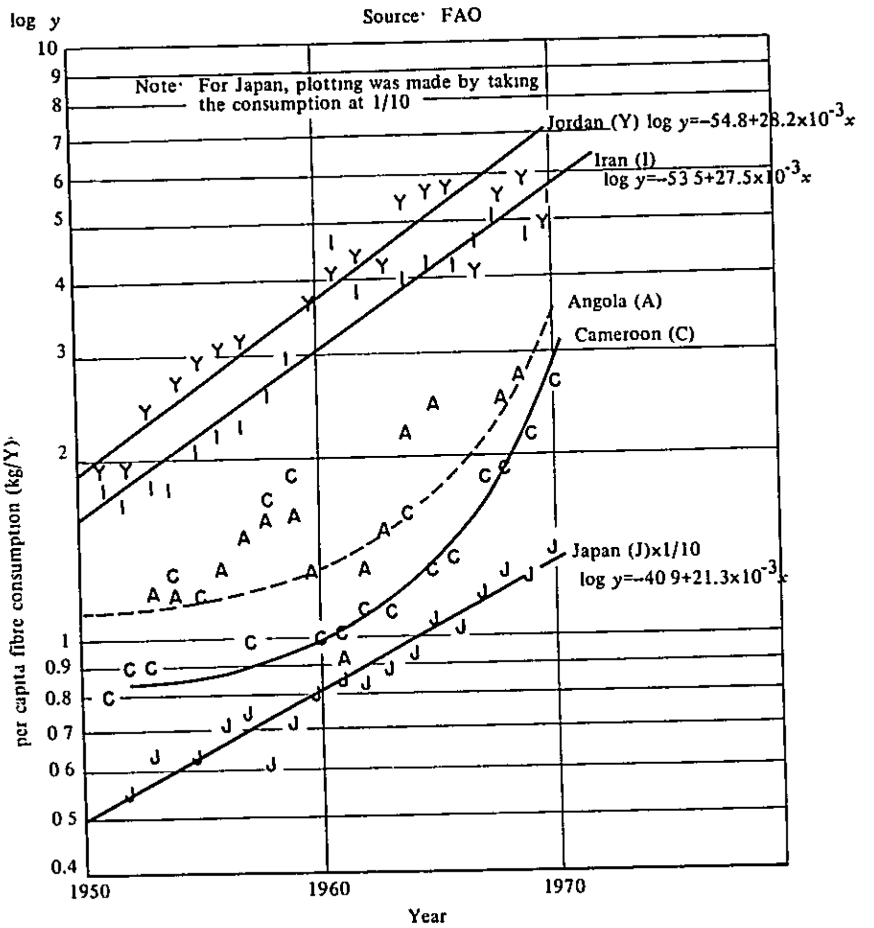


Fig. IV-11 Trend of Textile Consumption Amount Per Capita in Thailand, Taiwan and Korea



foreseeable future. Fig. IV-12 shows the increment in the past per capita consumption amount achieved in the other countries. As in the case of Angola and Cameroon, there have been cases where the consumption stagnated at the level of approximately 1 kg. per person per year around 1960, however, a rapid increment was shown during the following decade leading to the year 1970, thereby attaining the standard of 2.7 kg. level. In the cases of Jordan and Iran, a growth rate of 1.9 fold/decade was achieved on average over the past two decades. Japan showed a growth rate of 1.6 fold/decade. For Thailand, Korea and Taiwan, Fig. IV-10

Fig. IV-12 Variation in Total Textile Consumption Per Capita



and IV-11 show the per capita consumption amount trend from 1950 to 1970. From these figures, it can be expected that a sudden and quick increment will take place until the per capita textile consumption amount attains 2 to 3 kg. per year. The growth rate during such a period of rapid increase was 1.7 fold in the case of Thailand, 2.9 fold for Korea and 8 fold in the case of Taiwan per decade. In Indonesia, the future amount of per capita textile consumption will also grow rapidly towards the 2 to 3 kg. level. On the basis of the rate of increase in the textile consumption amount in the above-mentioned countries, the consumption per capita in Indonesia by 1980 will be at least double the present level in the forthcoming decade and by 1980 the amount will attain the level of the regression line shown in Fig IV-9.

If the figure of US$183, which is the Indonesian forecast GNP per-capita for 1980, is incorporated into the above-mentioned formulae (1) and (2), the following will ensue.

2.3 kg/person/Y from formula (1)
2.4 kg/person/Y from formula (2)

As there is little difference between the GNP and GDP in the case of Indonesia, these two were taken as being identical.

Therefore, taking into consideration the range shown in the illustration of Fig. IV-9, the forecast on the textile consumption in 1980 by means of this method of approach will bring about the result of 2.0 to 2.8 kg/person/Y. On the assumption that the population in 1970 was 121 million and the total textile consumption amount was 120,000 T/Y, the per capita consumption for the year must have been 1.0 kg/person/Y. Assuming that the population in 1980 will be 150 million, and the per capita textile consumption amount 2.4 kg/person/Y, the total textile consumption amount will become 360,000 tons. During this decade, the per capita consumption increment will therefore be 2.4 fold. The fact that an increase of 2.4 times the present level is to be achieved in the textile consumption amount in 10 years, implies a considerably large extent of increment.

Considering the fact that the present Indonesia per capita textile consumption amount is on a low level of 1 kg/person/Y and, in view of the fact that there are actual preceding examples that several countries have in the past shown a large extent of growth from a level comparable to that of present Indonesia as previously mentioned, it is highly probable that a sudden take-off from this level will be achieved, thereby showing a rapid growth in the consumption. The growth rate in such an event is very likely to be 2.4 fold/decade, in view of the above examples. During the course of the first 5-year Plan of Indonesia, the per capita textile consumption amount for the basic year 1969 was 7.6m/person/Y and the target set forth for five years thereafter, i.e. in 1973, is 10m/person/Y. This corresponds to a 37% growth over the five years and when converted into a span of ten years, an 88% (approximately 2 fold) growth is contemplated to be achieved.

Indonesia has ample resources of oil and national industrialization is now being rapidly undertaken, so that an extremely high rate of economic growth is expected. Therefore, this fact, together with the results of the scrutinizations, implies a high possibility that the per capita textile consumption amount in 1980 will be at the level of 2 to 3 kg/person/Y. From the above, the textile consumption amount in Indonesia in 1980 was forecasted as under.

(Population: 154 million)

	Per Capita Textile Consumption (kg/person/Y)	Total Textile consumption (ton)	Average Annual Growth (%)
Minimum	2.2	340,000	11.0
Median	2.4	370,000	12.0
Maximum	2.7	410,000	13.0

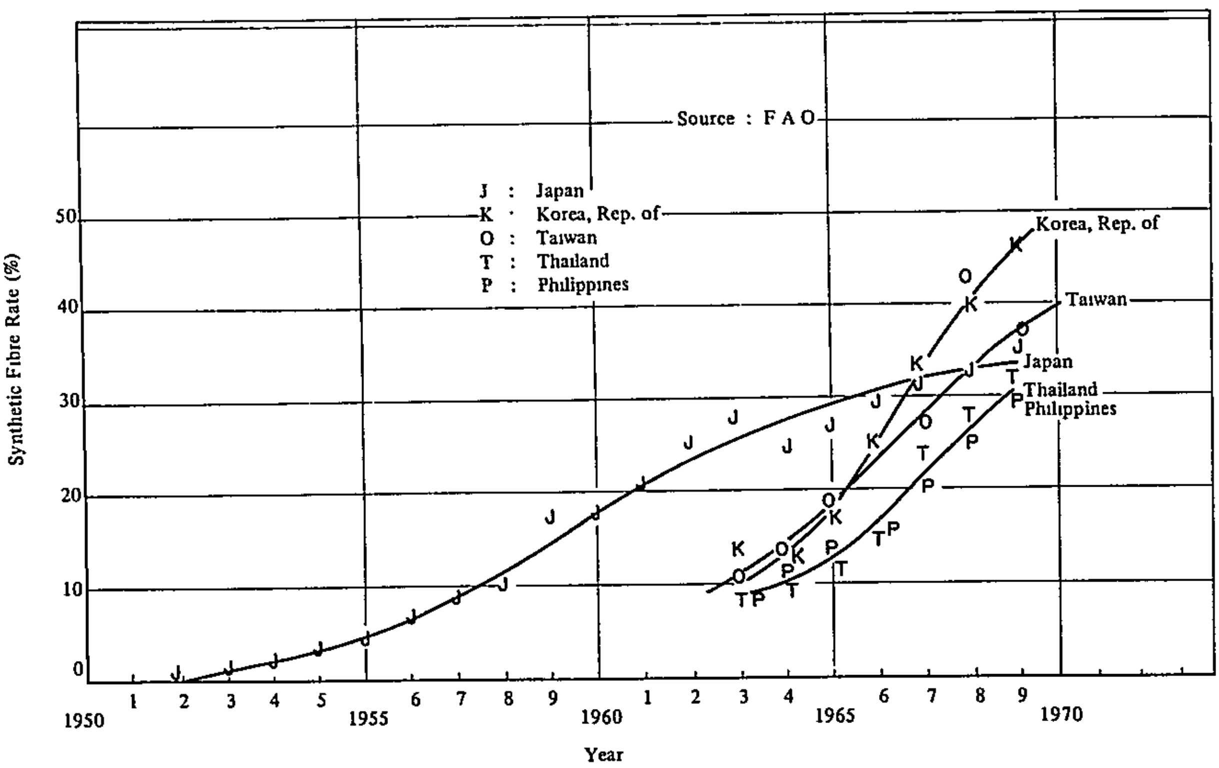
4-2. Synthetic Fibre Rate

(1) Forecast Upon the Synthetic Fibre Rate made on the basis of Other Countries

The past trends of synthetic fibre rate growth in various other countries where the present rates are comparatively high are shown in Fig. IV-13 for the purpose of forecasting the maximum attainable synthetic fibre rate and the growth of the rate in Indonesia.

As is evident from Fig. IV-13, the factor which exerts the most conspicuous influence upon the trend of the rate is the time factor. In other words, in the case of Thailand, the Philippines, Taiwan and (Korea), the rates in 1964 were 9 to 14%. Six years later in 1970, the rate attained a level of 30 to 35% in all cases and on this level a saturation point was achieved. Therefore, an extremely sudden and rapid growth of the rate can be noted during this period. In Japan, for seven years from 1959 to 1966, the rate changed from 10% to 30% quite rapidly and the synthetic fibre has shown thereafter approximately the same trend as in the case of the above countries. This fact implies that 6 to 7 years will be necessary from the synthetic fibre introduction until the full acceptance of the advantages in countries where the natural fibres have thus far been mostly employed. The synthetic fibre rate tends to show a growth stagnation once it attains the level of approximately 35%. Therefore, this level seems to be the universal saturation point of the growth of the synthetic fibre rate.

Fig. IV-13 Trend of Synthetic Fibre Rate



On the assumption that the 35 to 40% is the saturation level of the rate and when the data of Fig. IV-13 are employed as the basis for obtaining the logistic curve, the result will be as shown in Table IV-24. The value b in Table IV-24, which indicates the increment gradient of the

Table IV-24 Trend of Synthetic Fibre Rate in the World

	K = 35%			K = 40%		
	A	B	r	A	B	r
Thailand	-482	0.247	0.965	-390	0.200	0.976
Philippines	-404	0.207	0.961	-333	0.171	0.977
Korea, Rep. of	-690	0.353	0.899	-477	0.244	0.937
Taiwan	-476	0.243	0.991	-467	0.239	0.990
Japan	-319	0.164	0.980	-275	0.142	0.968

r : Correlation Coefficient

Formula $\log \left(\frac{y}{k - y} \times 10^3\right) = A + B x$

y : Synthetic Fibre Rate (%)

x : Year (ex 1960)

synthetic fibre rates can be deemed as being 0.20 to 0.25 except in the case of Japan. Therefore, the trend of the rate was forecasted by taking an assumption that the 35% rate is the saturation level of the rate also in the case of Indonesia and by taking the gradient b value at 0.22. The results are as shown in Table IV-25. From this, it is expected that the saturation level at 35% of the rate will be attained around 1977 in Indonesia. The Indonesian people who have so far been accustomed to natural fibres may or may not be prepared to accept the synthetic fibres with such a rapid rate. However, the answer to this question is implied by the fact that in Thailand, despite the fact that the self-sufficiency in cotton supply has been positively promoted, the synthetic fibre rate trend was displayed as mentioned above. In Indonesia, the cotton plantation is being undertaken on a trial basis, however, the future supply amount of cotton is scheduled on an extremely low scale. Taking into consideration the future increase in the cotton price, it is expected that the Indonesian conditions will inevitably push forward the increment in the synthetic fibre rate.

Table IV-25 Forecast on Trend of Synthetic Fibre Rate in Indonesia

	1970	1971	1972	1973	1974	1975	1976	1977
Synthetic Fibre Rate (%)	16.8	21.3	25.4	28.8	31.3	33.0	34.1	35.0

(2) Forecast on the Synthetic Fibre Consumption Rate in Correlation with the GNP per Capita

Forecasts were made concerning the demand trend for the synthetic fibres in Indonesia on the basis of the trend of synthetic fibre consumption in many countries. Table IV-26 shows the world-wide total textile consump-

Table IV-26 Consumption Amount of Main Textile Materials in the World

(t/y)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971*
Natural	12,120	12,217 (0.8)	12,790 (4.7)	13,272 (3.8)	13,608 (2.5)	13,669 (0.4)	13,776 (0.8)	13,989 (1.5)	14,033 (0.3)	14,093 (0.4)
Artificial (Cellulosic)	2,856	3,051 (6.8)	3,302 (8.2)	3,354 (1.6)	3,360 (0.2)	3,335 (0.7)	3,554 (6.6)	3,585 (0.9)	3,458 (Δ3.5)	3,347 (Δ3.2)
Synthetic (non-Cellulosic)	1,080	1,332 (23.3)	1,688 (26.7)	2,042 (21.0)	2,470 (21.0)	2,860 (15.8)	3,784 (32.3)	4,396 (16.2)	4,938 (12.3)	5,694 (15.3)
Total	16,056	16,600 (3.4)	17,780 (7.1)	18,668 (5.0)	19,438 (4.1)	19,864 (2.2)	21,114 (6.3)	21,970 (4.1)	22,429 (2.1)	23,134 (3.1)

( ) ... Rate of Growth (%/Y)

* Estimated Source : FAO

tion amount since 1962. The annual average growth rates in accordance with the raw materials employed for the total textile materials is only 4%, however, when the tynthetic fibres alone are extracted, the growth rate is approximately 20% for all types. Table IV-27 indicates that the region-wise production classification of the rapidly growing synthetic fibres. As is evident from this table, the synthetic fibre growth rate in the developing nations is approximately 40% per year in recent years, thereby indicating an extremely high level. For the future, it is expected that the speed of the growth of the synthetic fibre self-sufficiency rate will increase further.

Table IV-27 Production Amount of Synthetic Fibres in the World

	1965 (10^3 T)	1970 (10^3 T)	Annual Average Rate of Growth (%/Y)
Developed Countries	1,851.3	4,297.2	18.3
Centrally Planned Countries	137.2	363.7	21.5
U.S.S.R and Eastern Europe	136.0	352.6	21.0
Developing Countries	53.2	277.1	39.1
Total	2,177.7	5,290.6	19.4

Source : FAO

Table IV-28 shows the per capita synthetic fibre consumption amounts. As has been separately indicated, the actual achievement in Indonesia in 1970 was 20,000 tons of synthetic fibres as a whole, i.e. a per capita consumption of 0.17 kg/person/Y.

Table IV-28 Synthetic Fibre Consumption Amount per Capita (1970)

	(Kg/man.Y)
Japan	5.1
U.S.A.	7.8
Germany, Fed. Rep.	5.8
France	3.4
Italy	2.2
Taiwan	2.2
Thailand	0.9

Source: FAO

Fig. IV-14 shows, as the precedent examples, the production amounts of synthetic fibres in developing countries other than Indonesia where the production has already been undertaken for some time. These data have been obtained as one of the reference materials for forecasting the future in the synthetic fibre production in Indonesia. The data clearly indicate that the increment rate is 35%/Y which is quite high. In the cases of Korea and Taiwan where the dependency upon the export market is great, the textile processing facilities have also been quite substantially established, and therefore, it would be highly dangerous to adapt the cases such as these directly to the case of Indonesia, however, it must still be noted that there are precendent examples in other countries where the selfsufficiency rate development has shown an unexpectedly high level of velocity.

A type of international cross section analysis have been conducted on the basis of the actual achieved figures in various countries concerning the period from 1965 to 1970 pertaining to the correlation between the per capita textile consumption amount and the GNP per capita. The results are as shown in Fig. IV-15. The results indicate that the correlation between these two factors is considerably high. In the formula "$\log y = a + b \log X$" (where y = synthetic fibre demand and amount kg/person/Y, x = GNP US$/

Fig. IV-14 Trend of Synthetic Fibre Production Amount of the World

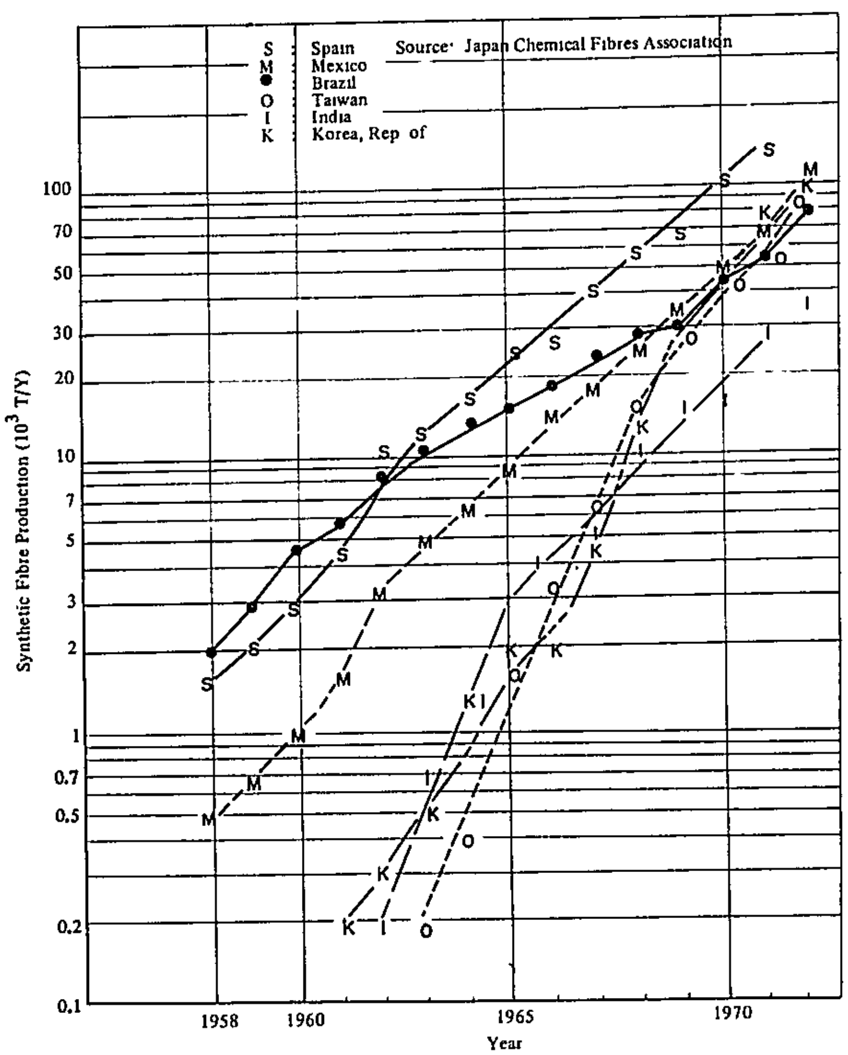
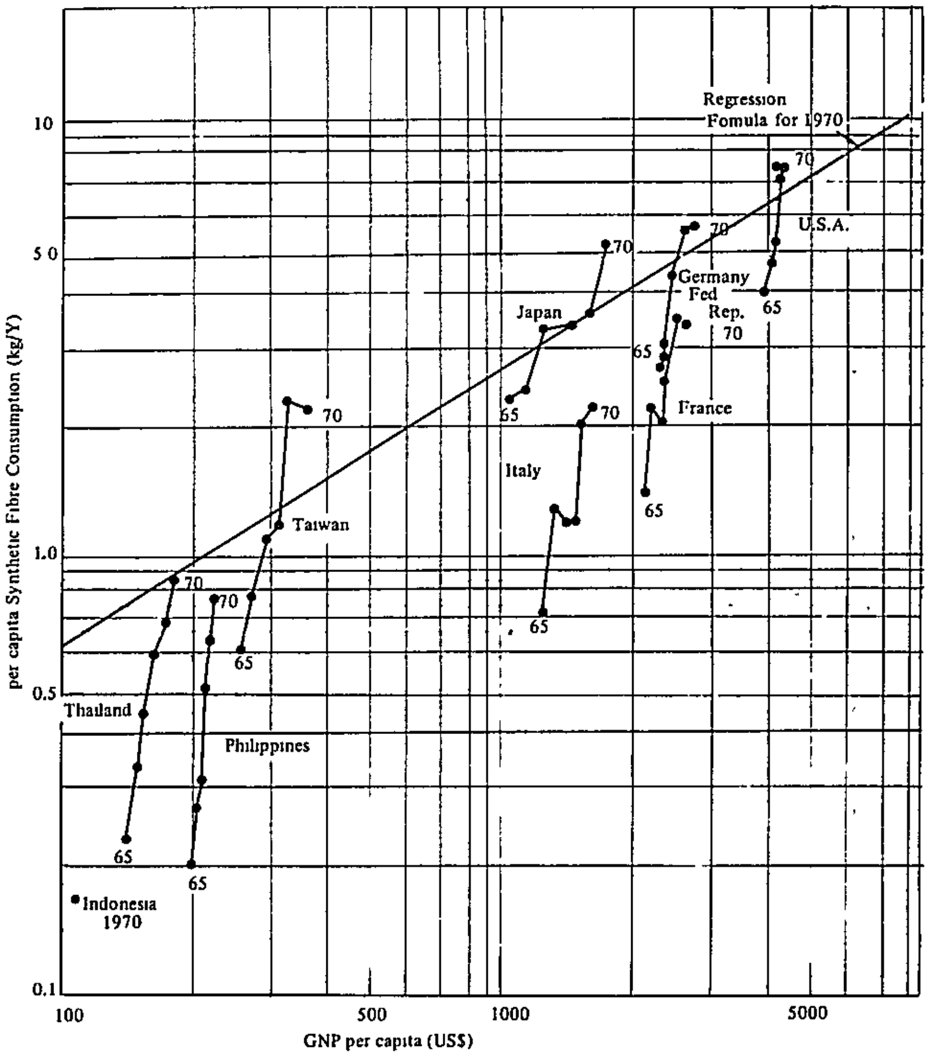


Fig. IV-15 Relationship between Synthetic Fibre Demand and GNP



person/Y), the coefficients "a" and "b" can be computed as shown in Table IV-29. As shown in Fig. IV-16, the intercept will show an increment and the gradient shows a decrease along with the advancement of the time.

Table IV-29 GNP per capita and Synthetic Fibre Consumption Amount per capita in the World (Kg/man.Y)

	a	b	Correlation Coeff.
1965	-2.365	0.8065	0.915
6	-2.172	0.7754	0.952
7	-1.932	0.7078	0.903
8	-1.802	0.6921	0.913
9	-1.558	0.6468	0.914
1970	-1.441	0.6189	0.920

Notes 1. Formula
$\log Y = a + b \log x$
y : per capita Synthetic Fibre Consumption (Kg/man.Y)
x : GNP per capita (US$)

2. Countries are U.S.A., Germany, Fed. Rep., France, Japan, Italy, Philippines, Thailand

This implies that, reflecting the fact that along with the influx of techniques, funds, capitals and products of the already industrialized countries into the developing countries, the synthetic fibre demands in the developing countries show increments even if the GNP does not show any increment along with the advancement of the time. On the other hand, along with the increment in the synthetic fibre rates throughout the world, the rates of the synthetic fibre demand increment (income elasticity) as against the improvement of the income show decreases. The above-mentioned relationship can be illustrated as in Fig. IV-17 in the form of an hypothetical formula. The extent of the variation in the coefficients "a" and "b" diminishes as the years go by as shown in Fig. IV-16 so that the saturation point is gradually attained. It is forecasted that the saturation figures are a = − 1.25 and b = 0.57. Table IV-30 shows the synthetic fibre demands for the years 1970

Table IV-30 Forecast on Synthetic Fibre Consumption (Indonesia)

Year		1970	1980
GNP per capita		108 US$	183 US$
Synthetic Fibre Demand			
per capita (Kg/man.Y)	Case I	0.66	0.91
	Case II	0.81	1.1
	Actual	0.17	-
Total (10^3Ton)	Case I	80	140
	Case II	98	169
	Case III	89	155
	Actual	20.2	-

Notes 1. Case I. Coefficients a and b of the year 1970 (Table IV-29)
a = -1.441 b = 0.6189

Case II. Coefficients a and b of the saturated figure
a = -1.25 b = 0.57

Case III. Average of Case I and II

2. Population 1970 121 x 10^6 men
1980 154 x "

Fig. IV-16 Time Sequential Change of Coefficient "a" and "b"

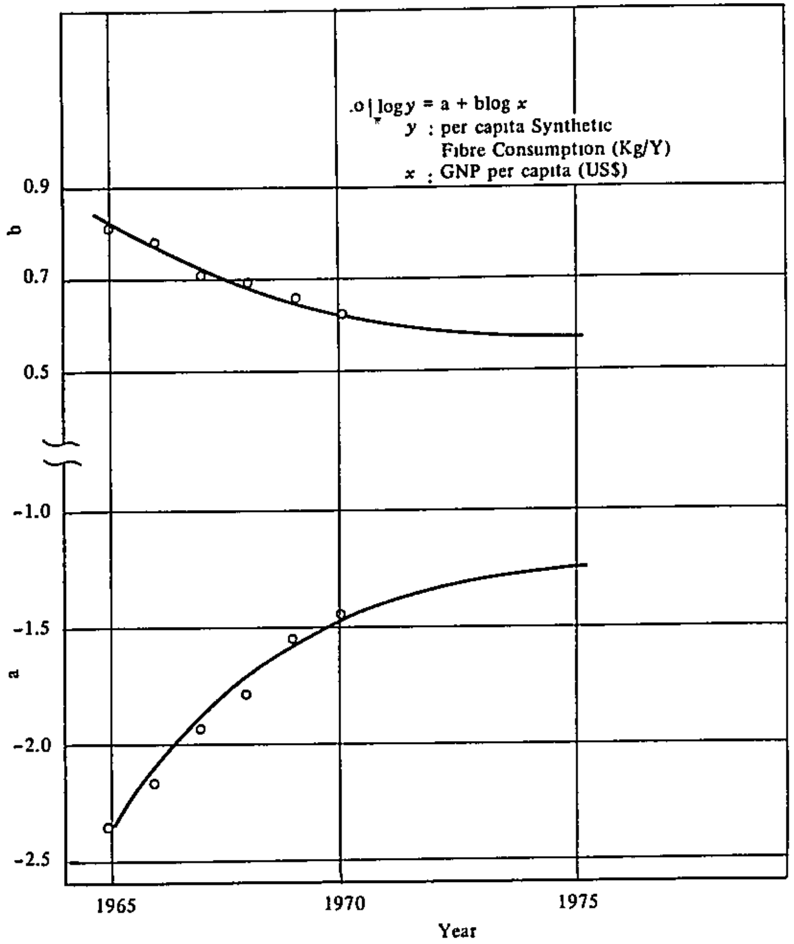
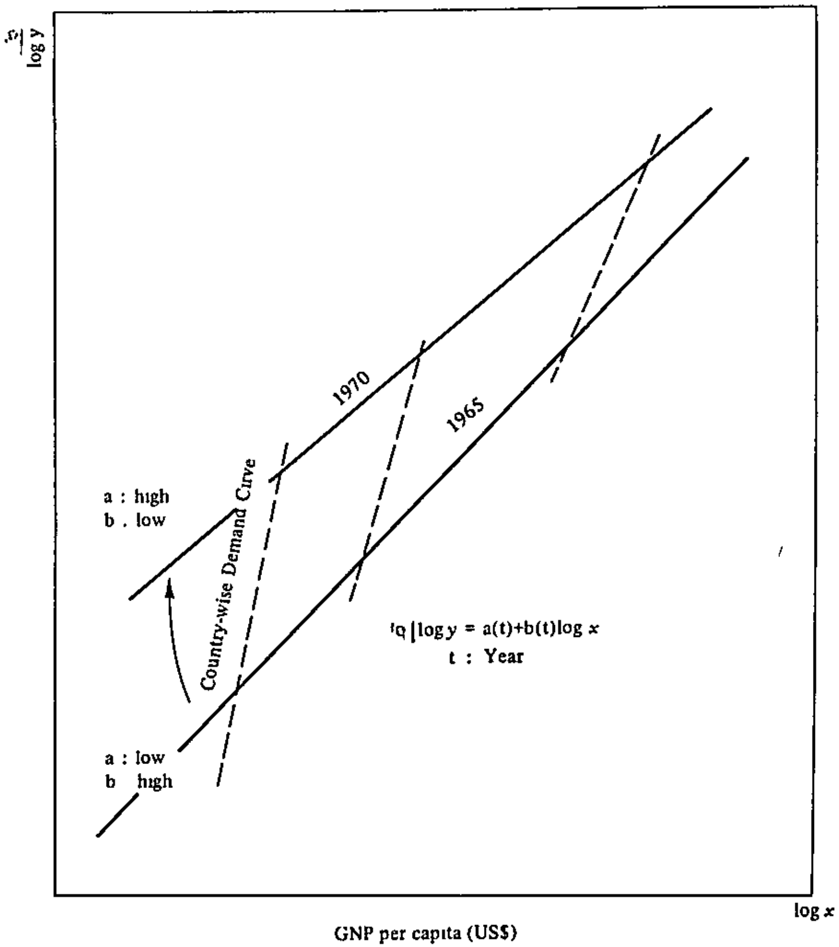


Fig. IV-17 Cross Section Analysis Model for Synthetic Fibre



and 1980 by adopting the 1970 figures (as the Case I) and the saturation values (as Case II). The demand amounts obtained by incorporating the GNP per capita of 1970 into these formulae shows the level which is extremely high when compared with the actually achieved figures. This implies that, as has already been explained, the extent of synthetic fibre replacement (the synthetic fibre rate) is rather low in the case of Indonesia and that in the future, the rate will rapidly and acutely increase along with the increment in the GNP per capita, as in the case of Thailand and the Philippines around 1965, towards the values of saturation level formulae (the formulae in which the coefficients "a" and "b" show the saturation values) of the synthetic fibre consumption amount. As is evident from Fig. IV-15, it took approximately six years in the cases of Thailand and the Philippines to attain the values corresponding to the regression formula for 1970 from the level of the synthetic fibre amount of 0.20 kg/person/Y. In the case of Indonesia, considering the fact that the synthetic fibre consumption is 0.17 kg/person/Y in 1970, it is assumed that approximately six to seven years at least will be necessary until the formula values can be obtained. Further, Table IV-30 shows the total consumption amount of synthetic fibres. The total demand amount of the synthetic fibres in 1980 will be 169,000 tons when utilizing the saturation values and the same will be 140,000 tons if the 1970 coefficients are incorporated.

As displayed by Fig. IV-15, the relationship between the Indonesian synthetic fibre consumption amount and the GNP per capita for the year 1970 are largely deviated from the regression formulae for 1970. This implies the fact that the situations and circumstances pertaining to the synthetic fibre production and consumption are largely different in the case of Indonesia from those of the other countries. Concerning this uniqueness of Indonesia, there seem to be two explanations of this situation due to which the Indonesian case does not correspond with the regression formulae obtained from the other countries. The first reason is that in the case of Indonesia, the total textile consumption amount is much lower than the others. In 1965, in spite of the fact that in the Philippines and Thailand, the total textile consumption was 2 to 2.5 kg/person/Y, the Indonesian figure showed 1.0 kg/person/Y even in 1970. As the Indonesian textile consumption is lower than the others, the regression formulae obtained from the other countries cannot be applied either. The second reason is that in the case of Indonesia, the synthetic fibre rate is considerably low. In the cases of Thailand and the Philippines, the rate was 30% in 1970, whereas the Indonesian rate was only 17% in the same year. The rate in Indonesia is presently increasing rapidly and therefore, where the rate attained saturation point, direct comparison with the others will evidently show a vast difference.

As explained in the foregoing paragraphs, Indonesia possesses a great potential for rapid and acute increment in the future in the textile consumption as a whole and the synthetic fibre consumption in particular. Therefore, even if the Indonesian per capita textile consumption rate does not attain the saturation regression formula level of 1970, it is evident that the regression formula level of 1970 will be attained in 1980.

The median values of the regression formulae for 1970 and 1980 are shown in Table IV-30 as Case III. Therefore, it is forecasted that the synthetic fibre consumption in 1980 will be on the level of 140,000 to 155,000 T/Y.

4-3. Rates in accordance with Fibre Types Employed

In order to carry out the scrutinization of the above rates, it is necessary to classify the textile materials into two categories, i.e. the textile materials to be processed into clothing and the textile materials to be used in industrial fields, interior materials, etc. However, on the level of the per capita textile consumption of 1 to 2 kg. per year, the first category, i.e. the textiles for clothing, takes up most of the consumption. Therefore, the portion destined for industrial use and interior use, etc. is extremely small. Also, in order to carry out the demand forecast on the industrial use materials, it is necessary to conduct thorough surveys concerning the related industries. As it is considered that the time is not as yet ripe for conducting such surveys concerning the demand fore-cast surveys on the industrial and interior use textile materials, the present scrutinization was made by taking the above two categories of textile materials together.

4-3-1. Synthetic Fibres

The synthetic fibres can be classified into two categories in accordance with the form assumed by them, i.e. filament yarns and staple fibres. The ratio of the filament and the staple in Indonesia at the present stage is approximately 1 : 1. As the replacement of natural fibre with synthetic fibre has just started, it is dangerous to formulate any forecast that the present rate will persist in the future along with the growth in the synthetic fibre rate. Table IV-31 shows the plant-based consumption of the synthetic fibre filaments and staples in various parts of the world and Table IV-32 stipulates the production ratio of these two categories. As is evident from these tables, the ratio of staple fibre vs. filament yarn is approximately 1 : 1. Table IV-33 shows the man-made fibre export amount from Japan and the domestic production amount of same in the case of Thailand which is geographically close to Indonesia. Further, Table IV-33 does not include the importation from Singapore or from other sources. Therefore, the figures stipulated in this table do not represent the total consumption amount in Thailand. If the tire-cords are included in this synthetic fibre consumption, the ratio between the filament yarn and the staple fibre is approximately 1 : 1. As is shown in Table IV-10, the Japanese exports of man-made fibres destined for Singapore show that the growth of the polyester FY has been particularly conspicuous is recent years so that the filament yarn vs. staple fibre ratio in this case is also nearing the 1 : 1 level. In Indonesia, due to the fact that the synthetic fibre rate is still low, the domestic fibre processing facilities are mostly used for treating cotton (in the form of staple fibre) so that it is forecasted that the future growth will be conspicuous in the synthetic fibre staples in general, and especially the polyester SF is expected to grow considerably. As shown in

Table IV-31 Rates of consumption of Synthetic Fibre Filament Yarn and Staple Fabric at Production Plants in the World

Country or Region	Total Fibre Consumption (Kg/man. Y)	FY (%)			SF (%)		
	1970	1968	1969	1970	1968	1969	1970
Developed Countries	15.4	50.9	50.6	49.4	49.1	49.4	50.6
Centrally Planned Countries	5.0	54.4	52.9	49.7	45.6	47.1	50.3
U.S.S.R. and Eastern Europe	13.0	54.5	53.8	50.3	45.5	46.2	49.7
Asian Centrally Planned Countries	1.9	-	-	41.7	-	-	58.3
Developing Countries	2.8	60.0	41.7	56.7	40.0	58.3	43.3
North America, Developed	20.5	51.5	50.9	51.6	48.5	49.1	48.4
Western Europe	12.7	53.4	52.0	48.5	46.6	48.0	51.5
European Economic Community	13.5	52.2	49.3	46.2	47.8	50.7	53.8
European Free Trade Association	14.5	58.6	60.7	56.1	41.4	39.3	43.9
Other Western Europe	7.8	41.6	40.6	38.8	58.4	59.4	61.2
Oceania, Developed	17.9	67.2	69.9	72.9	32.8	30.1	27.1
Other Developed Countries	13.6	44.0	45.9	45.4	56.0	54.1	54.6
Eastern Europe	12.5	39.4	41.3	38.7	60.6	58.7	61.3
Africa Developing	1.9	-	-	-	-	-	-
Latin America	4.3	61.8	59.7	61.9	38.2	40.3	38.1
Central America	4.3	67.1	61.4	62.8	32.9	38.6	37.2
South America	4.4	59.9	59.0	61.5	40.1	41.0	38.5
Near East, Developing	4.1	51.5	51.3	47.6	48.5	48.7	52.4
Near East in Africa	2.1	-	-	-	-	-	-
Near East in Asia, Developing	2.0	53.5	52.8	48.4	46.5	47.2	51.6
Asia and Far East, Developing	2.3	59.8	54.8	53.4	40.2	45.2	46.6
South Asia	2.2	-	64.3	64.2	-	35.7	35.8
East and South East Asia, Developing	2.6	58.6	53.3	51.7	41.4	46.7	48.3
Mean	7.9	54.7	53.3	52.3	45.3	46.7	47.7

Source : FAO

Table IV-32 Rates of Filament Yarn as against Synthetic Fibre in the Major Countries of the World

	Production in 1970 (10^3 ton)	FY (%) 1968	1969	1970
Australia	26.3	85.7	88.6	95.4
Argentina	24.1	78.3	79.1	73.0
Taiwan	42.9	64.5	62.5	72.0
Canada	73.0	71.8	69.7	71.6
U.S.S.R.	166.7	73.0	72.5	69.0
Czechoslovakia	28.7	67.9	71.1	68.3
Switzerland	47.7	69.7	69.1	67.3
Mesico	46.9	66.9	62.8	63.1
Netherlands	89.9	65.4	61.5	63.1
Brazil	43.6	59.9	57.2	62.4
Belux	33.4	64.3	56.4	57.2
Germany, Fd. Rep.	493.9	53.9	52.8	55.5
Korea, Rep. of	46.0	49.2	54.0	52.6
United States	1,626.7	51.5	50.1	50.0
United Kingdom	339.5	53.9	53.1	49.8
Spain	66.8	50.0	48.7	46.7
France	175.2	48.2	47.8	46.6
Japan	1,024.6	43.4	44.7	44.5
Italy	234.6	47.9	46.3	42.8
Poland	55.7	29.1	30.9	34.8
Germany, Eastern	40.1	38.6	41.4	33.9

Source : Textile Organon

Table IV-33 Domestic Production Amount of Man-made Fibre in Thailand and Importation thereof from Japan into Thailand

(ton)

	1967	1968	1969	1970	1971
Nylon FY	2,168	2,508	1,840	2,292	4,207
Polyester FY	615	820	360	1,429	2,578
Polyester SF	3,665	3,318	5,382	5,540	6,024
Acrylic SF	603	379	454	533	503
Rayon FY	984	735	401	1,053	481
Rayon SF	3,557	3,510	4,386	4,743	7,266
Others	2,135	1,649	1,429	1,796	1,861
Tyre Cord	671	890	1,371	1,394	1,638
Total	14,398	13,809	15,623	18,780	24,558

Note : As these figures do not contain the imports from Singapore and other countries, the figures do not represent the actual total consumption of Thailand

Fig. IV-18, the formwise ratio of the Japanese polyester export to Indonesia and Singapore evidently impiles that the portion comprised by FY is steadily growing year by year. From this point of view, in the event where the synthetic fibre rate in Indonesia grows considerably, it is forecasted that the 1 : 1 ratio will then be established between these two forms of synthetic fibres as was the case with the other nations. In other words, unlike the staple spinning plants, the filament processing facilities for the production of processed yarn do not call for a large extent of plant cost investment so that the scope of the investment required in this case will be comparatively low. This being the circumstance, the textile processing industrialists will be able to enter into this field comparatively easily. Further, the processed yarn is also used in the field of knitted products so that the advantage is obvious here that, unlike in the case of the woven fabric products, the knitted items call for a much lower extent of the plant cost investment in order to turn out the same amount of products. Therefore, it is forecasted that the filament yarn processing will show a considerable extent of growth in the future.

Regarding the cotton, the importation under the PL-480 will be reduced in the future so that in such an event, the cost-wise advantage of the polyester SF will become more evident and it is therefore expected that a high rate of growth will be embodied in the items woven with the mixture of polyester SF in general and in the T/C in particular.

Although the present demand level for the polyester SF is comparatively low, as shown in Fig. IV-18, a steady increment is noted so that it is forecasted that the consumption will show a considerable growth in the field of process yarn woven fabrics and knitted products.

As far as the nylon is concerned, this material is mostly in the form of filament yarn. At the present stage, a nylon FY production plant is under construction and there are several other projects for the construction of plants of this nature so that the consumption level of the nylon FY will take up approximately the same rate level as exists at present.

Regarding the acrylic fibres, a small amount is now being imported. Although there are several projects concerning the construction of spinning plants, it is not expected that any significant growth will materialize in this field due to the climatic disadvantages, etc.

From the above scrutinization, Table IV-34 was compiled concerning the rates in accordance with the fibre types employed, on the assumption that the synthetic fibre rate in Indonesia has grown to the level of 35%(the saturation level).

4-3-2. Rayon

Fig. IV-19 shows the rates of the rayon fibre production as against the total production amounts of the man-made fibres in various areas of the world. As these data show, the rate taken up by rayon is decreasing year after year, so that in North America where the rayon rate is the lowest of all, the rate is as low as 25%. This decrease tendency is expected to continue. However, the production amount of rayon does not show as high a degree of decrease as in the case of the rate against the total man-made fibres. The amount has been kept constant or is

Fig. IV-18 Form-wise Rates of Exportation of Polyester Fibres from Japan to Indonesia and Singapore

Source. Japan Lxports & Imports

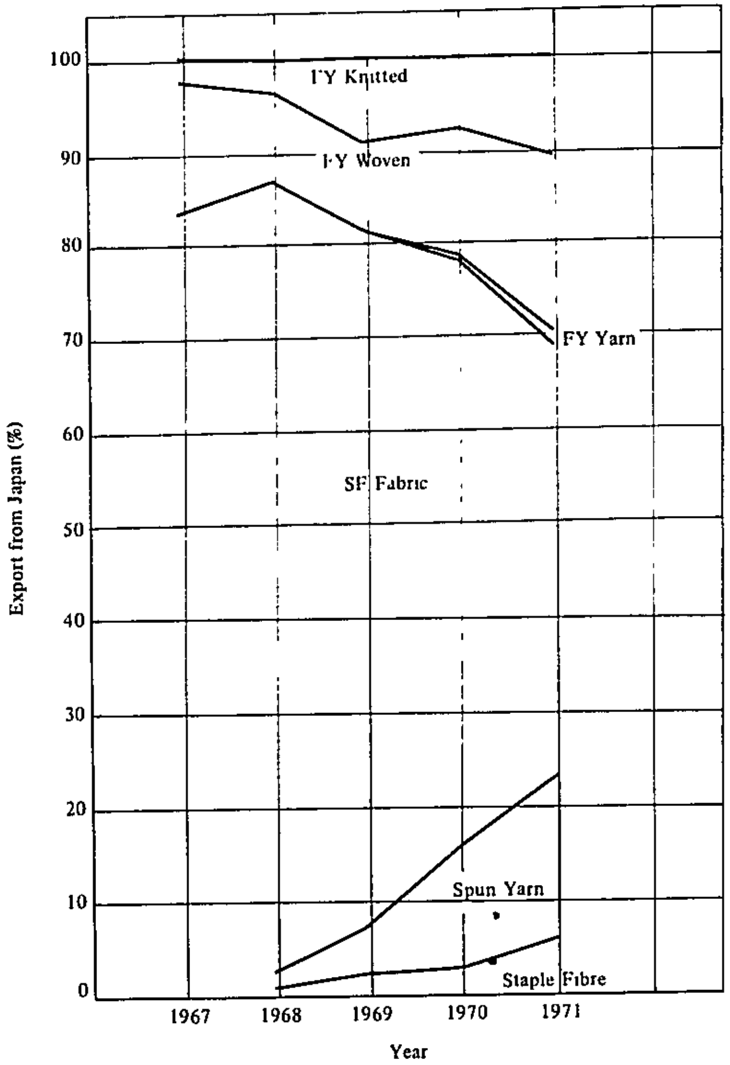


Fig. IV-19 Rates of Rayon Fibre in Man-made Fibres in the World

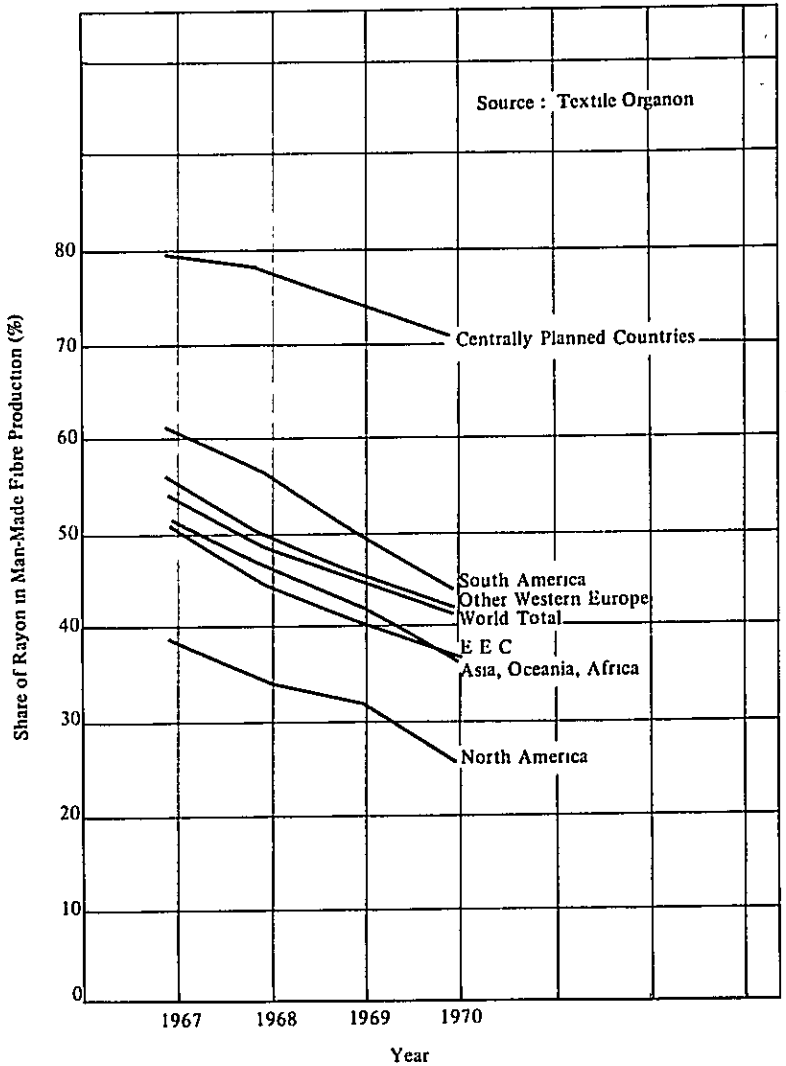


Table IV-34 Forecast on Type-wise Rates of Fibre Demand in Indonesia

(%)

		Average of 1970, 1971	Forecast on 1977
Type, Form	Cotton	79.1	59.4
	Rayon FY	0.7	0.7
	Rayon SF	3.4	4.9
	Nylon FY	4.8	9.2
	Polyester FY	2.7	6.6
	Polyester SF	7.1	16.6
	Acrylic SF	0.8	1.2
	Others	1.4	1.4
	Total	100.0	100.0
Type	Cotton	79.1	59.4
	Rayon	4.1	5.6
	Nylon	4.8	9.2
	Polyester	9.8	23.2
	Acrylic	0.8	1.2
	Others	1.4	1.4
	Total	100.0	100.0

showing only a slight trend toward decreasing. This is due to the fact that the increment in the production amount of synthetic fibre is large. At present in Indonesia, approximately 6,000 T/Y of rayon is being consumed, thereby comprising approximately 20% of the total man-made fibres. In actuality, the market price of rayon is on quite a critical level so that it is difficult for newcomers to enter into this field. It is not expected, therefore, that the production amount of rayon will show a large extent of growth in the future. From the viewpoint of the characteristics and the properties of rayon itself, it seems rather difficult for rayon to replace the cotton materials. From the cost point of view, no positive factor is present which predicts the reduction in the cost of rayon in the future.

In view of the above results, it is expected that, although the absolute consumption amount of rayon in the future will grow along with the increment in the synthetic fibre rate due to the consumption of rayon in the form of a mixture into woven fabric materials, the rayon rate in the total textile consumption amount will be gradually reduced. Therefore, by 1977 when the synthetic fibre rate is expected to attain the level of 35%, it is predicted at this stage that the rayon rate will be 14% (20% at present) in the total man-made fibre consumption.

4-3-3. Cotton

For Indonesia, the proper selection of the fibre type for spun yarn bears considerable significance. Especially regarding cotton, the inventory of the U.S. cotton upon which the cotton supply of Indonesia is dependent, because of the PL-480 background, is now decreasing, as shown in Table IV-35. At the same

Table IV-35 Amount of Stock Production and Consumption of U.S. Cotton

(Inventory figures as of the beginning of each fiscal year, on 1st August.)

(10^3 ton)

	Stock	Production	U.S. Consumption
1965	3098	3231	-
1966	3664	2138	2060
1967	2710	1561	2060
1968	1409	2385	1951
1969	1409	2168	1778
1970	1258	2233	1735
1971	932	2233	1756

Source : World Cotton Statistics

time, the production of cotton has not shown any increment since 1966. Therefore, it is obviously dangerous to depend entirely upon the cotton supply by PL-480. Also, the price level of the U.S. cotton is as shown in Table IV-36, showing a basic up-trend. Further, the cotton plantation in Indonesia has not necessarily been successful so far. It is therefore expected that the rate of cotton in the total textile consumption in Indonesia will reduce acutely. Thus, an assumption is made that the cotton rate in 1977 will be on an approximately level of 60% (presently 79%).

The above described demand forecasts are integrated into Table IV-37 through 39. Fig. IV-20 shows the trend variation of the rates in accordance with the fibre type employed.

Table IV-36 Price of U.S. Cotton

(US$/kg)

Source / Length / Year	World Cotton Statistics *1			U.S. Foreign Trade *2		
	M 1"	SM $1\frac{1"}{16}$	SM $1\frac{3"}{32}$	under 1"	$1\text{-}1\frac{1"}{8}$	over $1\frac{1"}{8}$
1967	-	-	-	0.44	0.55	0.72
1968	0.59	0.67	0.75	0.47	0.56	0.86
1969	0.58	0.64	0.69	0.46	0.53	0.66
1970	0.66	0.70	0.73	0.49	0.56	0.67
1971	0.79	0.81	0.85	0.56	0.63	0.72

* 1. U.S. Cotton C.I.F. Liverpool

* 2. FOB Price

Table IV-37 Forecast on Fibre Demand in Indonesia (Total Fibre Consumption Growth Rate at 11%)

(ton)

	Cotton	RayonFY	Rayon SF	Nylon FY	Polyester FY	Polyester SF	Acrylic SF	Others	Total
1970	94,900	800	4,100	5,800	3,200	8,500	1,000	1,700	120,000
1971	98,900	900	5,000	7,900	4,900	12,600	1,200	1,900	133,300
1972	103,200	1,000	6,100	10,200	6,700	17,100	1,500	2,100	147,900
1973	108,500	1,200	7,200	12,600	8,700	21,900	1,800	2,300	164,200
1974	115,500	1,300	8,400	15,100	10,600	26,700	2,000	2,600	182,200
1975	124,500	1,400	10,000	17,700	12,500	31,400	2,300	2,800	202,600
1976	135,500	1,600	10,800	20,200	14,400	36,200	2,700	3,100	224,500
1977	148,000	1,700	12,200	22,900	16,400	41,400	3,000	3,500	249,100
1978	164,200	1,900	13,600	25,400	18,300	45,900	3,300	3,900	276,500
1979	182,400	2,200	15,000	28,200	20,300	51,000	3,700	4,300	307,100
1980	202,400	2,400	16,700	31,300	22,500	56,600	4,100	4,800	340,800

Table IV-38 Forecast on Fibre Demand in Indonesia (Total Fibre Consumption Growth Rate at 12%)

(ton)

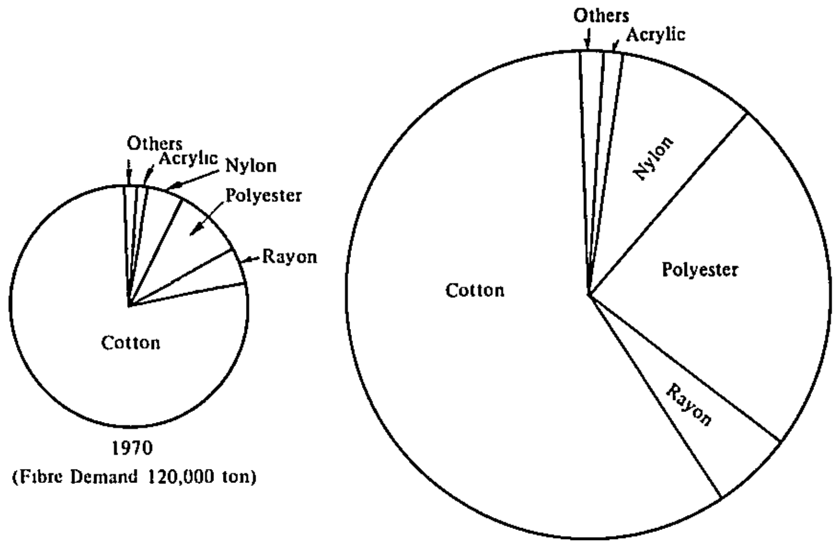
	Cotton	Rayon FY	Rayon SF	Nylon FY	Polyester FY	Polyester SF	Acrylic SF	Others	Total
1970	94,900	800	4,100	5,800	3,200	8,500	1,000	1,700	120,000
1971	99,800	900	5,100	7,900	4,900	12,700	1,200	1,900	134,400
1972	105,000	1,100	6,200	10,400	6,800	17,400	1,500	2,100	150,500
1973	111,500	1,200	7,400	13,000	8,900	22,500	1,800	2,400	168,700
1974	119,700	1,300	8,700	15,700	11,000	27,700	2,100	2,600	188,800
1975	130,200	1,500	10,000	18,500	13,100	32,900	2,400	3,000	211,600
1976	143,000	1,700	11,400	21,300	15,200	38,200	2,800	3,300	236,900
1977	157,600	1,900	13,000	24,400	17,500	44,000	3,200	3,700	265,300
1978	176,500	2,100	14,600	27,300	19,600	49,300	3,600	4,200	297,200
1979	197,700	2,300	16,300	30,600	22,000	55,200	4,000	4,700	332,800
1980	221,400	2,600	18,300	34,300	24,600	61,900	4,500	5,200	372,800

Table IV-39 Forecast on Fibre Demand in Indonesia (Total Fibre Consumption Growth Rate at 13%)

(ton)

	Cotton	Rayon FY	Rayon SF	Nylon FY	Polyester FY	Polyester SF	Acrylic SF	Others	Total
1970	94,900	800	4,100	5,800	3,200	8,500	1,000	1,700	120,000
1971	100,700	1,000	5,100	8,000	5,000	12,800	1,200	1,900	135,700
1972	106,900	1,100	6,300	10,500	7,000	17,700	1,500	2,100	153,100
1973	114,500	1,200	7,600	13,300	9,100	23,100	1,900	2,400	173,100
1974	124,100	1,400	9,000	16,200	11,400	28,700	2,200	2,700	195,700
1975	136,100	1,600	10,500	19,300	13,600	34,400	2,500	3,100	221,100
1976	150,800	1,800	12,100	22,400	16,000	40,300	3,000	3,500	249,900
1977	167,700	2,000	13,800	26,000	18,600	46,900	3,400	4,000	282,400
1978	189,500	2,200	15,600	29,400	21,100	53,000	3,800	4,500	319,100
1979	214,100	2,500	17,700	33,200	23,800	59,900	4,300	5,100	360,600
1980	241,900	2,900	20,000	37,500	26,900	67,600	4,900	5,700	407,400

Fig. IV-20 Type-wise Rates of Fibre Demand in Indonesia



4-4. Demand Forecast on the Basis of Knowledge Obtained through On-site Surveys

As has already been discussed in Chapter 4 "The Method of Demand Forecast", it was not possible to conduct surveys from the "Micro" point of view throughout the present surveys, however, on the basis of information collected during the course of investigations and by incorporating the impressions obtained through the on-site surveys, the following comments were formulated in addition to the so-far described discussions concerning the demand forecast which has virtually been compiled on the basis of the so-called "Macro" viewpoint.

4-4-1. Textile Situation in view of the Fibre Types

Traditionally, the Indonesian market is the so-called "market for spun materials", however, except for a mere 1% of the domestic supply of cotton, all other materials such as spun materials, cotton, rayon and synthetic fibre staple yarn are being imported. The following paragraphs will treat observations concerning the future trend of the above-mentioned fibre types for textile products.

1) Cotton

The major textile material which has been and is supporting the textile demands of Indonesia is cotton (mostly originated in the U.S.A.). This situation is also basically true in the case of the other developed nations, although there are differences between these nations and Indonesia in view of the utilization rate of cotton materials as against the total textile materials. Especially from the viewpoint that Indonesia is located in a tropical climate, the position assumed by cotton as being the moisture absorbing material may not be affected, perhaps more in the form of blended components, even if the synthetic fibre rate has been highly advanced in Indonesia.

Regarding the problems pertaining to the cotton plantation in Indonesia which is presently being carried out for the ultimate purpose of embodying self-sufficiency in the supply of cotton, the following findings were achieved as the result of visits to Perkebunan and spinning plants concerned. In view of the under-mentioned results, it seems inevitable that the cotton plantation project will have to be promoted more positively than at present, as the abolition of the PL-480 approaches. However, it will take a long time to replace all the present cotton consumption with the domestic production. The results of the visit paid to Perkebunan and the spinning plants concerned are as follows.

(1) As far as the quality of cotton is concerned, the U.S. cotton is adequate.

(2) As shown in Table IV-40, the quality of the U.S. cotton harvested in East Java showed no difference in quality when compared, at a Dutch laboratory with the U.S. cotton qualitatively. Further, it was confirmed through experimental application of the East Java cotton to the actual plant spinning tests that the spinning and processing capabilities and other properties and the quality of the products turned out presented little difference from the U.S. cotton.

Table IV-40 Quality of Cotton

Characteristics		Indonesia (Lombok) B.G.M. 1 3/32"	U.S. Cotton S.L.M 11/16"
Micronaire		4.08	4.18
Maturity		82	85
Pressley		79,000 lbs	78,000 lbs
Stelometer	0	38.1	38.5
	1/8"	21.4	21.0
Elongation		7.6	7.5
Meanlength		0.97	0.95
Fibre	25%	1.18"	1.19"
length	C.V.	28.3%	32.8%
Short Fibre	1/2"	5.9	8.5
Shirley analysis		95.3	94.2
Jrash.		2.5	2.0
Invisible loss		2.2	3.8

Source : Industrial and Agricultural aspects of cotton growing

(3) Although there is a slight fluctuation due to transportation charges, the domestically produced cotton price under small scale production is 300 Rp. for 1 kilogramme delivered at the

plant. The price of the U.S. imported cotton under the PL-480 on the same delivery basis is Rp. 260 for 1 kilogramme, resulting in a difference of Rp. 40 per kilogramme. There is a possibility that the PL-480 under U.S. Aid is to be abolished in the future and if the importation is to be made free from the U.S. Aid, the price would be Rp. 400/kg.

(4) The cotton plantation project of Indonesia is as shown in Table IV-41. In accordance with the project, 4,500 T/Y is targeted for 1974/75 and 30,000 T/Y is projected in 10 years.

Table IV-41 Cotton Plantation Projects in Indonesia

Year	Cultivated Area (Ha)	Production (t/y)
1971/1972	2,000	600
1972/1973	6,000	1,800
1973/1974	9,000	2,700
1974/1975	15,000	9,000
1981/1982	100,000	30,000

Source : Perkebunan

(5) The above-mentioned cost of Rp. 300/kg. is partly due to the fact that the production scale is extremely small, however, the major cause for the high cost is said to be due to the expenses incurred in connection with insect control.

2) Rayon Staple

The details of the scrutinization made concerning the rayon staple will be treated later in this report, as the feasibility studies of the Indonesian rayon industry were included as one of the purposes of the present survey. Generally speaking however, the yield of needle leaved trees which are the most adequate raw materials for DP (rayon pulp) is low in Indonesia. Although the plantation of woods is being undertaken, the materials are mostly destined for the production of paper, so that even if a certain portion of the planted woods is allocated for producing DP, it would fill up only a small portion of the total DP demand. Even if the plantation of the woods were undertaken purely for the purpose of producing DP, it would take some 15 years until the actual utilization of the materials could be undertaken. Concerning the utilization of the abundantly available tropical woods, there are several technical difficulties which make it extremely difficult to utilize these types of woods. Under such circumstances, the total supply amount, or almost all of the pulp for rayon (DP) will have to depend upon expensive imports for the future.

Further, the prices of the Indonesia domestically-produced basic chemicals are unexpectedly high, thereby making it even more difficult to carry out the industrial scale production of rayon SF. In view of the demand trend, it is evident that an increment will be made in the consumption of polyester/rayon blended spun materials and it is also evident that the demand for rayon SF will increase along with the increment in the demand for polyester.

3) Synthetic Fibres

At the present stage, the Indonesian textile industry virtually consists of suiting and shirting materials and knitted fabrics for underwear, all utilizing cotton as the main raw material. The existing spinning and processing facilities are therefore all designed for the production of these items. In recent years, Indonesia has experienced a rapid growth in the demand for fabric materials made of blended spun yarns of polyester/cotton and polyester/rayon. This phenomenon seems to be a natural result stemming from the fundamental nature of the textile industry of the country as mentioned above. Generally speaking, concerning the blending ratio for the blended spun yarn for use in producing woven fabric of polyester/cellulose is 65%/35%. This ratio is generally adopted in order to fulfil the functions required of the woven fabrics such as "easy care", "crease recovery" etc. On the other hand, the moisture absorbing characteristics of the above-mentioned woven fabrics are inferior to woven fabrics made of 100% cellulose yarn, however, in accordance with actual experiences throughout the present survey, no particular problems were noted in wearing woven fabrics made of blended spun yarn even under the Indonesian tropical climate. It was felt that the advantages in easy-care of the woven fabrics made of blended spun yarn offset the disadvantages. In view of the suitability aspect, the polyester rayon yarn is generally used for the fabrics for suiting and the polyester/cotton yarn is employed for the shirting fabrics. According to findings made through discussions with the engineers at the time of visiting textile mills during the course of the present survey, it was confirmed that the same trend is present in the textile markets of Indonesia.

When considering matters pertaining to the establishment of self-sufficiency in the supply of textile raw materials in Indonesia, a great future growth is anticipated in the case of synthetic fibres, as Indonesia has a great advantage in that it is a rich oil producing country and also a petro-chemical complex is planned to be established in the near future.

4-4-2. Textile Industry Situation at Present in view of Market Status

1) The main portion of the demand is taken up at present by count 20 cotton yarn woven fabrics, however, a remarkable growth is being achieved in the demand for woven fabrics of polyester/rayon blended spun yarn in the suiting field and of the polyester/cotton blended spun yarn in the shirtihg field. This seems to be due to the fact that in addition to the wash-and wear property, the strength (high resistance against tearing) of the fabrics made of blended spun yarn is an extremely favourable point.

2) In addition to the above-mentioned materials, in the Indonesian market a considerable extent of acceptance has been gained by the woven and knitted fabrics made of acrylic spun yarn, nylon yarn, and polyester yarn even under the tropical climate.

The fact that the adaptability range of the human body to the atmospheric temperature variation is extremely limited should be reassessed in relation to the textile demand. From this viewpoint, it seems possible to popularize sweaters which are made of synthetic fibre blended spun yarn. In connection with the body's limited adaptability as mentioned above it seems worth mentioning that the so-called motorization may also possess an induction effect on the textile demands. In this connection it seems possible that jumper wear will be popularized.

3) In the Indonesian textile market, all western style clothing now being used from spring to autumn in the countries in the temperate regions can be totally applicable to and acceptable for the Indonesian market because of the climatic conditions and in addition to this fact, the willingness to purchase clothing is quite strong in the Indonesian market.

4) From the aspect of production, as a result of the positive promotion rehabilitation programmes, all the existing machines in the spinning field are under full operation covering spinning machines built in the U.K. in 1939 up to the most modern machines. In the weaving field, the woven materials are being produced in accordance with the pre-designed weaving widths, thereby attaining a steady growth in production.

At the spinning, weaving, dyeing and finishing stages, the expansion of the already existing plants and constructions of new mills are being undertaken one after another. The general aspiration in the industrial sphere for the production enhancement of the synthetic fibre blended yarn and the woven fabrics therefrom is quite strong.

4-4-3. Demand Forecast

Observing the above general situation existing in the Indonesian textile industry at present, the following paragraphs concern the qualitative observation concerning the future fibre demand.

1) The Indonesian market will continue to be the so-called "spun market" and the cotton woven fabrics, and T/R woven fabrics will be the main materials. Also, this status will be further reinforced by the fact that at present, the number of processing machines for spun yarn is much greater than that of filament processing machines. Also, in the shirting and suiting fields, it is evident that a rapid growth will be realized in the demand for woven fabrics made of polyester/cotton and polyester/rayon blended yarns.

2) Concerning the nylon FY, polyester FY, acrylic SF, etc., these will also show a steady growth especially in the decoration and interior industry oriented fields along with the versatility of the products in the future textile market of Indonesia. However, it is difficult to forecast at this stage whether or not these types of fibres will assume as dominant a position as the polyester SF, because of the fact that the growth of these materials heavily depends upon the extent of future acceptance of knitted products in the market.

3) Concerning cotton, the inventory of the U.S. cotton, upon which Indonesia relies greatly under the background of the PL-480, it is evident that the demand/supply position has been improved in the international market in general. Therefore, the future trend may not permit Indonesia to rely solely upon U.S. cotton. The rather dim possibility of future continuation of the PL-480 should also be taken into consideration in this respect.

4) When considering the necessity to cope with such a fundamental change in the situation, which may shift the very basics of the fibre supply conditions in Indonesia, it seems highly necessary to consider the diminution of the blending amount of cellulose fibres into polyester SF, to the minimum required level, thereby shifting the major fibre supply source from cotton to polyester SF and, at the same time, taking the advantage of the cotton characteristics of the perspiration absorbing performance under the tropical climate. (When spinning the T/C yarn in the same manner as the T/R without the comber, it is technically impossible to draw out a high class yarn such as the 60s, however, 20s or 30s can be fully produced within the existing capacity range of the Indonesian spinning industry.)

5) On the assumption that the possibility of the above considerations are incorporated into the policy of the Government of Indonesia, the demand forecast in accordance with the fibre type seems to imply that the ratio of polyester SF in 1980 will attain the level of approximately 22%, and, along with this achievement, it seems possible that the rate taken up by rayon will also increase slightly. As a reference, Table IV-42, shows preliminary calculations by incorporating the

Table IV-42 Demand forecast based on knowledge obtained through on-site surveys

	Demand forecast based on knowledge obtained through on-site surveys		Demand forecast of fibres in Indonesia*	
	(%)	(t/y)1)	(%)	(t/y)1)
Cotton	59	219,900	59.4	221,400
Rayon	6	22,400	5.6	2o,900
Nylon FY	6	22,400	9.2	34,300
Polyester FY	4	14,900	6 6	24,600
Polyester SF	22	82,000	16.6	61,900
Acrylic SF	1 5	5,600	1.2	4,500
Others	1.5	5,600	1 4	5,200
Total	100	372,800	100	372,800
Synthetic fibre total	35		35	

* Final forecast figure of the team

1) Rate of growth 12% p.a.

above points on the basis of the forcast values for 1980. However, the figures shown in this table have been selected on the assumption that the governmental policy will be undertaken in such a way that the cellulose fibre utilization amount in blending would be kept to the minimum required level as mentioned above. Therefore, these figures should be understood as an illustration of one of the possibilities. This being the circumstances, these figures will not be employed in the following scrutinizations of the feasibility of industrial scale production of rayon and synthetic fibres.

4-5. Consumption Amount of Man-made Filament Yarn and Staple Fibre

The synthetic filament yarn and staple fibre consumption amounts in Indonesia do not imply the total demand for synthetic fibre. The amount obtained was calculated by subtracting the import amount from the total textile consumption. In other words, if the export of staple fibre and filament yarn from Indonesia is not taken into consideration, the amount corresponding to the total facility capacity for processing the staple fibre and filament yarn inside Indonesia should correspond to the demand amount for these items. This fact is important when assessing the scale of production when planning to construct synthetic fibre production plants in Indonesia.

4-5-1. Present Status of Textile Industry in Indonesia

The characteristics of the textile industry of Indonesia can be enumerated as follows.

(1) It is a labour intensive industry centering around cotton.

(2) Approximately 1% of the total consumption of cotton, i.e. 80,000 to 90,000 T/Y is being domestically supplied and all the other textile raw materials are relying entirely on imports.

(3) The productivity of the cotton spinning machines, comprising 513,652 spindles under operation at present is approximately 70% to 75% of the developed countries.

(4) Due to the fact that the production capacity facilities for producing spun yarn for clothing materials, such as spinning machines and processing machines is on a level of 40% to 50% of the total capacity of fabric producing facilities such as weaving or knitting machines. Therefore, the imported amount of filament yarn is much higher than the imported amount of staple fibre.

(5) At present, the replacement of natural fibres with synthetic fibres is being undertaken in the fields of T/C shirting, T/R suiting and warp knitted fabrics of nylon FY, however, the rehabilitation of the government-owned mills and plants, etc. is behind schedule.

During the present survey, 11 spinning mills (comprising 304,620 spindles), 7 weaving mills (weaving and finishing), and one warp knitting mill were visited including the ITT's spinning pilot plant.

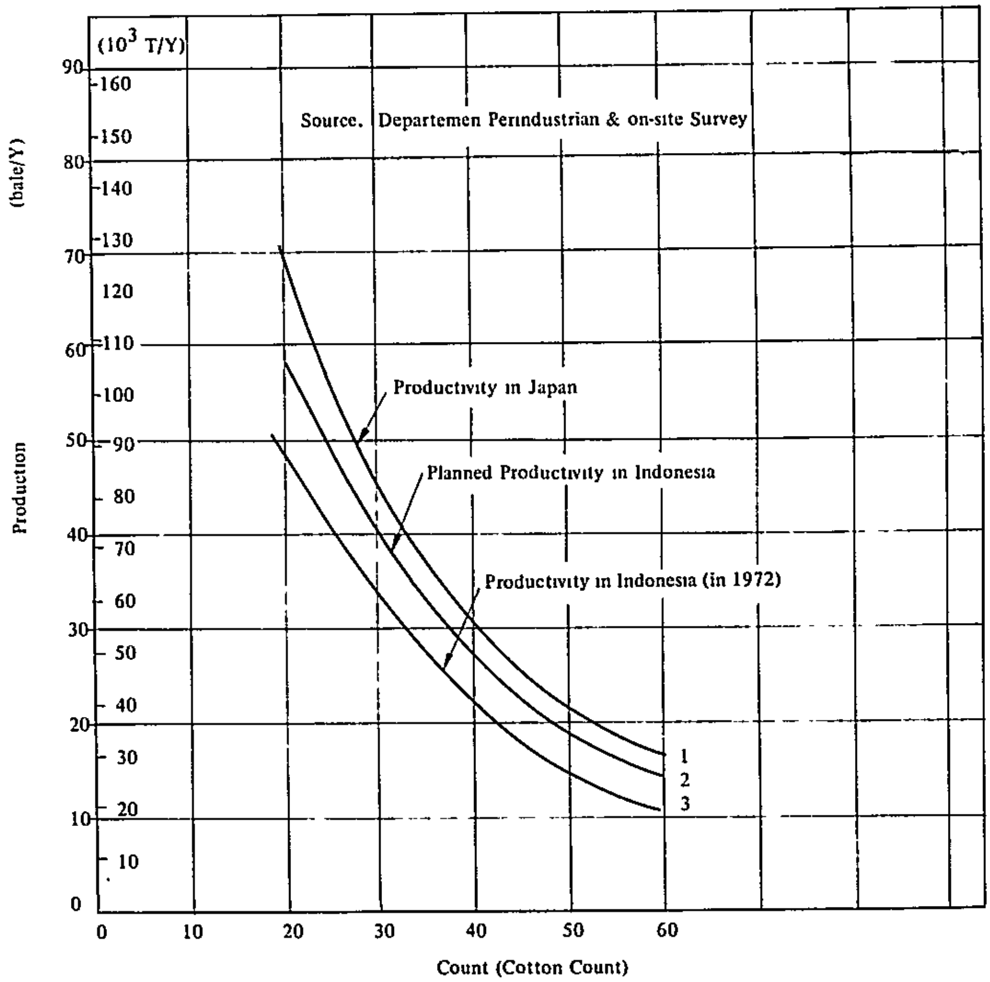
Table IV-43 shows the outline of the mills and plants which were visited.

1) Facilities in Indonesian Textile Industries

(1) Spinning Facilities

Except for the 6,000 spindles of the Ramie Siantar, all the existing Indonesian spinning facilities are of cotton spinning type equipment. Table IV-44 shows the outline of the existing spinning facilities in Indonesia. As shown in Fig. IV-21, the productivity of these facilities is approximately 70% to 75% that of industrialized countries such as in the case of Japan. The possible reason for this fact are as follows.

Fig. IV-21 Spinning Productivity in Indonesia



a. Techniques in the operation and maintenance are insufficient.

b. Facilities are not sufficiently developed in such fields as the employment of auto-doffers, etc. for the labour-saving and production speed enhancement.

Table IV-43 Outline of the plants and Mills Visited

Name of Mills	Location	Machinery				Actual Production	
		Spinning (SP)	Weaving (m/c)	Dyeing & Finishing	Knitting	Yarn (t/d)	Fabrics (m/d)
Patal Senajan	Djakarta	30,000	-	-	-	C^{100} 20/1 30/1 36/1 ; 10.5	-
Patal Bandjaran	Bandung	30,784	-	-	-	C^{100} 20/1 30/1;4.1 T/C 44/1;4.4	-
Patal Tjilatjap	Tjilatjap	60,000	-	-	-	C^{100} 24/1 ; 26.1 T/C 45/1 ; 2.3	-
Patal Grati	Pasuruan	30,132	-	-	-	C^{100},20/1,30/1;6.8,T/R,20/1,40/1;4.3	-
Patal Palembang	Palembang	30,384	-	-	-	C^{100} 20/1 30/1 ; 12.1	-
G.K.B.I.	Jogjakarta	34,000	500	1 set	-	C^{100} 32/1 36/1 ; 9.0	C^{100} ; 80,000
Primissima	Jogjakarta	9,072	180	-	-	C^{100} 60/1 ; 1.1	C^{100} ; 10,000
Inbritex	Pasuruan	35,176	456	-	-	C^{100} 20/1 30/1 ; 15.4	C^{100} ; 41,700
Texin	Tegal	37,072	1,244	2 sets	-	C^{100} 20/1 30/1 36/1 ; 19.0	C^{100} ; 45,000
Intiteks	Bandung	8,000	-	-	-	C^{100} 20/1 ; 3.2	-
Perintex	Bandung	-	?	1 set	-	?	?
B.T.N.	Bandung	-	300	1 set	-	-	C^{100}; 8,000 T/C;6,000 T/R;600
Naintex	Bandung	-	232	2 sets	-	-	T/R ; 18,000
Famatex	Bandung	-	600	2 sets	-	-	T/R ; 24,000
Kamadjaja	Pasuruan	-	491	1 set	-	-	T/C C^{100} ; each 16,700
C.V. Langsung	Bandung	-	-	1 set	22(Raschel)	-	N^{100} N/R ; 5,000

Table IV-44 Spinning Facilities in Indonesia

Name of group	Name of mill	Location	No. of spindles	Products	Production (t/d)			Process *1		
					Actual	Conversion to 20/1	Production in Japan	Spinning	Weaving	Dyeing & Finishing
P.N. Industri Sandang	Patal Palembang	Palembang	30,384	C^{100} 20/1 30/1	12.1	15.9	21.2	○	-	-
	Patal Senajan	Djakarta	30,000	C^{100} 20/1 30/1 36/1	10.5	15.4	21.0	○	-	-
	Patal Tjipadung	Bandung	30,132	C^{100} T/C or T/R	-	-	-	○	-	-
	Patal Bandjaran	Bandung	30,784	C^{100} 20/1 30/1 T/C 44/1	8.5	16.8	21.6	○	-	-
	Patal Bekasi	Djakarta	30,240	C^{100} T/C or T/R	-	-	-	○	-	-
	Patal Setjang	Magelang	30,132	C^{100} T/C or T/R	-	-	-	○	-	-
	Patal Grati	Pasuruan	30,132	C^{100} 20/1 30/1 T/R 20/1 40/1	11.1	15.7	21.2	○	-	-
	Patal Lawang	Malang	15,200	C^{100}	-	-	-	○	-	-
	Patal Tohpati	Bali	15,200	C^{100}	-	-	-	○	-	-
Sub. Total			242,204		-	-	-	-	-	-
I.T.T.	Intiteks	Bandung	8,000	C^{100} 20/1	3.2	4.1	5.6	○	-	-
Pinda group (Sumatra)	Rami Siantar	Pem.-Siantar	6,000	Rami 100	-	-	-	○	-	-
Pinda group (Central Java)	P.P.K.Tjilatjap	Tjilatjap	60,000	C^{100} 24/1 T/C 45/1	28.4	32.7	42.0	○	-	-
	P.P.K. Djantra	Semarang	31,528	C^{100}	-	-	-	○	-	-
	Texin	Tegal	37,072	C^{100} 20/1 30/1 36/1	14.5	19.0	25.9	○	○	○
Sub. Total			128,600		-	-	-	-	-	-
Private Firm	G.K.B.I. Medari	Jogjakarta	34,000	C^{100} 32/1 36/1	9.0	18.0	23.7	○	○	○
	T.D. Pardede	Medan	30,000	C^{100}	-	-	-	○	○	-
	P.T.Wisma Usaha	Bandung	10,600	C^{100}	-	-	-	○	-	-
	P.T. Inbritex	Pasuruan	35,176	C^{100} 20/1 30/1	15.4	19.0	24.6	○	○	-
	Primissima	Jogjakarta	9,072	C^{100} 60/1	1.1	4.6	6.5	○	○	-
	Primatex	Jogjakarta	abt. 10,000	C^{100}	-	-	-	○	-	-
Sub. Total			128,848		-	-	-	-	-	-
Total			513,652		113.8	-	-	-	-	-

* : Circles signify that the process is equipped.

c. Idle operation is frequent due to the lack of replacement parts.

On the assumption that the total consumption for the years 1972/1973 is 150,000 tons in Indonesia and also assuming that the demand for spun yarn is approximately 86% of the total demand, approximately one million spindles would be in the case of producing the mean count of 32/1 as shown in Fig. IV-21, the data which show the Indonesian government target for the productivity of the textile industry.

In addition to the spinning facilities of 513,652 spindles shown in Table IV-44, government approval for a new installation of 291,322 spindles has already been granted so that it is expected that the two to three years, approximately 800,000 spindles will be the total production force, thereby making it possible to domestically supply approximately 100,000 T/Y of spun yarn in the case of an average count at 32/1.

(2) Knitting and Weaving Facilities

Table IV-45 shows the present status and the expansion projects in the textile knitting and weaving facilities. The figures in this table are based on the "LAPORAN Direktorat Djendral Perindustrian Tekstil" compiled by the Departemen Perindustrien concerning the 1971/72 period of the First 5-Year Plan of the Government. In accordance with the data shown in this table, while the projected production for the period concerning the grey of knitted and woven fabrics is 1,262,226,975m, the actual production which was indicated by the government authorities separately shows a production total figure of 731,000,000m, which is approximately 58% of the projected level. The major causes for this discrepancy and insufficiency in the productivity seem to be that a large extent of hand loom operations and the full operation of obsolete facilities are anticipated to be included in the production of the grey and also due to the lack of spun yarn supply, the latter having been confirmed through visits paid to several mills and plants during the course of the present survey. Further, if the above data are correct, as was explained in the footnote of Table IV-45, the most modern machines for producing synthetic fibre woven fabrics are, in the main, planned to be installed during the course of the expansion projects and therefore, if the supply of the yarn is smoothly undertaken at the time of the completion of these expansions and, if the efforts for the improvement of the operation rate is undertaken adequately with the rehabilitation programmes concerning the equipment having been satisfactorily undertaken, the power looms of the existing ones and the newly installed ones, the 500 units of the warp knitting machines and the double jersey knitting machines altogether will be able to undertake the processing of approximately 200,000 T/Y of fabrics. If the hand looms and the hand knitting capacities are also to be included in the force, approximately 250,000 T/Y of processing fabrics should be possible.

Table IV-45 Fibre Processing Facilities in Indonesia

	Existing Facilities			Planned Facility Expansion		
	Plant	No. of m/c	Planned Production (m)	Plant	No. of m/c	Planned Production (m)
Power loom	866	40,496	668,184,000	101	21,102	348,183,000
Hand loom	3,344	259,645	408,940,875	4	63	99,225
Power knitting m/c	328	6,251	185,102,100	21	485	18,887,040
Hand knitting m/c		21,479			416	
Total			1,262,226,975			367,169,265
Printing m/c	112	668	183,656,000	27	30	164,318,000
Finishing m/c	104	106(138)	490,040,000	58	58	252,130,000
Dyeing m/c	124	846	486,590,000	32	32	237,520,000
Sewing m/c	1,167	15,546	-	13	841	-
Batik dyeing	1,449	11,307	135,684,000	16	250	3,000,000
Total	-	-	1,295,934,000	-	-	656,968,000

Notes :-Single width rate is higher in existing power loom, however, expansion plan includes higher rate of double width machines.

-Existing power knitting machines are mainly Single however, the expansion includes under-wear, however, the expansion mainly includes Double Jersey Circular m/c for Tricot Raschel, outer-wear.

-Existing hand knitting m/c are mainly Single Jersey Circular m/c for under-wear, however, the expansion mainly includes flat m/c for sweater.

-30 machine prints and 638 hand prints already exist, however, the expansion includes machine prints totally.

-106 stenters and 138 calenders exists as finishing m/c for woven cotton finishing, however, the expansion mainly includes machines for synthetic fibre woven items.

-Jigger, Winch, etc. of machine dyeing exists in 425 units and 421 hand dyeing m/c already exist, however, the expansion is totally for dyeing woven synthetic fibres.

(3) Texturizing Equipment

The facilities of texturizing in Indonesia at present is approximately 20 to 30 machines and it is estimated that the yearly production amount of nylon texturized yarn is approximately 2,000 tons. On the other hand, the approval for new installation of 63 machines has already been granted by the Departemen Perindustrian so that at the time of the completion of the expansion, it will be possible to produce approximately 5,000 tons of synthetic texturized yarn.

(4) Other Facilities

a. For Use in the Industrial Field
The dipped fabric for producing nylon tire-cord is being imported from Japan on the level of approximately 900 tons per year and no domestic production is being undertaken in Indonesia. Concerning the fishing nets, the development of fishing boats and the fishing industry are not as yet being carried out satisfactorily and therefore, they are still on a small scale. As far as the fishing net consumption is concerned, almost the total amount thereof is obtained by means of importing the finished products. Further, regarding ropes, the consumption is filled up by small scale domestic production of cotton ropes and imported synthetic fibre ropes as well.

b. For Use in Interior Materials
The demand for carpets in Indonesia is still extremely small. The supply is entirely dependent upon the hand-made carpets produced in the vicinity of Bandung. However, in recent years, hotels and other buildings have been constructed quite actively in and around the Djakarta area and therefore, the so-called contract carpet demand is expected to grow rapidly in the near future. However, even when this growth is taken into consideration, the absolute demand will still be on a low level.

4-5-2. The Immediate Trend in the Textile Processing Facility Capacities

As has already been discussed, in accordance with the data announced by the Departemen Perindustrian it is considered possible to obtain the processing capacity to cope with approximately 250,000 T/Y of the materials on the assumption that the existing facilities and the projected expansion facilities go into full operation regarding woven fabrics and knitted fabricts production as well as for the dyeing and finishing processings.

On the other hand, regarding the production of yarn, as has already been discussed, if the projected 300,000 spindles commenced operation in two to three year's time, the production capacity of yarn would be approximately 100,000 T/Y in the case of an average count of 32/1. Further, even if the existing and projected texturizing facilities are to be operated fully, the production capacity would be approximately 5,000 T/Y, so that these two together, the spun yarn production facility capacity would be 105,000 T/Y. Therefore, if the total domestic consumption amount at the time of 1970/1971 is to be covered purely by the domestic spinning facilities, approximately 1,000,000 spindles (with the addition of 500,000 spindles by expansion) would be necessary.

1) Synthetic Fibres

The scrutinization of the facility capacities for the synthetic filament yarn and staple fibres disclosed the following factors.

(1) Polyester Staple Fibres (Polyester SF)

The following are the five mills where at present the spinning of T/C and T/R are being undertaken.

Patal Tjipadung	Patal Setjang
Patal Bandjaran	P.P.K. Tjilatjap
Patal Bekasi	

The present consumption amount of polyester SF by these five mills is estimated at within 5,000 T/Y. The consumption of polyester SF at these mills will increase in 1973 and it is also expected that more mills will start consuming polyester SF. However, in the years 1973 and 1974, as shown in Table IV-46, approximately 100,000 spindles of spinning facilities owned by foreign-based joint-venture companies will start operation one after another so that the demand for polyester SF is expected to grow rapidly. It is reported that the

Table IV-46 Facility Installation Projects of Foreign-Based Joint-Venture Spinning Companies

Name	Type of the Products	Spindles
P.T. UNILON	T/C	20,000
P.T. UNITEX	T/C	15,000
P.T. CENTEX	T/C	20,000
P.T. K.T.S.M	T/C	10,000
SOUTHERN CROSS	T/R	10,800
ISTEM	T/R	20,000
Total		95,800

government has already granted authorization for installation of approximately 300,000 new spindles including the projects laid out by the above-mentioned foreign-based companies in order to fill up the shortage of spinning spindles. Of the 300,000 spindles, 100,000 spindles owned by the foreign-based joint-venture companies are for the production of T/C and T/R as shown in Table IV-46 and it is expected that a considerable portion of the remaining 200,000 spindles will be destined also for the production of the synthetic fibre spun yarn. The T/C and T/R spinning capacity of the foreign-based companies' spindles shown in Table IV-46 are assumed to be as follows.

T/C 800 T/Y by 10,000 spindles

T/R 1,400 T/Y by 10,000 spindles

If the above capacities are assumed, the capacity displayed by 95,800 spindles will be for the production of 9,512 T/Y. Again assuming the blending ratio of polyester SF of such production is at 65%, the consumption of polyester SF would be 6,183 T/Y. In addition to the above, considerable spinning would be undertaken for T/C and T/R by the newly expanded spindles (the 20,000 spindles not owned by the joint-venture companies) and also, it is expected that the spinning of T/C and T/R will also grow rapidly by utilizing the already existing facilities. Therefore, in one or two years, consumption amount of polyester SF by the spinning mills would be on the level of approximately 20,000 T/Y.

However, the demand for polyester SF at such a time is forecast at approximately 30,000 tons which exceeds the consumption amount expected of the spinning mills. Therefore, it seems necessary to promote the expansion of the facilities of the synthetic fibre spinning as well.

(2) Filament Yarn

As mentioned above, the present production capacity of the existing texturizing machines is approximately 2,000 T/Y. On the other hand, the Indonesian nylon filament imports (except for the ones destined for tire-cord production) in accordance with the Japanese export statistics, was 3,100 T/Y in 1971 so that this figure and the above production figure roughly coincide. The importation of polyester FY (filament yarn only) into Indonesia on the other hand was 93 T/Y in 1971 which is an extremely small figure.

Approximately 60 units of the texturizing machines for which the Indonesian government has already given approval for construction are fully operated, the production would be brought up to 4,000 to 5,000 T/Y. It is also forecast that the production of plain woven and knitted fabrics will also be undertaken in addition to the fabrics using the texturized yarn. However, the amount of such plain yarn fabric production is not known.

As has been discussed above, while estimating the production capacity if the textile processing facilities in one to two years hence, the extent of demand for staple fibre and filament yarn is estimated to be on a considerably lower level than the total textile demand.

4-5-3. Future of Textile Processing Facilities

With textile industry in general, it is the usual practice to carry out expansion commencing with the process which assumes a position closer to the finished fabric through the long line of the production processes covering the raw material treatment to the final product turn out, i.e., the delivery of the fabrics. Therefore, if the weaving facility is increased and the spinning capacity therefore becomes short, the extent of the shortage must be filled up by importing spun yarn. If the importation of spun yarn becomes excessive, the spinning facilities will then be expanded in order to substitute the importation so that eventually, the domestic production of the basic raw materials will be achieved. From the point of view, however, the question is how the textile processing facilities are to be expanded in Indonesia in the future. The answer to this question bears prime importance in determining the demand forecast on the extent of staple fibres and filament yarn. Were it not for the correction of the imbalance between the processing and the spinning capacities and without the proper expansion of the textile processing facilities, the development of the Indonesian textile Industry would become impossible. As it is strongly anticipated that positive textile industry promotion and development policies will be undertaken by the government of Indonesia, approximately 50% of the total textile demand level shall be taken as a preliminary criterion for the purpose of this survey for determining the filament yarn and staple fibre demand as far as the period from 1976 to 1977 is concerned.

Assumption of production Capacity

As has already been discussed, it is believed that in the near future, 250,000 T/Y of fabric textile materials can be processed of the assumption that the full operation of the existing facilities is carried out and the projected facilities are to be also operated fully regarding the production of woven and knitted fabrics in accordance with the announcement made by the Departemen Perindustrian. However, as far as this point is concerned, the actual concrete background for formulating such anticipation is not clearly known. Regarding the production of spun yarn of the other hand, as has already been described, even if the total 800,000 spindles were fully operated within two to three years by adding approximately 300,000 spindles which are now projected, the production capacity of spun yarn would be approximately 100,000 T/Y in the case of the average count of 32/1 so that further spinning facility over the above would become necessary.

V. Synthetic Fibre Industry (Polymerization and spinning)

1. Introduction

There is no synthetic fibre industry as such in Indonesia, as all the Staple fibres and filament yarns are imported from overseas. The only exception here is that a polymerization spinning plant is being constructed with a capacity of 6 T/D of nylon filament and 12 T/D of polyester staple (hereinafter referred to as polyester SF). This plant will not however be able to cope with the demand for synthetic fibre in the country which is increasing year by year. Therefore, Indonesia will still have to rely on imports for the foreseeable future.

On the other hand, the industrialized nations already possess large-scale synthetic fibre industries, and, partly due to the United States control of fibre imports, excessively keen competition in the international trade of synthetic fibre is being staged. It is, therefore, necessary to work out well-planned strategies when newly establishing a synthetic fibre industry in the presence of pressure of exports from advanced nations.

The synthetic fibre industries in the industrialized countries are transforming themselves from a labour intensive type to either a capital intensive or a technology-dependant type. However, the costs of investment for the incorporation of labour saving equipment to handle the ever-increasing labour costs are vast. Further, it is extremely difficult to equip labour saving machinery to the presently existing synthetic fibre manufacturing equipment and advantages thus obtained would not be very great. It is therefore inevitable to modify present machinery completely if labour saving equipment is to be installed, thereby calling for a vast amount of investment. The profitability of synthetic fibre industries in the industrialized nations has, however, been showing a considerable deterioration due to the commencement of domestic production in developing countries and also to the excessively keen competition among advanced nations.

For a developing country to establish a new synthetic fibre industry, the advantages are that she can introduce new and highly productive equipment which have been thoroughly developed by advanced nations. It is also advantageous for the developing country in that she can utilize comparatively low cost and abundant labour. Synthetic fibre industries in the industrialized nations have reached their peak and now face major problems in controlling the increasing production costs, caused mainly by the labour cost increment. The recruitment of labour forces is also posing another problem. It should also be noted, however, that there are a number of disadvantages for developing countries when they plan to newly establish a synthetic fibre industry, e.g., the expensive costs of ocean freight charges for the importation of machinery and equipment, engagement of instructor engineers from industrialized nations, extra costs for spare parts and purchasing costs of raw materials and sub-raw materials.

The synthetic fibre industry is one of the basic industries covering the petro-chemical industries to clothing industries, so that the establishment of the synthetic fibre industry will display significant effects to the effective utilization of labour man power to the other related industries as well as to the national economy.

There are several South East Asian countries in which positive promotion of the synthetic fibre industry is being undertaken and even some who not only have already fulfilled their domestic consumption but are also allocating the products for export. These being the precedent examples, it seems imperative for the Indonesian government to undertake positive fostering of the industry under effective protective policies.

2. Outline of Process

There are many available processes for the polymerization and spinning of synthetic fibre materials. Some of these processes are not yet sufficiently established with industrialized engineering or are not suitable for introduction into Indonesia, although excellent in economical performance. The following will examine some of the processes in order to determine the best selection for Indonesia. Preliminary cost analysis of the selected processes will also be made.

2-1. Nylon

Two types of nylon are available, i.e. Nylon-6 and Nylon-66. Nylon-66 is considered to be unsuitable for Indonesia industry as this material involves difficulties in economic performance as compared with Nylon-6 and technical problems of inferior heat stability during the polymerizing and spinning process. Therefore, scrutinization regarding Nylon-6 alone will be undertaken. The following discussions will also be limited to the nylon filament yarn as the demand for nylon staple fibre in Indonesia is deemed quite small.

The continuous polymerization method has so far been used for the polymerization of Nylon-6 and no other process is available. For the spinning of filament yarn there are two available methods, i.e. the direct spinning and drawing method (the D.S.D. method) and the conventional method. The conventional method spins the filament yarn after melting nylon chips and takes up the spun yarn in the form of undrawn filament before producing the drawn yarn therefrom. The D.S.D. process spins and draws the yarn continuously without taking up the yarn in the undrawn form. The D.S.D. process means less labour costs and thus has economical advantages, however, the disadvantages of this process are the high initial investment costs and the process applicability, i.e. the product yarn is not applicable to some fields as the spun yarn is not twisted. Special equipment is required to give a similar twisting effect to this spun yarn, thereby offsetting the cost reduction effect. For these reasons, the scrutinization will be focussed only on the conventional process in the following discussions.

2-2. Polyester

Several processes are available for the polymerization and spinning of polyester material which can be classified as follows in view of the methods of polymerization and the continuity of polymerization and spinning.

D.M.T. Process	(Batch polymerization)
	(Continuous polymerization)
	(Continuous polymerization and spinning)
Direct Esterification Process	(Batch polymerization)
	(Direct continuous polymerization)
	(Direct continuous polymerization and spinning)

BHET Process

Two types of spinning processes are available in the case of nylon; the conventional process and the D.S.D. process. The D.S.D. process can be used only for the filament yarn.

The D.M.T. process (dimethyl terephthalate process) has been used most popularly world-wide and has gained the highest extent of actual application. Although this is the most reliable process technically, application of this process to Indonesia could be disadvantageous economically if Indonesia is to import D.M.T. and carry out polyester polymerization and utilization of by-produced methanol (which will be produced in large amounts during the polymerization process of polyester, i.e. approximately 30 weight % of the polyester). This shortecoming will be solved if, in the future, D.M.T. can be produced in Indonesia, as methanol can be recovered for recirculation use, thereby eliminating the methanol utilization problem. It must be noted that economical disadvantages will be present until D.M.T. can be produced domestically. It is probable that the D.M.T. process will be less advantageous economically when compared with the direct esterification method, the outline of which is described in the following paragraphs.

The principle of the direct esterification process is that high purity terephthalic acid is directly reacted with ethylene-glycol. Currently 10 to 15% of the total polyester is being produced under this process worldwide. The percentage is expected to be further increased to 25 to 30% in 2 to 3 years. The main reason for the increasing application of the direct esterification process is that the production engineering of high purity terephthalic acid through p-xylene has been established so that the production of polyester at a much lower cost than the D.M.T. process has now become available. No problem pertaining to the methanol recovery is present in the case of the direct esterification process. In the case of the BHET process, the crude terephthalic acid is reacted with ethylene oxide to produce bis-hydroxy-ethyl terephthalate which is purified for polymerization to produce polyester. This process has not yet been applied to actual industrial scale operation. As is evident from the foregoing paragraphs, the direct esterification process should be the most suitable process for Indonesia if domestic production of polyester can be carried out. The following paragraphs will treat further the discussions regarding the direct esterification process.

The direct esterification process is classified into three types, i.e. the batch polymerization process which employs batches, the direct continuous polymerization process which effects polymerization continuously and the direct continuous polymerization and spinning process which carries out the continuous operation from polymerization to spinning. The batch polymerization process has the highest extent of actual industrial application with the most established technical reliability. The direct continuous polymerization process and the direct continuous polymerization and spinning process seem to have economical advantages over the batch polymerization process. However, these continuous processes have been applied to actual operations to a much lesser extent than the batch processes. These continuous processes are suitable for continuous production of the same type of polyester for a long period, as a production unit larger than that of the batch process is required and as these are comprehensive continuous production processes. These processes are therefore suitable for large scale production plants for turning out the same quality and type continuously.

Changes in qualities and types of products in accordance with demands are quite frequent when producing synthetic fibre and therefore it is normally the case that several different types of spun yarn are produced at the same time. Adoption of the direct continuous esterification process or direct continuous esterification and spinning process is therefore not desirable for Indonesia for the time being as economical disadvantages due to the obviously expected changes in the qualities and types. For Indonesia, these continuous processes should be studied when the total production of polyester reaches the 200 T/D level. For the foregoing reasons, the direct batch esterification process shall be discussed in the following paragraphs.

The conventional process alone shall be studied regarding the spinning process for the same reason as in the case of nylon.

2-3. Acrylic Fibres

It is estimated that the demand for the acrylic fibres in Indonesia will be approximately 4,500 tons in 1980 and therefore no sharp increase is expected in the future. For this reason, there will not be an opportunity for industrializing the production of acrylic fibres in Indonesia for some time to come. At least

15 to 20 T/D of production is required for an acrylic fibre production plant in order to carry out economical operation, so that the industrialization of the acrylic fibre production is expected to be feasible for the year 1980 if such an enterprise is then possible. The scrutinization of this subject should therefore be carried out again after 1975.

The following discussions will therefore be limited to the processes as stated below together with relative cost analysis for the purpose of economic assessments.

Processes to be examined

	Esterification & Polymerization Process	Spinning
Nylon Filament Yarn	Continuous	Conventional
Polyester Filament Yarn	D.M.T., Batch	- ditto -
Polyester Filament Yarn	Direct, Batch	- ditto -
Polyester Staple Fibre	D.M.T., Batch	- ditto -
Polyester Staple Fibre	Direct, Batch	- ditto -

Hereafter, filament yarn and staple fibres shall be referred to as FY and SF, respectively.

3. Selection of Basic Materials to Start Production (Monomer or Polymer)

The production of the synthetic fibres can be carried out by using either monomer or polymer. From a long term point of view for the development of the synthetic fibre industry, the switch-over from purchasing the raw materials to produce monomer and then the more basic raw materials will eventually be undertaken in the future, however, for the time being, when the industry is at the initial development stage, the production of synthetic fibres is normally carried out by purchasing either monomer or polymer from outside sources. Although the purchase of polymer seems to be advantageous as it eliminates the construction cost of polymerization equipment, it actually has a disadvantage over the purchase of monomer from the economical point of view, the reasons for which are described hereunder.

Another point in recommending the use of monomer rather than polymer from the outset in Indonesia is that the industry is expected to expand rapidly so that the use of the disadvantageous polymer would not be suitable for the forecast extent of the scale of production of the Indonesian textile industry.

(1) Although monomer (caprolactam, terephthalic acid, DMT, etc.) is available in the open market, the chips are only available within the closed market at a higher price.

(2) Usually, as in the case of spinning equipment, polymerization equipment is constructed on a scale sufficient to fill the need for own consumption within a plant as it has a low degree of scale merit. On the contrary, monomer producing equipment is normally constructed on a large scale as it has sufficient degree of scale merit. Therefore, when constructing a monomer plant, it is usually the case that the future expansion in the polymerization equipment and also the spinning facilities are also taken into consideration for the monomer production capacity, thereby making it possible for Indonesia to procure monomer, from Japan for example, on a comparatively low price level until, on the supplier's side, the above-mentioned excess monomer production capacity is filled up by the projected polymerization and spinning expansion.

(3) For the foregoing reasons, exportation of chips is usually undertaken for a short period and it is very rare for the exportation to last for a long period.

(4) In view of the actual results achieved in the past, while chips have on occasions been exported to subsidiary companies, there have been only a few exceptions of exportation to others for a short period only.

(5) There is no significant difference in the quality of monomer among manufacturers, while the qualities of polymer are versatile. Therefore, it is difficult to change the polymer supplier from one to another as, if changed, the production lot must also change due to the consequential necessity of changing the spinning conditions, dyeing process and the fibre processing conditions. This would inevitably cause inconvenience to customers as well as complications to the production.

(6) Most synthetic fibre spinning firms in South East Asian countries have their own polymerization process.

4. Price Situation Concerning Synthetic Fibre Raw Materials, Filament Yarn and Staple Fibre

Export prices of monomer, filament yarn and staple fibre from Japan as well as the CIF Indonesia prices when importing them from Japan are as follows.

4-1. Raw Materials

4-1-1. Price Situations in Japan

Table V-1 and V-2 show the trend of exportation from Japan and the FOB Japan prices regarding monomer (caprolactam, terephthalic acid, dimethyl terephthalate, ethylene glycol and acrylonitrile)

Table V-1 Trend of Exportation Amount of Monomer from Japan

(10^3 T/Y)

	1967	1968	1969	1970	1971	1972 Jan.-June
Caprolactam	15	13	30	23	40	(21)*
D.M.T.	-	-	-	5	60	(54)
Terephthalic Acid	-	-	-	0.2	0.2	(0.1)
Acrylonitrile	17	19	35	55	104	(54)

* Cumulative figure from Jan. to June

Source : Japan Exports & Imports

Table V-2 Exportation Price of Monomer from Japan (FOB Japan)

	1967	1968	1969	1970	1971	1972 Jan.-June
Caprolactam	196.5 (178.5)	200.7 (213.4)	183.3 (203.3)	208.1 (217.5)	180.5 (193.8)	171.9 (170.8)
D.M.T.	-	-	-	185.0 (181.6)	153.8 (170.4)	135.1 (150.2)
Terephthalic Acid	-	-	-	200.4 (185.3)	152.7 (112.2)	179.6 (154.0)
Acrylonitrile	135.6 (114.8)	151.5 (173.5)	165.4 (181.6)	130.8 (97.1)	101.3 (85.0)	85.4 (95.0)

( ) ... Export to the Country, to which Japan Exported Maximum Quantity (F.O.B.)

Source : Japan Exports & Imports

Table V-3 shows the domestic prices of these items in Japan.

Table V-3 Price Trend of Chemicals

(Rp/kg)

	Terephthalic Acid	D.M.T.	Ethylene Glycol	Methanol	Acrylonitrile	Caprolactam
1962	-	-	-	43	234	391
1963	-	-	-	39	224	396
1964	-	-	-	38	240	396
1965	267	-	139	38	221	-
1966	249	-	125	38	183	-
1967	240	290	117	36	160	-
1968	232	261	110	35	150	229
1969	210	256	101	35	145	207
1970	200	237	96	35	140	201
1971	189	168	94	31	133	197
1972 Jan.- June	(167)	(168)	(94)	(31)	(128)	(193)

Source : Year Book of Chemical Industries Statistics

Fig. V-1 to V-5 show the trends of these prices. Export amounts from Japan reached the level of 40,000 to 60,000 tons for caprolactam and dimethyl terephthalate and 100 thousand tons for acrylonitrile in the year 1971. Also, the export of terephthalic acid was on an extremely low level at only 100 to 200 tons, so that the export prices of this item should be used for reference only. As shown in Fig. V-1 to 5, the export prices, i.e. FOB Japan were slightly lower than the domestic prices. With regard to all the export prices, a comparison between the average figures (the total export price divided by the total export quantity) and the export price to a country to which the largest export from Japan has been made, reveals that the average price was usually lower than the export price.

It is probable that, although one of the reasons for the fact that the domestic prices in Japan were higher was that the prices taken from the Year Book of Chemical Industries Statistics do not correspond to the purchasing prices by major users, the main and basic reason is that the fundamental policy on export prices taken by Japanese manufacturers is different from that taken regarding the domestic prices.

(Usually there is strong cooperation between monomer producers and polymer producers, and synthetic fibre manufacturers are continuously purchasing monomer on a constant level.)

It is probable that the reason for the fact that the average export price was lower than the export price to the country to which the highest extent of exportation was made is that the average export price contained much of the so-called "spot prices". It is obvious in this connection that the Yen revaluation effected in 1971 influenced the export prices of 1972 to a considerable extent. The price of pure terephthalic acid (hereinafter called the P-TPA) for the direct esterification process was estimated as being the same as the price of dimethyl terephthalate (hereinafter called the "DMT"). No statistical report on the

Fig. V-1 Trend of Caprolactam Price

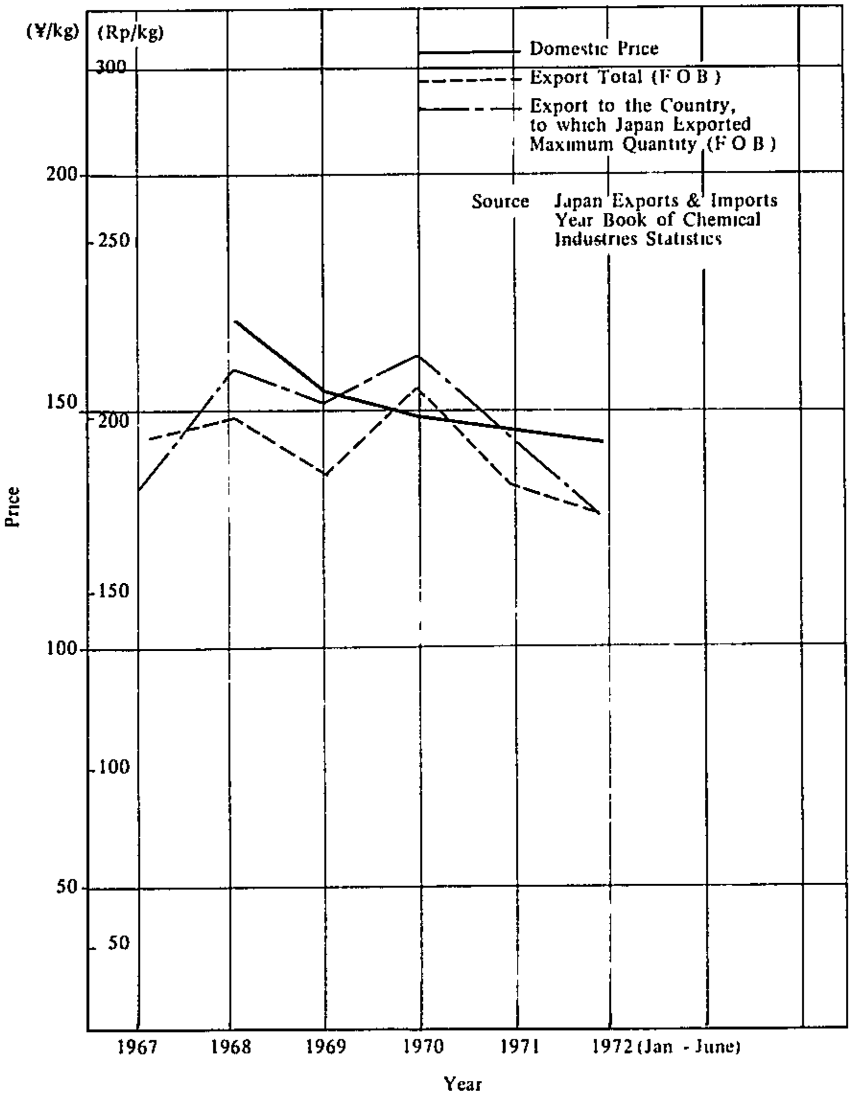


Fig. V-2 Trend of Terephthalic Acid Price

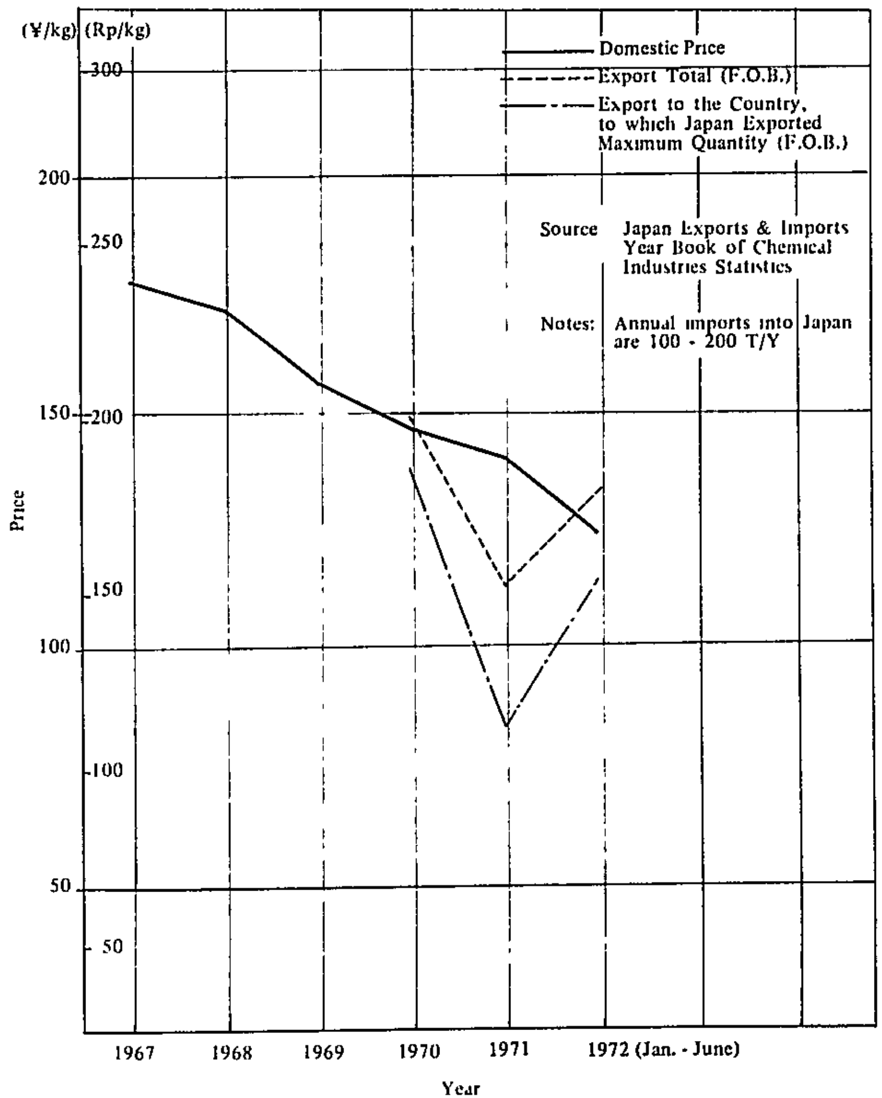


Fig. V-3 Trend of Dimethyl Terephthalate Price

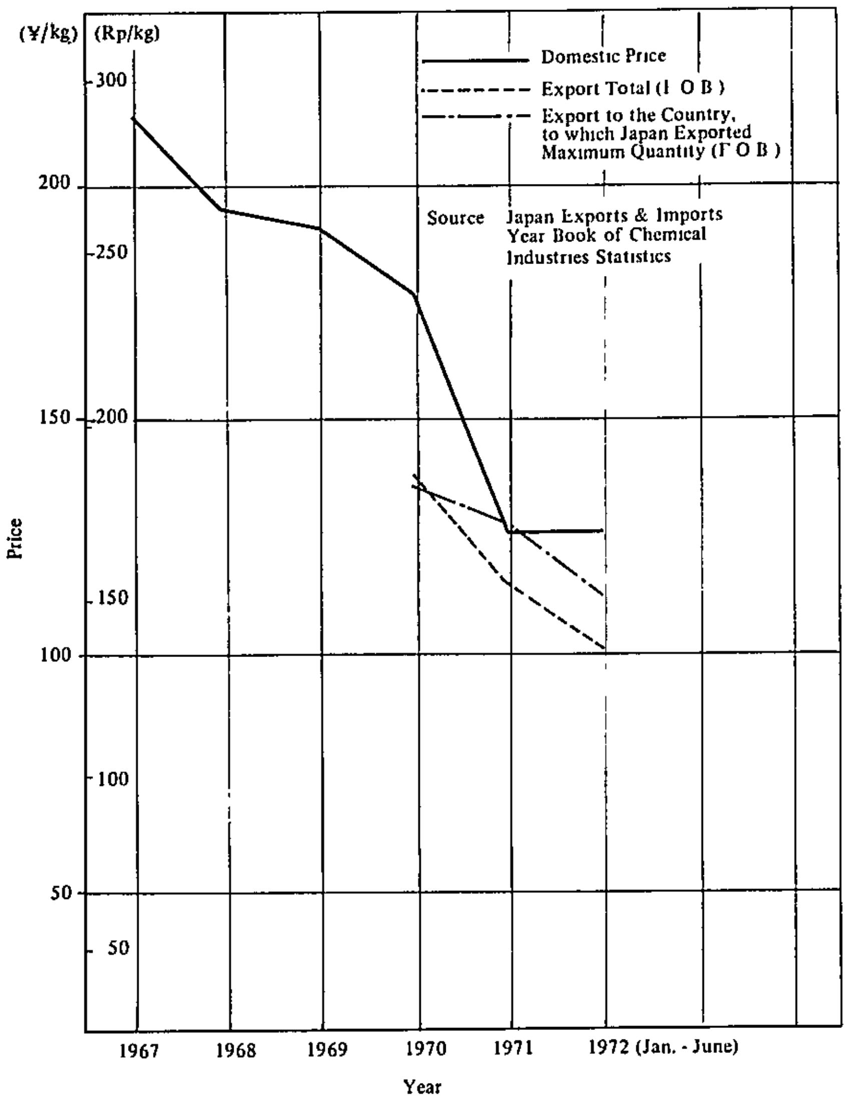


Fig. V-4 Trend of Ethylene Glycol Price

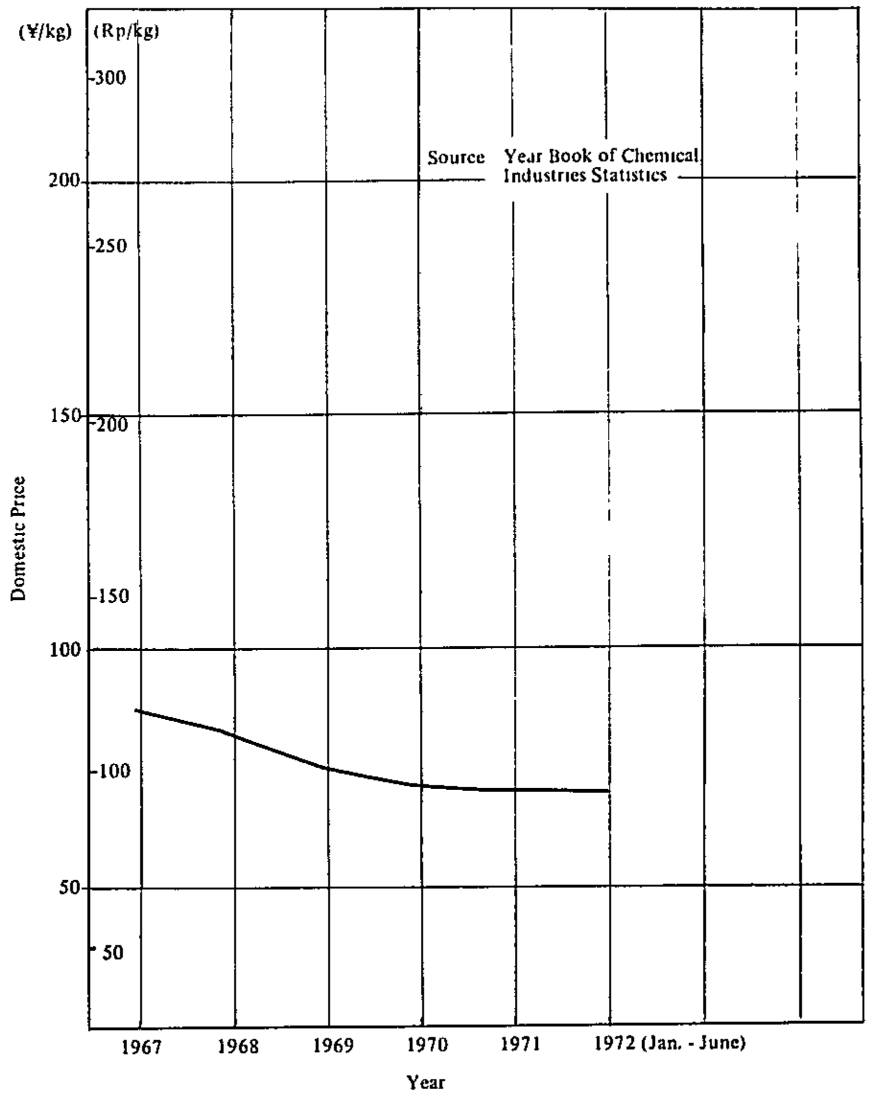
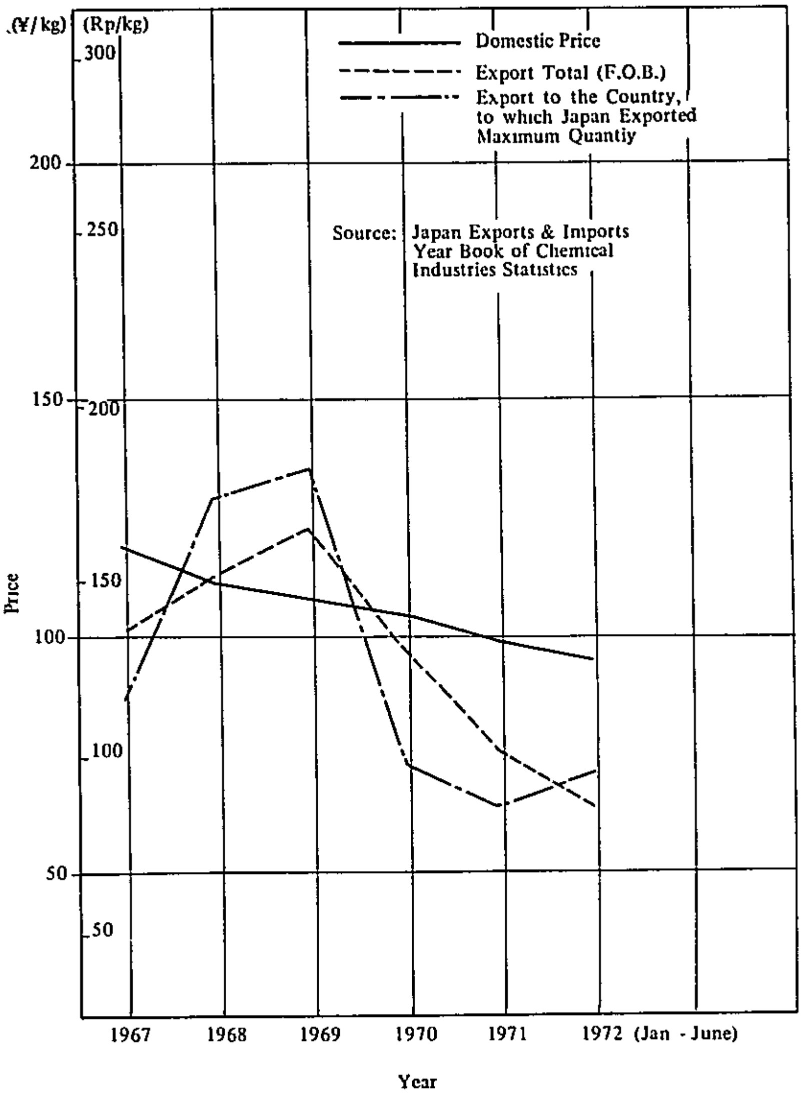


Fig. V-5 Trend of Acrylonitrile Price



polymer export prices was available as it is very seldom that the export of polymer (chips) from Japan is undertaken. There is no Japanese textile firm who carries out merely spinning by purchasing polymer, and therefore it was impossible to examine the polymer prices from the available date.

4-1-2. Forecast on the CIF Prices

The trend of FOB prices in the future will be forecasted by making reference to the past trend of the domestic and FOB prices. It is, however, quite difficult to estimate the future export price trend from the same references, as export prices are volatile. On the other hand, it was not so difficult to estimate the domestic prices as the price fluctuation range is comparatively narrow. It must, however, be borne in mind that the domestic prices are usually higher than the export prices, and it is likely that the estimated figures will be on the higher side if the estimation is carried out by making reference only to the movement of the domestic prices. The estimation of future prices was therefore achieved by combining the average export price with the domestic price trend. The export prices show irregularities as shown in Fig. V-1 through V-5 which is due to the variation in the supply/demand balance. Therefore, FOB export prices were obtained for the year 1972 by averaging the values taken from the past price trend.

The values are:

Caprolactam	.175 Rp/kg.
DMT	148 "
Ethylene glycol	94 "
Acrylonitrile	94 "

With regard to the trend of the domestic prices, the price remained on a comparatively high level at the initial stage, as shown in Fig. V-6. Then the price decreased sharply and the decreasing curve slowed down thereafter. The price decrease rate in caprolactam, acrylonitrile and ethylene glycol slowed down in the years 1967 to 1968, however, the price for DMT showed a sharp decrease in the years 1970 to 1971, and the prices then stabilized in the years 1971 to 1972.

The price decrease rate of caprolactam, acrylonitrile and ethylene glycol when the prices seemed to have become stable was 5 to 8 Rp/kg/Y. Percentages of the annual price decrease rates were 2.4% for caprolactam, 4.4% for actylonitrile and 7.2% for ethylene glycol. The price of ethylene glycol was stabilized at 94 Rp/kg. in 1970 to 1972. It is expected, therefore, that the prices of other monomers will be stabilized at a certain level. From these points of view, future prices of other monomers are not expected to show the decrease rate of 5 to 8 Rp/kg/Y.

Some specialists also anticipate that the price decreases of chemicals in Japan will slow down considerably due to such factors as pollution control problems, increase in plant and equipment construction costs, labour cost increases, the extremely low profitability of the present chemical industry, and increases in the raw material costs for the petro-chemical industries.

Past price increases in caprolactam and DMT largely involved the price decreases in the basic raw materials for these products such as benzene, xylene, p-xylene and cyclohexane. The price trend in Japan is shown in Table V-4. It is evident from this table that the price of p-xylene reduced by 29.1 Rp/kg. during the four year period from 1968 to 1972; cyclohexane by 16.1 Rp/kg. for the five year period from 1967 to 1972; and benzene and xylene reduced by 5 to 8 Rp/kg during the same period. It is unlikely that the prices of the above-mentioned basic raw materials will decrease further in the future as they are now at 32 Rp/kg. for benzene, 28 Rp/kg. for xylene, 36 Rp/kg. for cyclohexane and 76 Rp/kg. for p-xylene.

Fig. V-6 Trend of Japanese Domestic Price of Monomer

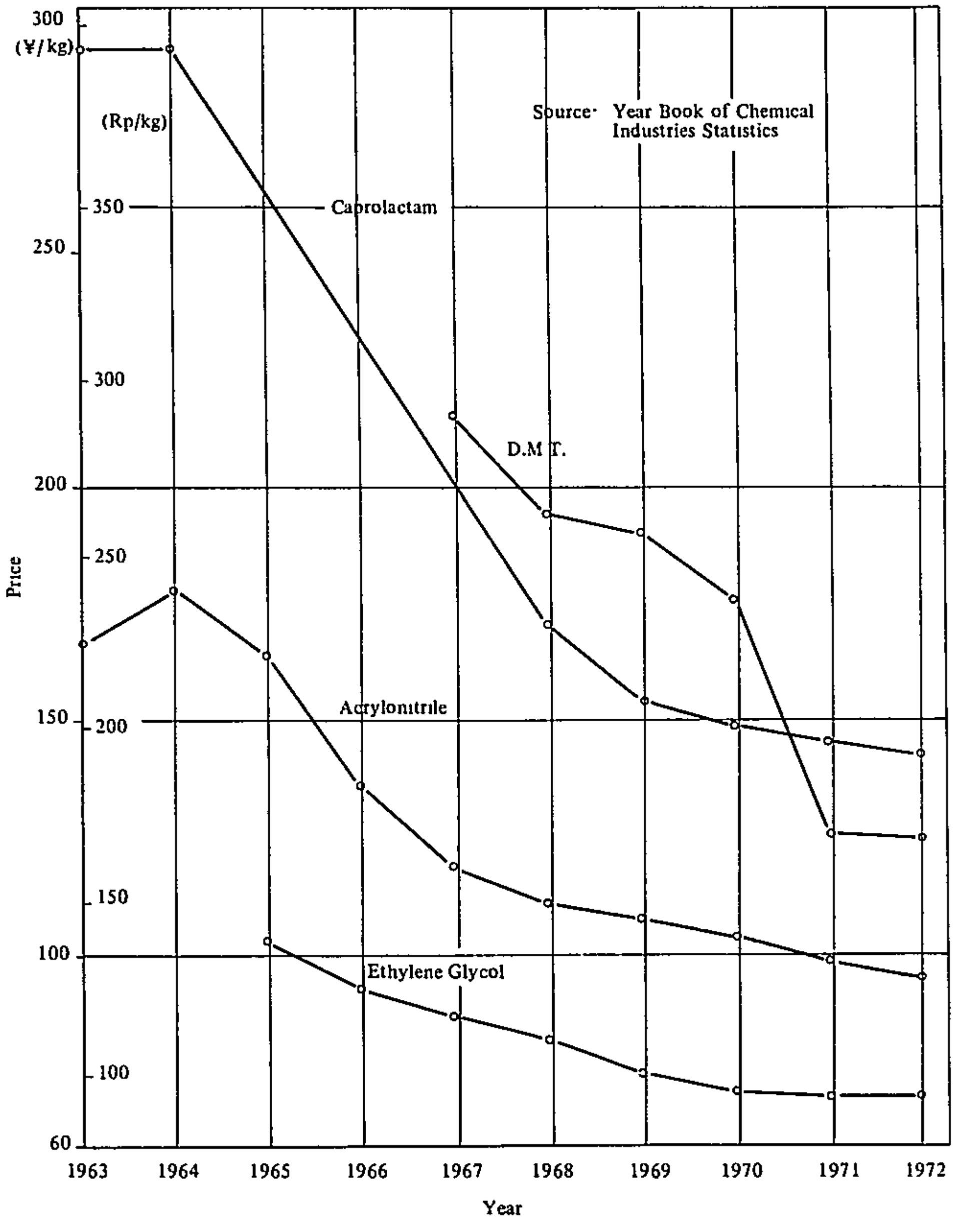


Table V-4 Price Trend of Basic Raw Materials in Japan

(Rp/kg)

	Pure Benzene (Petroleum)	Pure Toluene (Petroleum)	Pure xylene (Petroleum)	p-Xylene	Cyclohexane
1965	44.5	37.7	35.0	-	-
1966	41.8	36.4	32.3	-	56.6
1967	40.4	35.0	32.3	-	52.5
1968	38.3	33.3	30.7	105.2	48.5
1969	37.3	31.8	30.0	89.2	45.8
1970	35.7	30.7	29.2	82.9	40.4
1971	34.0	30.5	28.7	77.5	37.7
1972 Jan.-June	32.1	29.4	27.5	76.1	36.4

Source : Year Book of Chemical Industries Statistics

The present monomer export price is lower than the domestic price, however, the difference will become smaller as the synthetic fibre industry gradually recovers from the depression.

In view of these factors, it is not expected that the future export prices of monomer will decrease to any great degree. With regard to the freight costs, it is estimated that these increase by 5% each year. This increase corresponds to approximately 1 Rp/kg. per year, as the present freight cost for caprolactam and TPA is 22 Rp/kg.

The anticipated increase in freight costs will be offset by the expected decrease in the monomer price by 1 to 1.5 RP/kg. each year, so that the future CIF price will remain at the present level.

4-1-3. Prices in Indonesia

Concerning those materials which are not manufactured in Indonesia and must therefore be imported, the CIF prices were obtained on the basis of the FOB Japanese prices and then the inland transportation charges and others were added to estimate the domestic prices in Indonesia. Although the inland transportation charges may vary depending on where the plant site is located, it was taken at 5.4 Rp/kg. (by setting at 0.015 Rp. per 1 Kg./1 Km). The costs are shown in Table V-5. Prices of monomer in Indonesia as obtained through the above calculation are shown in comparison with Japanese prices in Table V-12.

Table V-5 Charges and Expenses regarding Importation into Indonesia (at present)

	Freight (PR/kg)	Insurance (%)	Tax (RP/kg)	Margin etc.	Inland* Charge (RP/kg)
Ethylene glycol	8.1	C&F x 1.2%	0	CIF x 10%	5.4
Caprolactam (25 kg. Pkg.)	21.6	"	0	"	5.4
TPA.DMT (25kg. pkg.)	21.6	"	0	"	5.4
Polymer chips (-do-)	16.2	"	0	"	5.4
Filament yarn (-do-)	49.9	"	0	"	5.4
Staple fibre (150-200 kg. pkg.)	32.3	"	0	"	5.4

* Inland Charge 0.015 RP/kg/km

4-2. Filament Yarn and Staple Fibre

4-2-1. Price Situation in Japan

Table V-6, 7 and Fig. V-7 show the trends in the export quantities of staples and filament, and the FOB prices in Japan. The prices of synthetic fibres have been decreasing to a considerable extent for the past decade and the trend is still in progress. The sudden decrease in the export prices in 1971 was mainly due to the effects of the Yen revaluation undertaken in October 1971, and therefore it is not expected to continue in the future. As the synthetic fibre manufacturers have been curtailing their operations due to the depression caused by the Yen revaluation, their export prices have been lowered considerably. As a general tendency, the speed of price decreases of textile materials, materials in general, and the prices of staple fibres in particular, are slowing down and therefore a sharp price decrease is not expected in the near future. Although the extent of filament price decreases were larger than those of staples, such decreases are expected to be slower in future.

Table V-6 Exportation Amount Trend of Synthetic Fibre from Japan

(10^3 T/Y)

	1967	1968	1969	1970	1971	1972 1) Jan.-June
Nylon FY	30	41	58	50	68	(31)
Polyester FY	5	11	15	24	74	(26)
Polyester SF	12	16	20	23	53	(40)
Acrylic SF	13	20	30	28	34	(23)

1) Cumulative Figure from Jan. to June

Source : Japan Exports & Imports

Table V-7 Exportation Price of Synthetic Fibre from Japan (FOB)

(Rp/kg)

	1967	1968	1969	1970	1971	1972 Jan. - June
Nylon FY	929.0 (839.0)	905.5 (889.4)	896.3 (849.1)	810.6 (793.9)	689.8 (653.7)	598.9 (575.2)
Polyester FY	1,319.8 (1,135.7)	1,301.1 (1,148.4)	1,218.9 (1,133.4)	1,092.5 (1,068.5)	981.9 (1,045.6)	739.3 (653.0)
Polyester SF	612.7 (542.3)	542.2 (641.9)	523.9 (473.5)	468.6 (435.1)	358.3 (372.2)	289.7 (274.1)
Acrylic SF	537.1 (400.6)	481.0 (400.2)	454.6 (536.4)	453.9 (504.7)	428.9 (486.1)	343.6 (407.1)

( ) ... Export to the Country, to which Japan Exported Maximum Quantity

Source : Japan Exports & Imports

4-2-2. Forecast on the CIF Prices

As shown in Fig. V-7, regarding the trend of the FOB prices of filament yarn and staple fibre, prices suddenly fell during the years 1971 to 1972, although prices seemed to almost stabilize during the period 1967 to 1970. This sudden decrease was due to the Yen revaluation and the depression in the synthetic fibre industry. Prices are now said to be recovering and it is not anticipated that the price decrease which took place during the period 1971 to 1972 will continue. As is shown in Fig. V-7, it is rather difficult to forecast the future price trend from past price trends. Prices usually vary due to a number of factors such as production costs and balances between supply and demand, and therefore the forecast becomes extremely difficult.

A forecast on the future production costs of filament yarn and staple fibre in Japan was made as one of the references. The results are shown in Table V-8. Fig. V-8 to V-11 show the production costs and the export FOB prices of fila-

Table V-8 Estimate on Production Costs of Filament Yarn and Staple Fibre in Japan

(Rp/kg)

	Nylon FY	Polyester FY	Polyester SF	Acrylic SF
Variable Cost				(Acrylonitrile)
Caprolactam	217.2	-	-	87.7
P-TPA	-	139.3	133.4	-
Ethylene Glycol	-	46.2	43.4	-
Ethylene Glycol Recovery	-23.6	-14.6	-11.2	-
Others	5.4	5.4	5.4	31.4
(Raw Materials Total)	(199.0)	(176.3)	(171.0)	(119.1)
Electric Power	25.6	25.6	12.8	10.2
Others	13.5	11.5	10.8	23.2
(Utilities Total)	(39.1)	(37.1)	(23.6)	(33.4)
(Variable Cost Total)	(238.1)	(213.4)	(194.6)	(152.5)
Fixed Cost				
Labor	50.7	48.0	12.7	8.8
Maintenance	19.1	23.6	8.8	7.0
Depreciation	87.7	107.3	42.0	33.7
Others	57.4	56.1	15.9	11.3
(Fixed Cost Total)	(214.9)	(235.6)	(79.4)	(60.8)
Production Cost	453.0	448.3	273.9	213.3
Cost				
Distribution	40.4	40.4	6.7	6.7
General Administration	90.5	89.6	54.8	42.7
Interest	55.6	66.3	27.6	21.7
(Cost Total)	(186.5)	(196.3)	(89.1)	(71.1)
Total Production Cost	639.6	644.6	363.1	284.4

Notes 1. Raw Materials Cost

Caprolactam	175 Rp/kg
P-TPA	148 "
Ethylene Glycol	94 "

2. Labor Cost 2,021 10^3 Rp/man.Y

3. General Administration Fee is estimated 20% of Production Cost

Fig. V-7 Trend of Synthetic Fibre Exportation Price from Japan

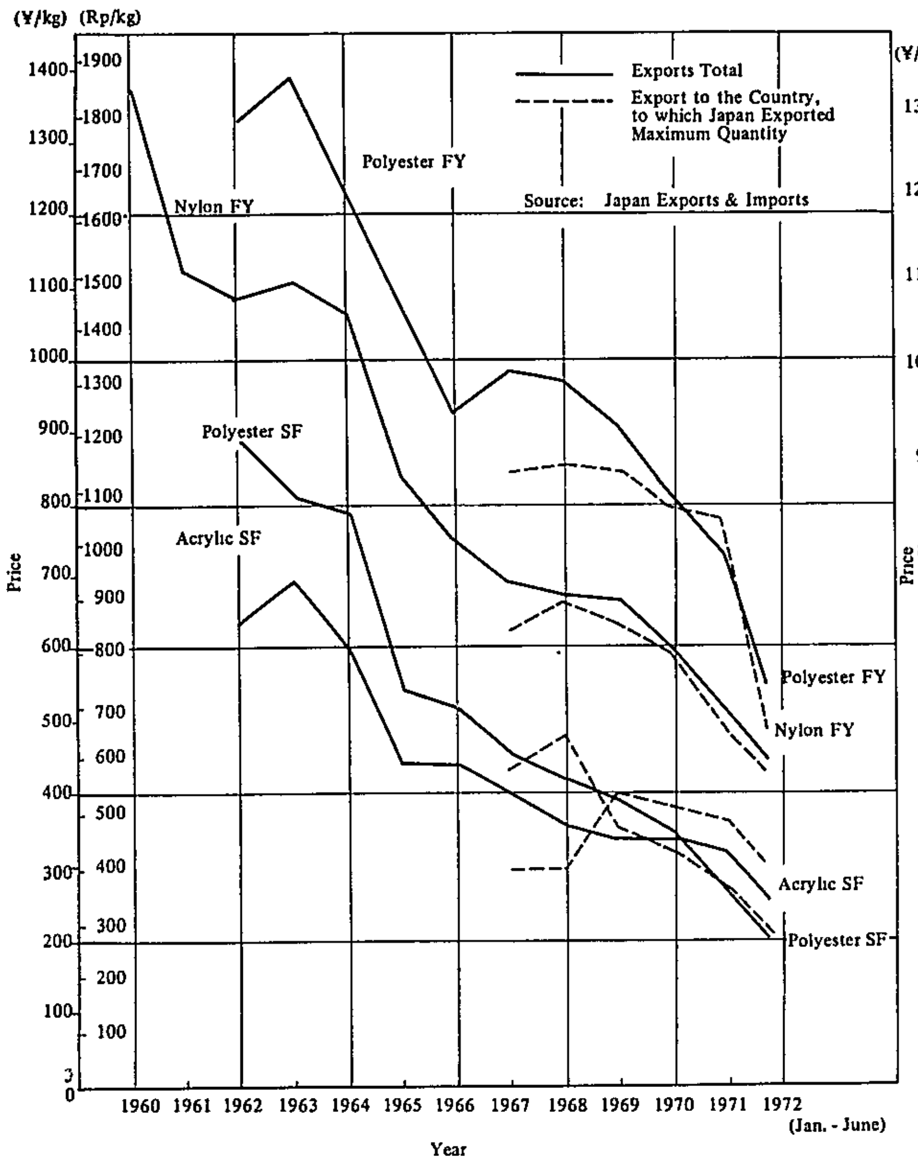


Fig. V-8 Trend of Nylon FY Exportation Price from Japan
(FOB Japan)

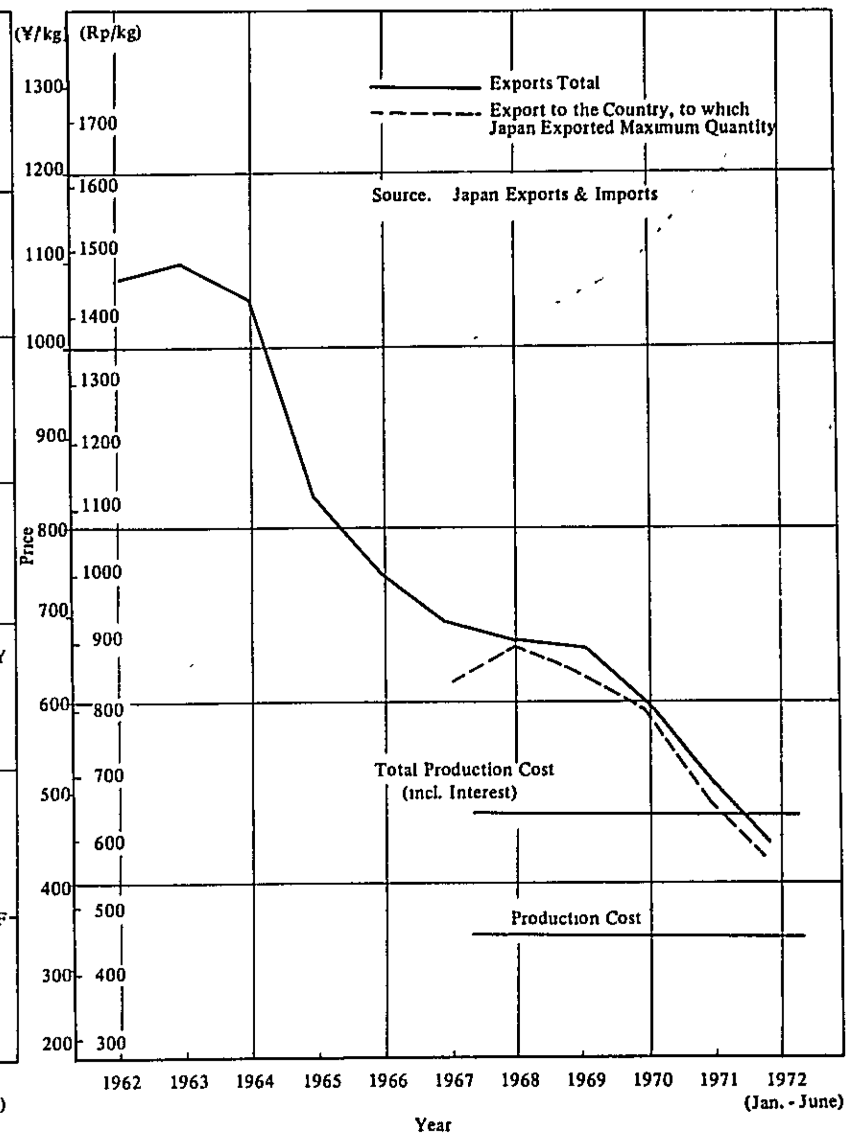


Fig. V-9 Trend of Polyester FY Exportation Price from Japan (FOB Japan)

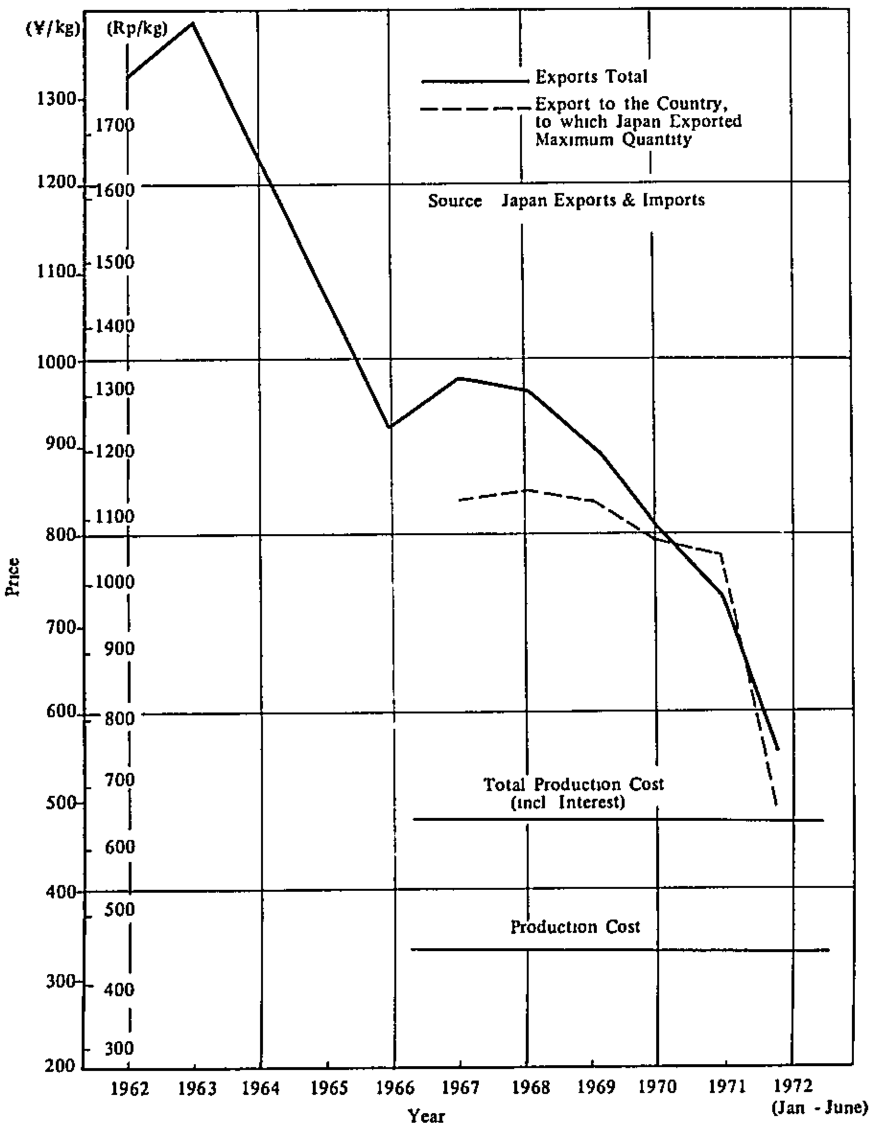


Fig. V-10 Trend of Polyester SF Exportation Price from Japan (FOB Japan)

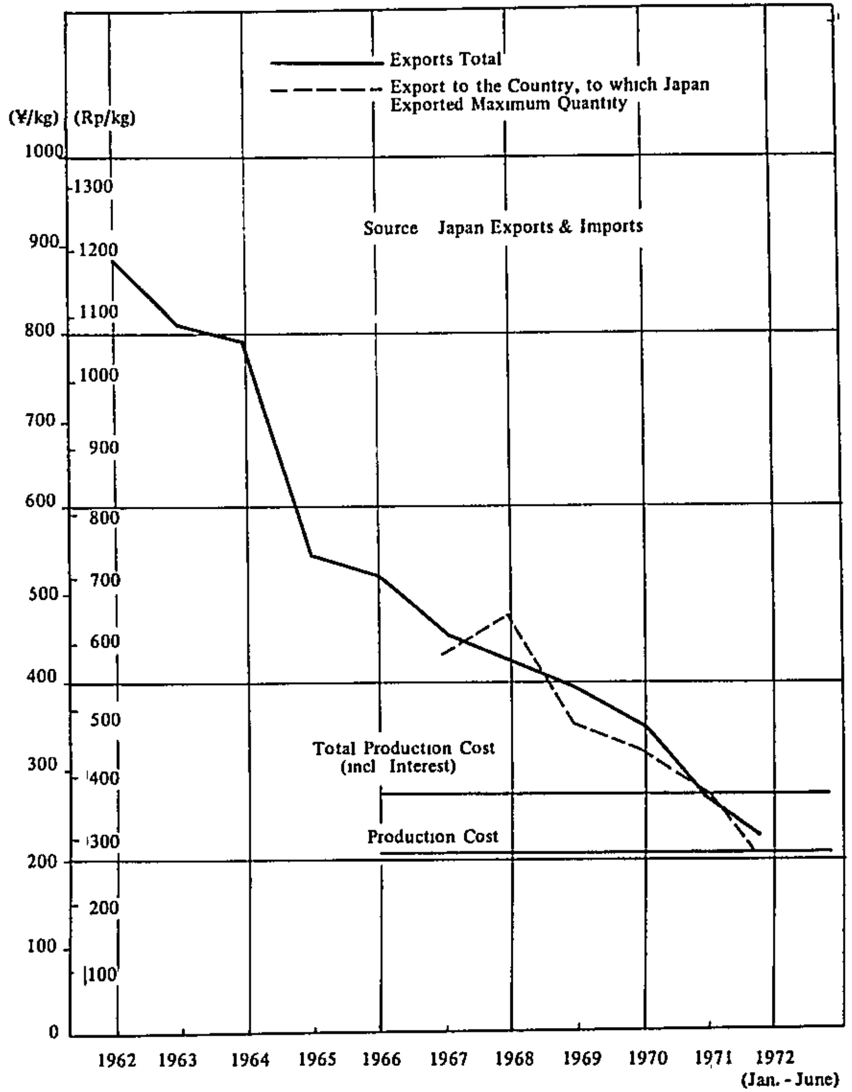
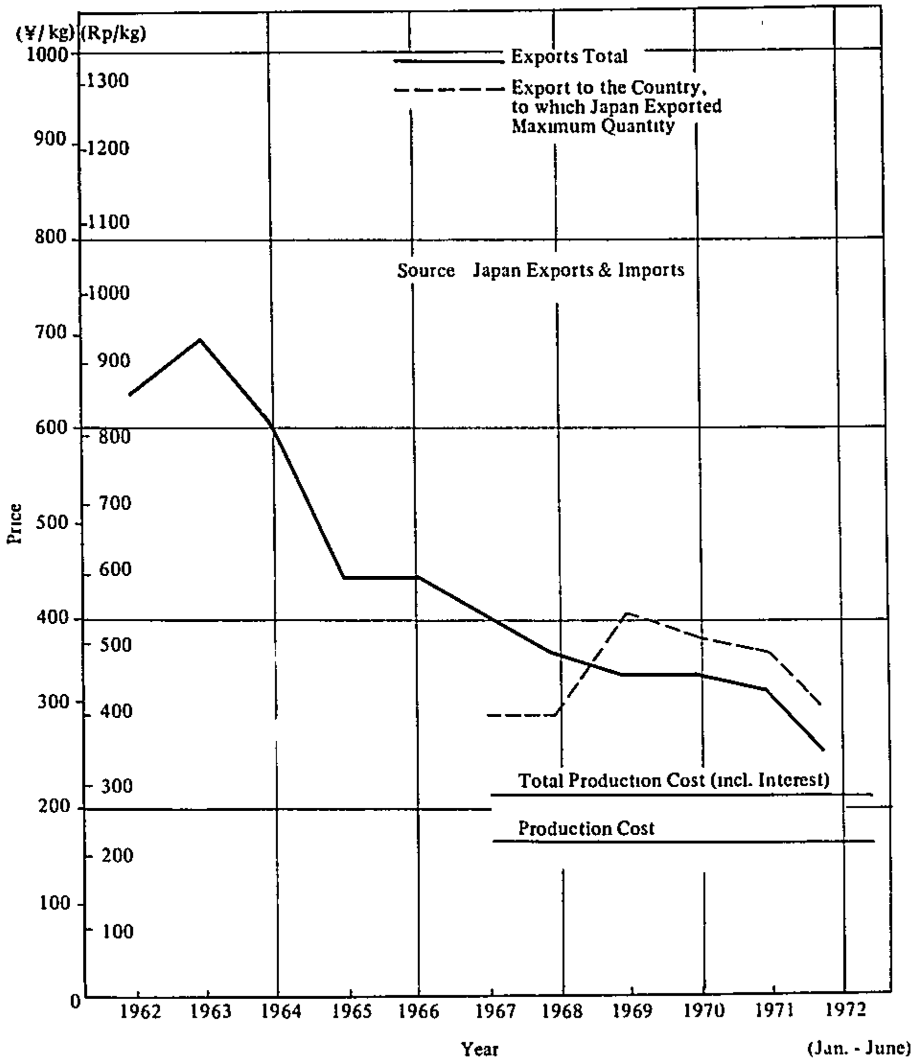


Fig. V-11 Trend of Acrylic SF Exportation Price from Japan (FOB Japan)



ment yarn and staple fibre from Japan. The present FOB prices attained a level close to the total cost (the total cost includes interest and the general administration charges), due to the price decrease during the years 1971 to 1972. It is very unlikely that the FOB prices will remain at the present level as the profit is not included in the total cost. It is forecasted that a sharp decrease in export prices will not take place in Japan due to such factors as the increase in labour costs, decrease in the degree of monomer price reductions, the necessity for investment for the installation of labour saving equipment, replacement of low efficiency equipment, etc. The following two cases are therefore hypothetically established regarding the forecasted FOB price levels on the basis of the forecast made on the Japanese FOB prices and production costs.

Case 1 : The average value for the period from January to June 1972

Case 2 : (The average value for the period from January to June 1972) – (total cost including interest – production cost) x 1/2

As will be discussed later, the Indonesian synthetic fibre industrialization would not be feasible if Case 2 is taken as the basis. Therefore, unless otherwise stated, the CIF price of Case 1 will be used for the purpose of this discussion. As is evident from Table V-8, the total sum of the proportional costs and the labour costs is 207 Rp/kg. in the case of the polyester staple so that it is evident that the 1972 ex-price of 283 Rp/kg. is too low. Therefore, calibrated figures as shown in Table V-9 shall be employed. Table V-10 shows the CIF prices which include the anticipated increase in the freight charges at 5% per year so that the freight costs in 5 years time should be 63 Rp/kg. for the filament (presently 50 Rp/kg.) and 39 Rp/kg. for the staples (presently 32 Rp/kg.) This being the assumption, the CIF prices will be as shown in Table V-10.

Table V-9 Forecast on FOB Prices of Filament Yarn and Staple Fibre (Japan)

(Rp/kg)

	Case-1	Case-2
Nylon FY	587	493
Polyester FY	697	598
Polyester SF	364	319
Acrylic SF	337	300

Table V-10 Forecast on CIF Price of Filament Yarn and Staple Fibre

(Rp/kg)

	Case-1	Case-2
Nylon FY	659	563
Polyester FY	769	670
Polyester SF	408	362
Acrylic SF	381	344

4-2-3. Prices in Indonesia

Various expenses necessary for the importation of filament yarn and staple fibre into Indonesia are already shown in Table V-5. Prices in Indonesia are estimated at a level approximately 10% higher than the CIF prices shown in Fig. V-10.

5. Construction Costs (Investment)

The reduction in the costs of facilities per unit production due to the expansion in the production scale is not as conspicuous in the case of polymerization and spinning processes as in the case of the petro chemical or monomer industries. This is due to the fact that the polymerization and spinning facilities usually consist of the assembly of many small-size pieces of equipment. Therefore, no merits are expected in the reduction of costs per unit production by means of a scale expansion of major machinery, although the merits in the cost reduction regarding auxiliary facilities are greater. The costs of some of the auxiliary facilities per unit production can be reduced considerably depending upon their size as in the case of the utility facilities. The reductions of costs for the organization administration and inspection sections per unit production can also be achieved considerably due to the expansion in the production scale. In view of the above-mentioned factors, merits due to the expansion of the production scale can be expected as a whole until the production scale reaches a certain point after which the extent of the merits will be reduced drastically. Table V-11 shows the outline of construction costs (including main and auxiliary facilities and engineering fees) of a synthetic fibre spinning plant in Indonesia. It must be noted, however, that there will be differences in costs, depending on the technical level of companies who furnish the engineering and the process.

Table V-11 Total Construction Cost of Synthetic Fibre According to Scale of Production

(10^6 Rp)

t/y	Nylon FY	Polyester FY	Polyester SF
1,800	3,100	3,800	1,500
3,600	5,700	6,900	2,700
5,400	8,100	9,800	3,800
11,000	15,100	18,300	7,000
18,000	23,300	28,300	10,800
27,000	33,400	40,400	15,400
36,000	43,100	52,300	20,000
72,000	80,000	97,100	36,100

Note : The ratio of construction cost and building cost in the Indonesian domestic fund within the above total construction costs is as follows:

FY : 27%
SF : 22%

The cost of building a synthetic fibre plant by a company which owns a high production technical know-how will be more expensive than the cost quoted by a company which provides only the construction work, however, the former will have the high-cost-offsetting merits. The calculation of the construction costs in Indonesia was made on the basis of the costs in Japan. The construction cost in Indonesia was obtained by adding the costs of freight for the equipment and the construction of diesel electric generators to the Japanese costs. The costs of lands are not included in the construction cost. An investment of three to five times the costs of construction of a filament yarn and staple fibre plant will be necessary to build facilities for spinning and dyeing processes, although it is not directly related to the construction costs of polymerization and spinning facilities.

6. Economy Scrutinization

6-1. Cost differences between Japan and Indonesia

6-1-1. Basic conditions

Comparisons with the production costs in Japan and with the CIF prices were made concerning the production of filament yarn and staple fibre in Indonesia which were calculated on the basis of the foregoing data. The advantages and problems when producing synthetic fibres in Indonesia will be pointed out from these comparison studies. The basic data for cost calculation were assumed on the basis of the actual general experiences in Japan. The differences in the conditions of cost calculation between Japan and Indonesia are as follows.

(1) The construction cost will be higher by approximately 20% than in Japan as the ocean freight from Japan for the equipment and other charges must be added.

(2) The labour cost was estimated at 20,000 Rp/person/month on average and the number of workers was set at 1.2 times that of Japan.

(3) Engineering fees are estimated to be 10% of the cost of the main and auxiliary facilities. (Estimated to be zero in the case of Japan.)

(4) All the electric power is to be supplied by an inplant generating station. (The electric power is procured in the case of Japan.)

Table V-12 shows the present prices of raw materials and utilities in both Japan and Indonesia.

The prices of raw materials in Indonesia were calculated by adding the charges shown in Table V-5 to the present raw material prices in Japan. The price of monomer in Indonesia is approximately 30% higher than the Japan price.

Table V-12 Unit Costs of Raw Materials and Utilities in 1972

(Rp)

			Japan	Indonesia *1
Raw Materials	Caprolactam	/Kg	175	225
	P-TPA	"	148	194
	D.M.T.	"	148	194
	Ethylene Glycol	"	94	120
	Caprolactam Recovery	"	-128	-171
	Ethylene Glycol Recovery	"	-88	-110
	Methanol Recovery		-20	-20
	Waste Recovery	"	-81	-108
Utilities *2	Electric Power *3	/kwh	5.1	2.7
	Water	/m^3	4.0	4.0
	Steam	/kg	0.67	0.67
	Refrige-ration	/10^3JRT	0.18	0.18
Labor (10^3 Rp/man. year)			2,695	323

Notes : *(1) The raw material prices in Indonesia was obtained by adding the CIF price when importing from Japan and the various inland charges. (Calculated on the basis of Table V-5)

*(2) Only proportional variable costs are taken for utilities costs.

*(3) In-plant power generation in Indonesia and purchased electrical power in Japan, both comprising the proportional variable costs only.

6-1-2. Production Cost of Polymer

The disadvantages in producing synthetic fibre by procuring polymer have already been discussed. Purchasing polymer is quite disadvantageous. The disadvantages can also be explained from the viewpoint of production costs.

Table V-13 shows the total production cost of polyester chips by the direct esterification method. This table clearly explains that the cost in Indonesia is 51.6 Rp/kg higher than the Japanese cost. The cost becomes 46.6 Rp/kg. even for those shown in Table V-5 if the chips are imported from Japan.

The difference in the total production costs between Japan and Indonesia would be further increased if the packing costs and profit margins for Japanese exporters (trading firms) are added, thereby making the export prices higher. It should therefore be concluded that polymer ought to be manufactured in Indonesia as the purchasing of polymer is disadvantageous as has already been discussed.

Table V-13 Comparison of Production Costs of Polyester Chips (Direct Esterification Method)

			Indonesia (11,000 t/y)			Japan (11,000 t/y)		
			Consumption (/kg)	Price (Rp)	Cost (Rp/kg)	Consumption (/kg)	Price (Rp)	Cost (Rp/kg)
Variable Cost	P - TPA	(kg)	0.87	194	168.8	0.87	148	128.9
	Ethylene Glycol	(")	0.45	120	54.0	0.45	94	42.4
	Ethylene Glycol Recovery	(")	0.10	-110	-11.0	0.10	-88	-8.8
	Others	(")			2.0			2.0
	(Raw Material Total)	(")			(213.8)			(164.5)
	Electric Power	(KWH)[1]	0.5	3	1.3	0.5	5.1	2.6
	Others	(kg)			3.9			3.9
	(Utilities Total)				(5.2)			(6.5)
	(Variable Cost)				(219.0)			(171.0)
Fixed Cost	Labor		25	323 10^3 Rp /man.Y	0.7	21	2,695 10^3 Rp/man.Y	5.1
	Maintenance				5.4			4.0
	Depreciation				30.3			19.3
	Others				0.7			5.1
	Fixed Cost				(37.1)			(33.5)
	Production Cost				256.1			204.5

Notes : Total Investment (Machinery & Equipment, Auxiliaries, Building, Engineering Fee)

Indonesia 3,220 10^6 Rp
Japan 2,237 10^6 Rp

1) Electric Power Ref. Table V-12

6-1-3. Production Costs of Filament Yarn and Staple Fibre

In view of the above scrutinization results, no calculation of production costs for filament and staple fibres was conducted concerning the case of purchasing polymer. However, the calculations of production costs on the basis of purchasing monomer were undertaken. As has already been described, there are two methods available for the production of polyester, i.e. the DMT method and the direct esterification method. The direct esterification method is superior to the DMT method economically.. Table V-14 shows the production costs of polyester SF produced by these two methods. The prices of P-TPA and DMT are almost identical and the construction costs of a polymerization plant are almost the same whichever one of these two methods is employed.

The disadvantages of the DMT method over the direct esterification method is that methanol is by produced from the DMT process and the unit consumption of DMT is larger than that of P-TPA. Especially in the case of Indonesia, if methanol is by-produced from the DMT method in the amount equivalent to 35% of the amount of the total synthetic fibre production, the utilization of such methanol is very limited, and, even if it were used, the value of this material would be extremely low as the costs for distillation and transportation would be extremely high. As shown in Table V-14, the difference in the costs between the direct esterification method and the DMT method is the difference in the proportional costs of the two, especially in the prices of DMT and P-TPA.
The price of P-TPA under which its proportional costs can be maintained on the same level as those of the DMT method is 217 Rp/kg. In other words, the direct esterification method is more advantageous than the DMT method if the price of P-TPA is not higher than that of DMT by 23 Rp/kg. The direct esterification method was therefore scrutinized as the production method for polyester.
Comparison were made regarding the production costs in Japan and Indonesia by taking polyester FY and polyester SF as examples in order to clarify the advantages and disadvantages when producing them in Indonesia. The main purpose of the comparison was to describe the differences in the production costs in Japan and Indonesia, so that the basic conditions for the calculation (such as depreciation, interests, etc.) were set at the same level and the labour costs and the raw material costs were varied. The results are shown in Table V-15 and V-16.
Disadvantages in producing synthetic fibres in Indonesia as compared with the production in Japan are that the costs of raw materials and the depreciation costs (including the in-plant electric power generating facilities in the case of Indonesia) are higher. Due to these two cost items, the cost of polyester SF becomes 74 Rp/kg. higher and polyester FY cost becames 110 Rp/kg. higher.

On the other hand, the advantage in Indonesia is the low labour costs. As the other items of the fixed costs consist mostly of the labour costs in the managements and the auxiliary departments, the low labour costs in Indonesia is, together with the favourable direct labour costs, the most significant advantage. The low labour costs are especially advantageous in the production of polyester FY as the operation requires a high extent of labour, while in the case of polyester SF this advantage is not as conspicuous due to the fact that the operation does not call for as much labour as in the case of polyester FY.

The production cost of polyester SF is higher by 50 Rp/kg and that of polyester FY by 28 Rp/kg. in the case of Indonesia. It should be noted however that these higher costs will be ameliorated considerably if the ocean freight charges, i.e. 32 Rp/kg. for polyester SF and 50 Rp/kg. for polyester FY, together with other charges inside Japan are added to the Japanese costs.

Table V-14 Production Cost of Polyester SF in Indonesia (Comparison between the DMT Method and Direct Esterification Method)

(11,000 t/y)

			Directesterification Process			D.M.T. Process		
			Consu-mption (/kg)	Price (Rp)	Cost (Rp/kg)	Consump-tion (/kg)	Price (Rp)	Cost (Rp/kg)
Variable Cost	P - TPA	(kg)	0.90	194	174.6	-	-	-
	D.M.T.	(")	-	-	-	1.04	194	201.8
	Ethylene Glycol	(")	0.46	120	55.1	0.36	120	43.1
	Ethylene Glycol Recovery	(") (")	0.10	-110	-11.0	-	-	-
	Methanol Recovery	(")	-	-		0.34	-20.2	-6.9
	Others	(")	1	2.2	2.2	1	3.5	3.5
	(Raw Material Total)	(")			(220.9)			(241.5)
	Electric Power (KWH)[1]		2.5	2.7	6.7	2.5	2.7	6.7
	Others	(kg)	1	10.8	10.8	1	10.8	10.8
	(Utilities Total)				(17.5)			(17.5)
	(Variable Cost)				(238.4)			(259.0)
Fixed Cost	Labor		83	323 10^3/ man.Y	2.4	83	323 10^3/ man.Y	2.4
	Maintenance				11.7			11.7
	Depreciation				64.8			64.9
	Others				2.4			2.6
	(Fixed Cost Total)				(81.3)			(81.6)
	Production Cost				319.7			340.6

1) Electric Power Ref. Table V-12

Table V-15 Production Cost Comparison of Polyester SF, Japan and Indonesia

(11,000 T/Y)

			Indonesia (A)			Japan (B)			Difference
			Consumption (/kg)	Price (Rp)	Cost (Rp/kg)	Consumption (/kg)	Price (Rp)	Cost (Rp/kg)	(A) - (B)
Variable Cost	P-TPA	(kg)	0.90	194	174.6	0.90	148	133.4	41.2
	Ethylene Glycol	(")	0.46	120	55.1	0.46	94	43.4	11.7
	Ethlene Glycol Recovery	(")	0.10	-110	-11.0	0.10	- 88	-8.8	-2.2
	Others	(")			2.2			3.0	-0.8
	(Raw Material Total)	(")			(220.9)			(171.0)	(49.9)
	Electric Power	(KWH)	2.5	2.7	6.7	2.5	5.1	12.8	-6.1
	Others				10.8			10.8	0
	(Utilities Total)				(17.5)			(23.6)	(-6.1)
	(Variable Cost)				(238.4)			(194.6)	(43.8)
Fixed Cost	Labor		83	323 10³ Rp/man.Y	2.4	69	2,021 10³ Rp/man.Y	12.7	-10.3
	Maintenance				11.7			8.8	2.9
	Depreciation				64.8			40.7	24.1
	Others				2.4			12.7	-10.3
	(Fixed Cost)				(81.3)			(74.9)	(6.4)
	Production Cost				319.7			269.5	(50.2)

*: In-plant electrical power generation in the case of Indonesia (Cost depreciation of power generation equipment cost). Electrical power procured in the case of Japan.

1) Electric Power Ref. Table V-12

Table V-16 Production Cost Comparison of Polyester FY, Japan and Indonesia

(11,000 t/y)

			Indonesia (A)			Japan (B)			Difference
			Consumption (/kg)	Price (Rp)	Cost (Rp/kg)	Consumption (/kg)	Price (Rp)	Cost (Rp/kg)	(A) - (B)
Variable Cost	P-TPA	(kg)	0.94	194	182.4	0.94	148	139.3	43.1
	Ethylene Glycol	(")	0.49	120	58.7	0.49	94	46.2	12.5
	Ethylene Glycol Recovery	(")	0.11	-110	-12.1	0.11	-88	-9.7	-2.4
	Others	(")	-		-1.1			0.5	-1.6
	Raw Material Total	(")			(227.9)			(176.3)	(51.6)
	Electric Power	(KWH)	5.0	2.7	13.5	5.0	5.1	25.6	-12.1
	Others		-		11.5	-		11.5	0
	(Utilities Total)				(25.0)			(37.1)	(-12.1)
	(Variable Cost)				(252.9)			(213.4)	(39.5)
Fixed Cost	Labor		313 men	323 10³ Rp/man.Y	9.2	261 men	2,021 10³ Rp/man.Y	48.0	-38.8
	Maintenance				30.5			23.6	6.9
	Depreciation				162.1			103.3	58.8
	Others				9.2			48.0	-38.8
	(Fixed Cost)				(211.0)			(222.9)	(-11.9)
	Production Cost				463.9			436.3	27.6

1) Electric Power Ref. Table V-12

Another problem in Indonesia which adversely affects the price difference is the decrease in the production yield. Discussions on this point will be excluded from the scope of this survey as this problem can be solved by the efforts of each enterprise.

6-2. Variation in the Construction Costs, the Raw Material Costs, Selling Prices and Effects thereof on Profitability

The costs of raw materials and CIF prices of filament yarn and staple fibre in the future have already been discussed. Table V-17 to V-19 show the cost calculations made on the assumption that various synthetic fibres have been produced at the rate of 18,000 T/Y. The estimated costs contain a number of variable factors as have already been explained. It is therefore expected that the profitability will vary sharply depending on the manner of variation of the factors in the future.

Fig. V-12 to V-14 show the extent of variation in profitability when these basic prices vary within the range of plus of minus 20%. Other items which influence the profitability such as the labour costs, utility costs and interests were not included in the estimation as variations of these costs were low or had little effect on the costs. The effect to the costs caused by a variation within the extent of plus or minus 10% in the costs of raw materials for nylon FY and polyester FY is almost comparable to the effect to the cost caused by a variation in the construction cost within the same percentage. The effect of variation in the raw material costs for polyester SF is, however, approximately double the effect of construction cost variation.

Fig V-12 Sensitivity of Total Production Cost to Raw Material Prices and Total Investment Changes - Nylon FY - (18,000 T/Y)

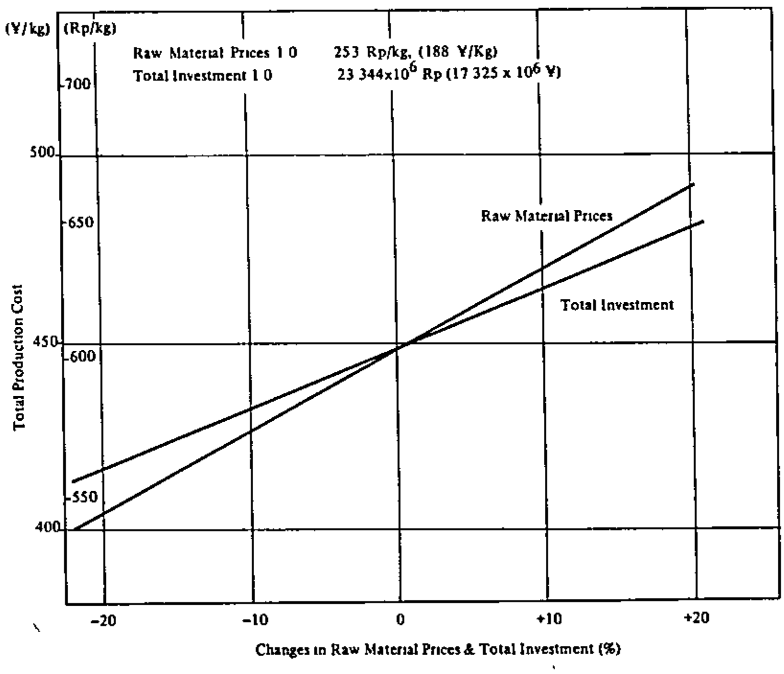


Fig. V-13 Sensitivity of Total Production Cost to Raw Material Prices and Total Investment Changes - Polyester FY - (18,000 T/Y)

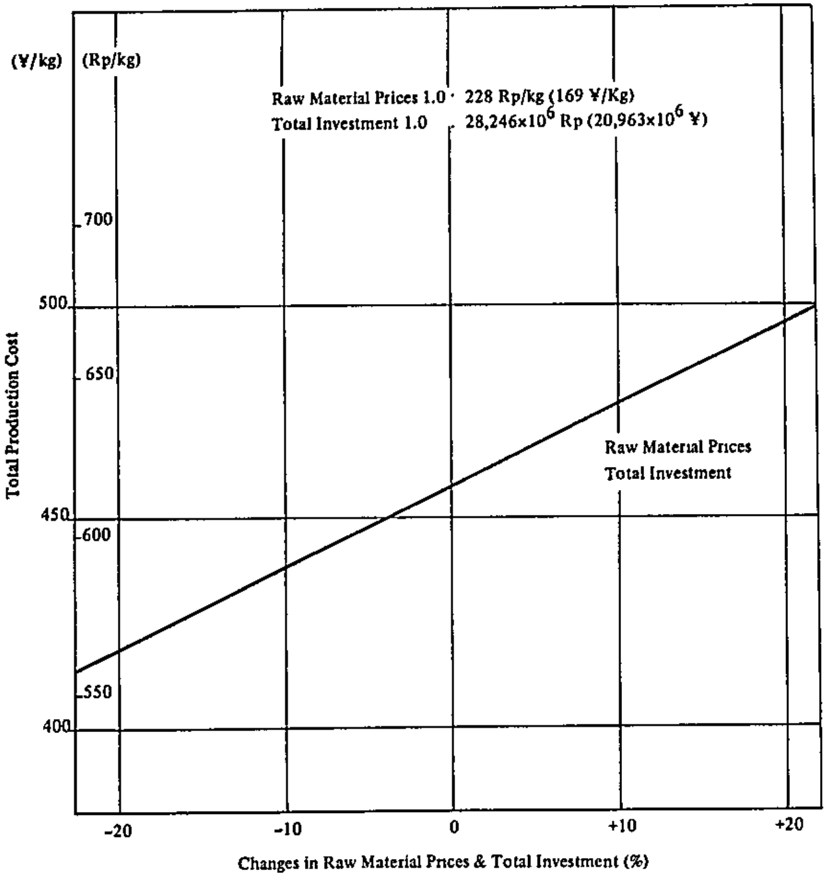


Fig. V-14 Sensitivity of Total Production Cost to Raw Material Prices and Total Investment Changes - Polyester SF - (18,000 T/Y)

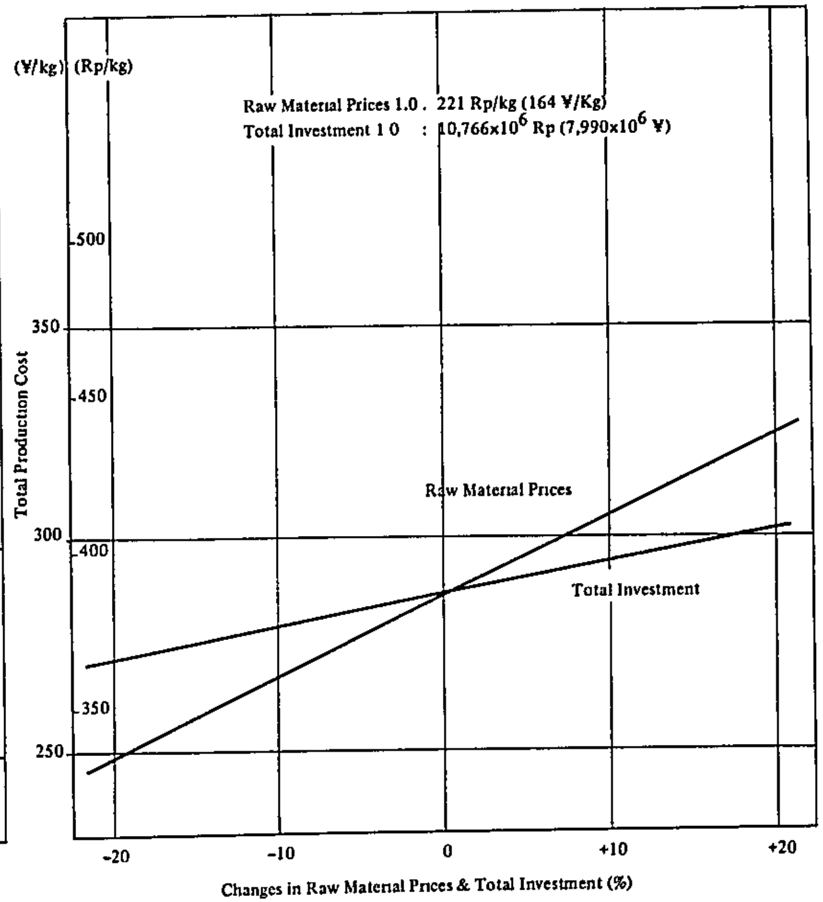


Table V-17 Production Cost of Nylon-FY (Indonesia)

(18,000 T/Y)

		Consumption (/kg)	Price (Rp)	Cost (Rp/kg)
Variable Cost				
Raw materials				
Caprolactam	(kg)	1.24	225	279
Caprolactam Recovery	(")	-	-	-31.5
Others	(")	-	-	5.4
Total	(")			252.9
Utilities				
Electric Power	(KWH)	5.0	2.7	13.5
Others		-	-	13.5
Total				27.0
Variable Cost Total				280.0
Fixed Cost				
Labor		516 men	323 10^3 Rp/man.Y	9
Depreciation				
Total Investment		21,486,000 10^3 Rp		92
Engineering Fee		1,858,000 "		21
Sub-Total		23,344,000 "		112
Start-Up Cost		209,000 "		2.3
Interest during Construction		1,074,000 "		11.9
Total		24,627,000 "		127
Manintenance				24
Plant Overhead				9
Fixed Cost Total				169
Production Cost				449
Distribution		49 Rp/kg		49
General Administration				45
Total Production Cost				543
Interest				
Interest on Total Fixed Capital				50
Working Capital		1,431,000 10^3 Rp		
Interest on Working Capital				10
Total				60
Total Production Cost including Interest				603
Total Capital Investment		26,058 10^6 Rp		

Table V-18 Production Cost of Polyester FY (Indonesia)

(18,000 T/Y)

	Consumption (/kg)	Price (Rp)	Cost (Rp/kg)
Variable Cost			
Raw materials			
P-TPA (kg)	0.94	135	182
Ethylene Glycol (")	0.49	44	59
Rocovery (")	-	-	-18.6
Others (")	-	-	5.4
Total (")			227.8
Utilities			
Electric Power (KWH)	5.0	2.7	13.5
Others	-	-	11
Total			24.5
Variable Cost Total			252
Fixed Cost			
Labor	488 men, 323 10^3 Rp/man.Y		8.8
Depreciation			
Total Investment	25,969,000 10^3 Rp		111
Engineering Fee	2,277,000 "		25
Sub-Total	28,246,000 "		136
Start-Up Cost	189,000 "		2.1
Interest during Construction	1,298,000 "		14.4
Total	29,733,000 "		153
Maintenance			29
Plant Overhead			8.8
Fixed Cost Total			199.6
Production Cost			452
Distribution	49 Rp/kg		49
General Administration			45
Total Production Cost			546
Interest			
Interest on Total Fixed Capital			60
Working Capital	1,360,000 10^3 Rp		
Interest on Working Capital			9
Total			69
Total Production Cost including Interest			615
Total Capital Investment	31,093 10^6 Rp		

Table V-19 Production Cost of Polyester SF (Indonesia)

		Consumption (/kg)	Price (Rp)	(18,000 T/Y) Cost (Rp/kg)
Variable Cost				
Raw materials				
P-TPA	(kg)	0.90	194	175
Ethylene Glycol	(")	0.46	120	55
Recovery	(")	-	-	-14
Others	(")	-	-	5.4
Total	(")			221.4
Utilities				
Electric Power	(KWH)	2.5	2.7	6.8
Others		-	-	10.7
Total				17.5
Variable Cost Total				238.9
Fixed Cost				
Labor				
Depreciation		129 men, 323 10^3 Rp/man.Y		2.3
Total Investment		9,926,000 10^3 Rp		43.7
Engineering Fee		839,000 "		9.3
Sub-Total		10,765,000 "		53
Start-Up Cost		178,000 "		2
Interest during Construction		496,000 "		5.5
Total		11,439,000 "		60.5
Maintenance				11
Plant Overhead				2.3
Fixed Cost Total				76.1
Production Cost				315
Distribution		8 Rp/kg		8
General Administration				31
Total Production Cost				354
Interest				
Interest on Total Fixed Capital				
Working Capital		1,135,000 10^3 Rp		25
Interest on Working Capital				8
Total				31
Total Production Cost including Interest				385
Total Capital Investment		12,574 10^6 Rp		

Fig. V-15 to V-17 show the status of changes in the DCF rate obtained by the discount cash flow method in the event that each of the raw material costs, construction cost and CIF prices (selling prices) varied independently and when they varied simultaneously. Fig. V-15 to V-17 were compiled on the basis of 18,000 T/Y production. The reason for selecting this production figure is explained later in this report. CIF prices (selling prices) exert the highest extent of influence on the DCF rate, as shown in Fig. V-15 to V-17. The DCF rate varies by 5 to 7% when the CIF price (selling price) varies by 10%. As has already been explained, price variations of fibres in the past were considerable. The FOB prices of nylon FY, polyester FY and polyester SF decreased by 10% each year. (Ref. Fig. V-7) The extent of influence upon the DCF rate caused by the variations in the raw material costs and construction costs is approximately one-half the extent of influence caused by the variation in the CIF prices. (Ref. the gradients of curves in Fig. V-15 to V-17.) However, in the case of polyester SF, the effect of the raw material cost variation is comparatively high. In the event that CIF prices, raw material costs and construction costs vary simultaneously with the same rate, the DCF rate increases only slightly and gradually along with the increases of the prices, as shown in Fig. V-15 to V-17.

As has already been discussed, the profitability varies depending upon the variations in the selling prices, raw material costs and construction costs, and it is expected that the procurement of the raw materials and the machinery below the current prices at the time of importation will be extremely difficult.

Selling prices can be adjusted by the Indonesian government by means of import duty. It is therefore desirable to protect and foster the domestic synthetic fibre industry by imposing import duties, the details of which will be discussed later in this report.

6-3. Scale of Production and Costs

There are two possible forms of synthetic fibre plants, i.e. a plant to produce only one type of synthetic fibre, and a plant to produce several types of tynthetic fibres, such as polyester SF and polyester FY. In the case of the latter, even if the scale of production of each synthetic fibre is comparatively small, the production can be achieved at a cost close to the cost of the former type of plant provided that the total scale of production of the latter is large. However, discussions here will cover the type of plant in which the production of only one type of fibre is undertaken, as the economic evaluation concerning a plant for producing several types of fibres will be highly complicated.

The relationship between the production scale and the construction cost has already been discussed. Another item which varies depending upon the scale of production is the labour cost. A synthetic fibre plant, especially a spinning mill, consists of a number of small production units, and the amount of labour necessary cannot be reduced any further when the production scale is reduced to a certain level so that the man hour per unit production will increase sharply. This is due to the fact that the operation consists mainly of discontinuous work processes. The total extent of the required labour cannot be reduced when the total production of filament attains a level at or lower than 15 T/D or, the level of staple production attain a level at or lower than 30 T/D.

Fig. V-18 shows the relationship between the production scale and the total cost, which explains that the total cost increases sharply when the production scale becomes smaller.

Fig. V-15 Sensitivity of D.C.F. Rate to Price Changes (%)
(18,000 T/Y) – Nylon –

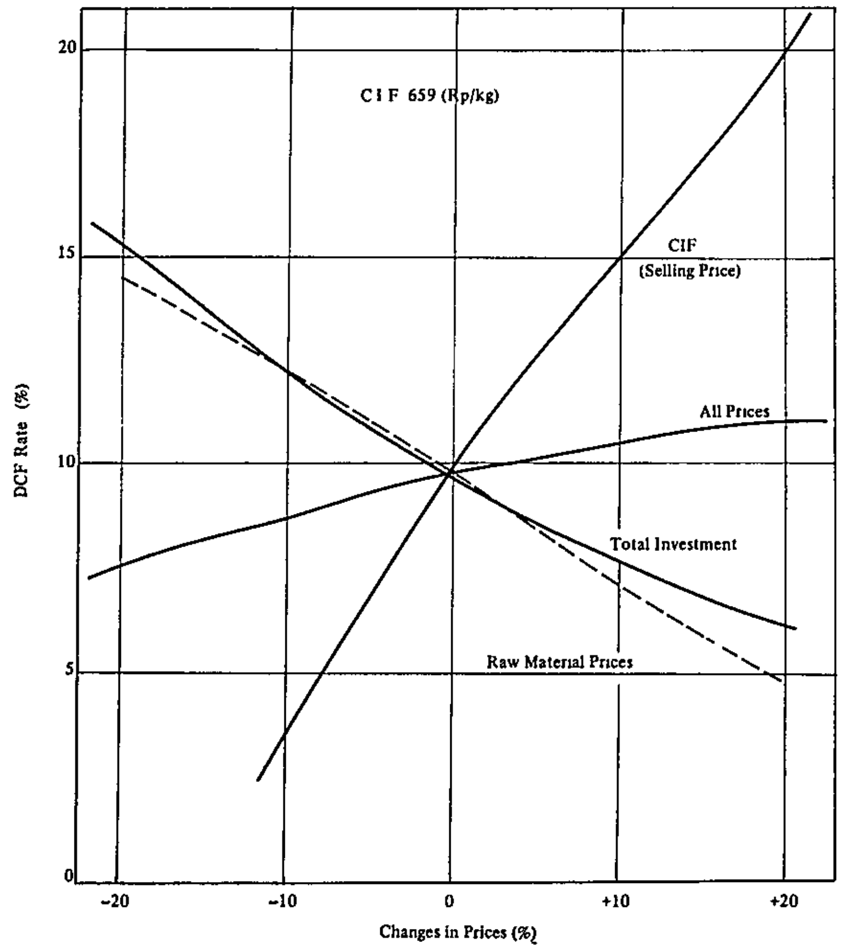


Fig. V-16 Sensitivity of D.C.F. Rate to Price Changes (%)
(18,000 T/Y) – Polyester FY –

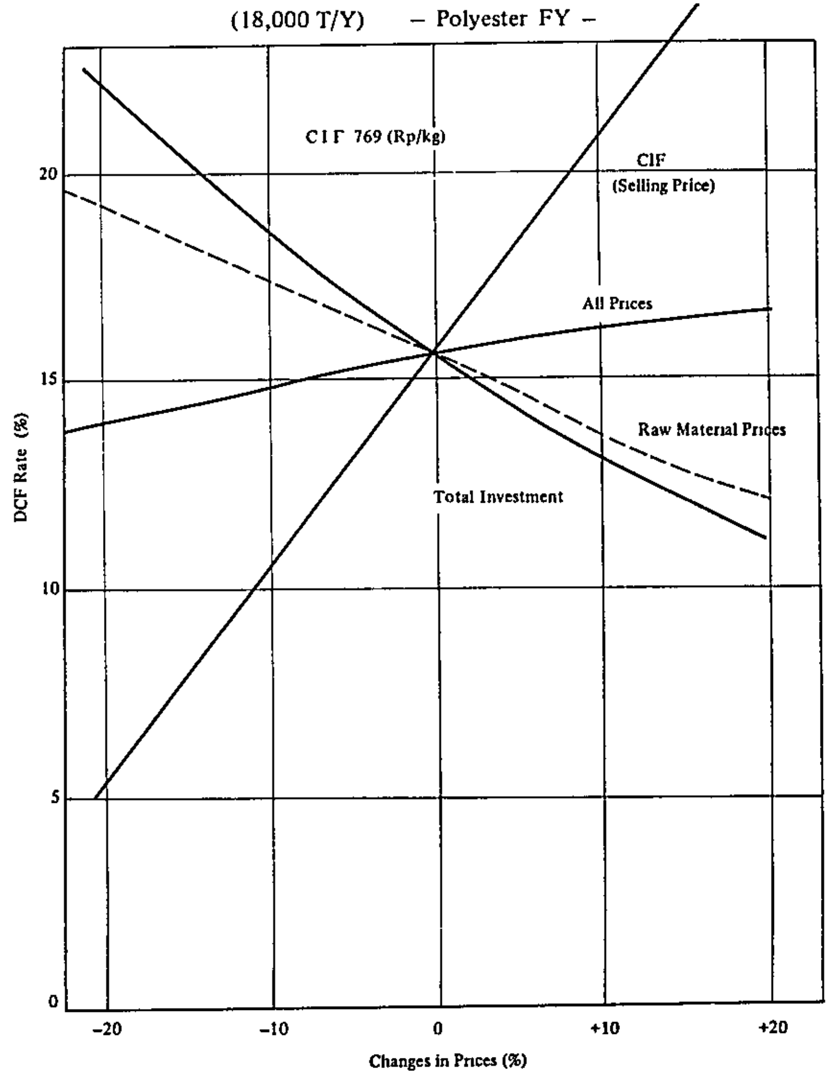


Fig. V-17 Sensitivity of D.C.F. rate to Price Changes (18,000 T/Y)
- Polyester SF -

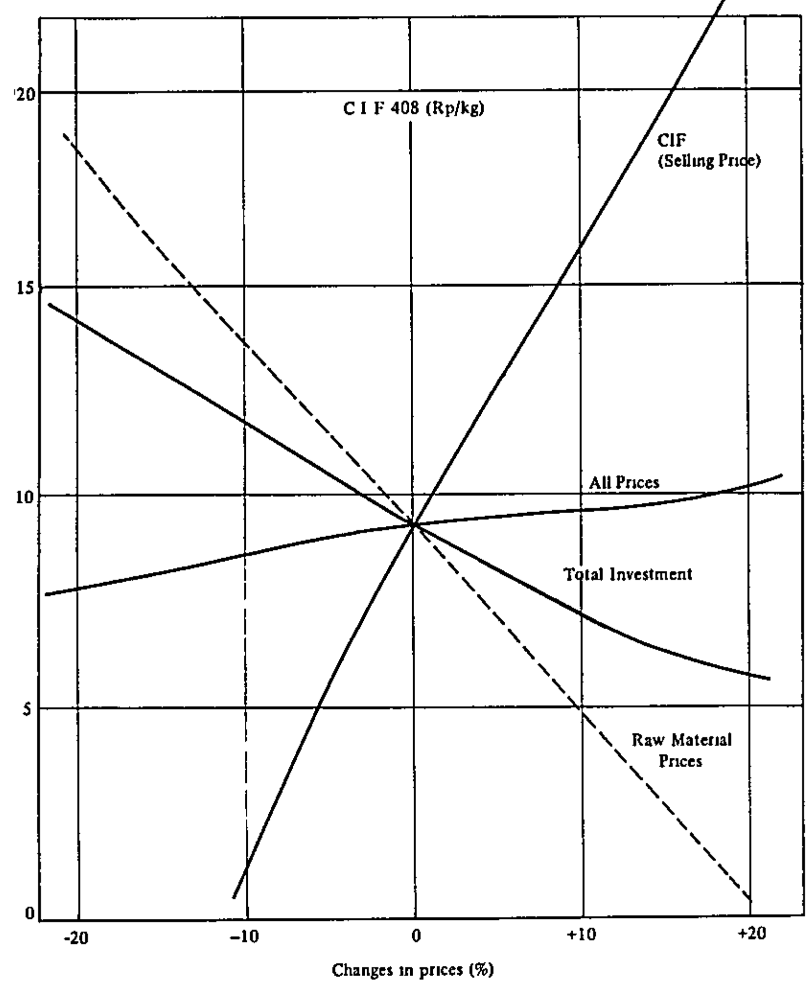
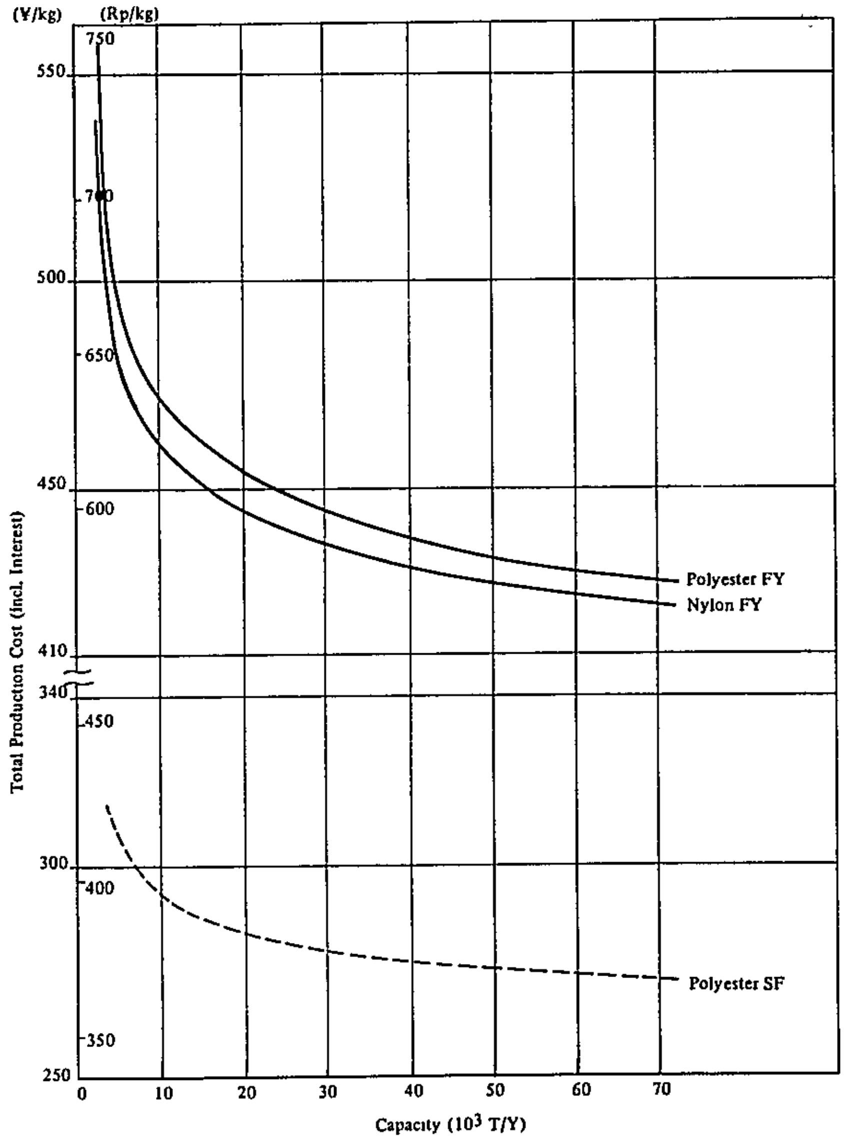


Fig. V-18 Production Scale and Cost of Synthetic Fibre Production (Indonesia)



As is evident from this illustration, it is desirable to construct a synthetic fibre plant with a production capacity of at least 10,000 T/Y and, if possible, to construct a plant with a production scale of over 20,000 T/Y.

Fig. V-19 to V-21 show the relationship between the production capacity and the DCF rate on the basis of the CIF prices (selling prices) as the parameter. If the CIF prices are set at selling prices, the polyester FY production over 15,000 T/Y is the only case where the DCF rate of over 15% can be attained. Even in such a case, the profitability sharply decreases if the CIF prices are reduced by 5%. It is, therefore, necessary to increase the selling price by imposing adequate import duties. In the event where an import duty at 5% or 10% on the CIF price is levied, a plant with a 40,000 T/Y production capacity would be necessary both in the cases of producing nylon FY and polyester SF, if the duty rate is set at 5%.

However, for the time being, there seems no feasibility for constructing a plant with a production capacity as high as this.

On the other hand, more than 15% of the DCF rate can be obtained at a production scale of 15,000 to 20,000 T/Y if a 10% import duty is imposed. It is therefore desirable to construct a synthetic fibre plant which has a production capacity of approximately 20,000 T/Y for polyester SF for which there is a large demand, and a plant of at least 10,000 T/Y for nylon FY and polyester FY, the demand for which is comparatively lower. One large plant with a capacity of 15,000 to 20,000 T/Y should be constructed rather than a number of small-sized plants scattered over the country if it is desired to develop the Indonesian synthetic fibre industry capable of coping with international competition.

Fig. V-19 Scale and Profitability of Nylon FY Production

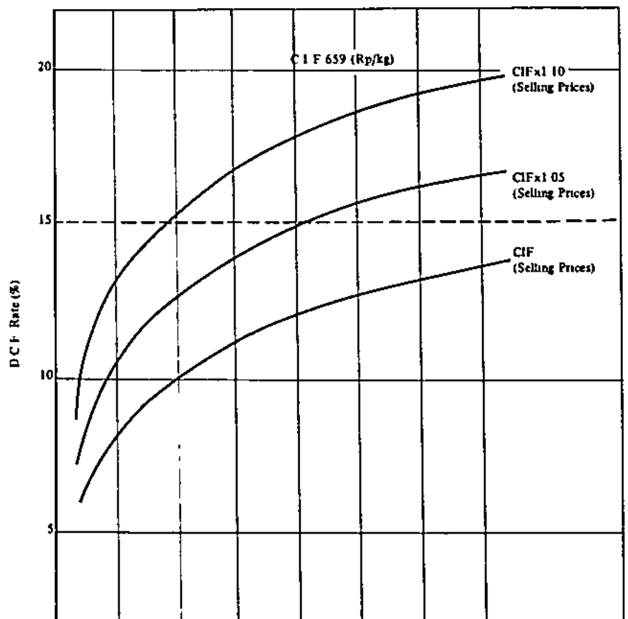


Fig. V-20 Scale and Profitability of Polyester FY Production

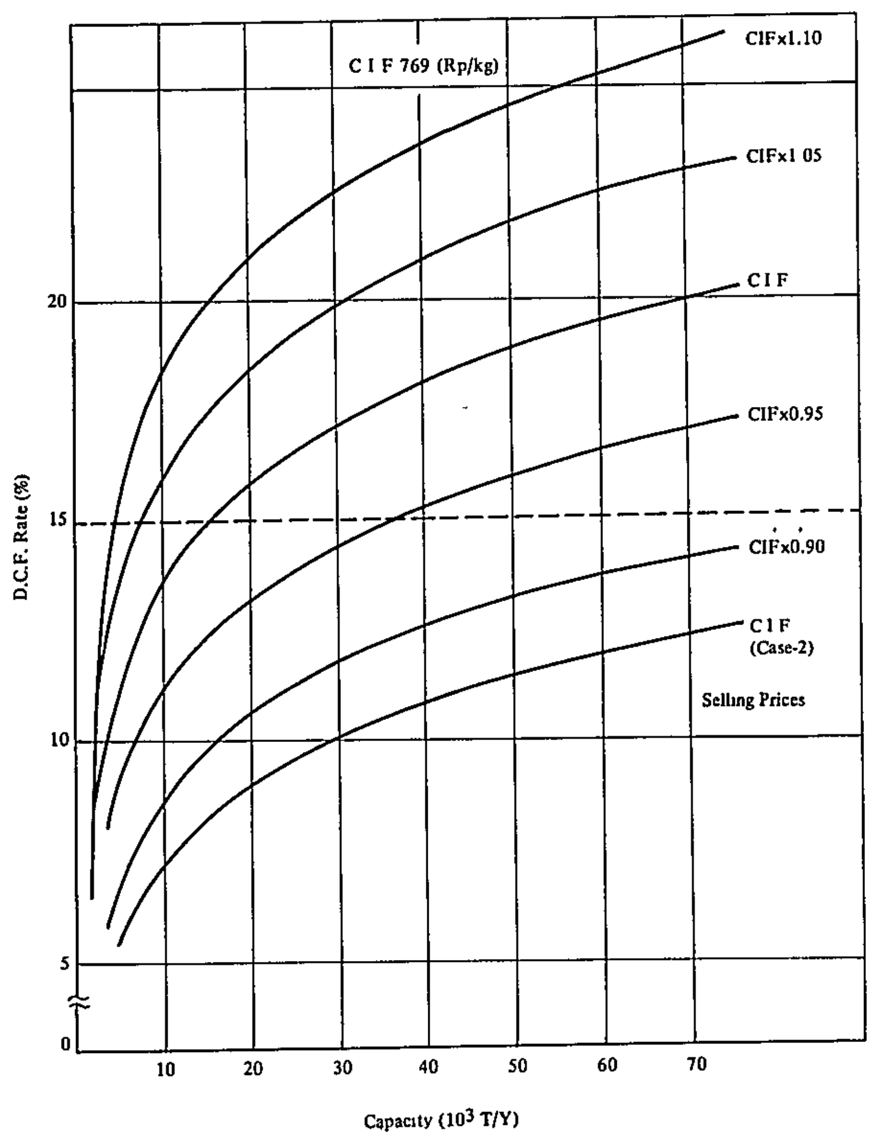
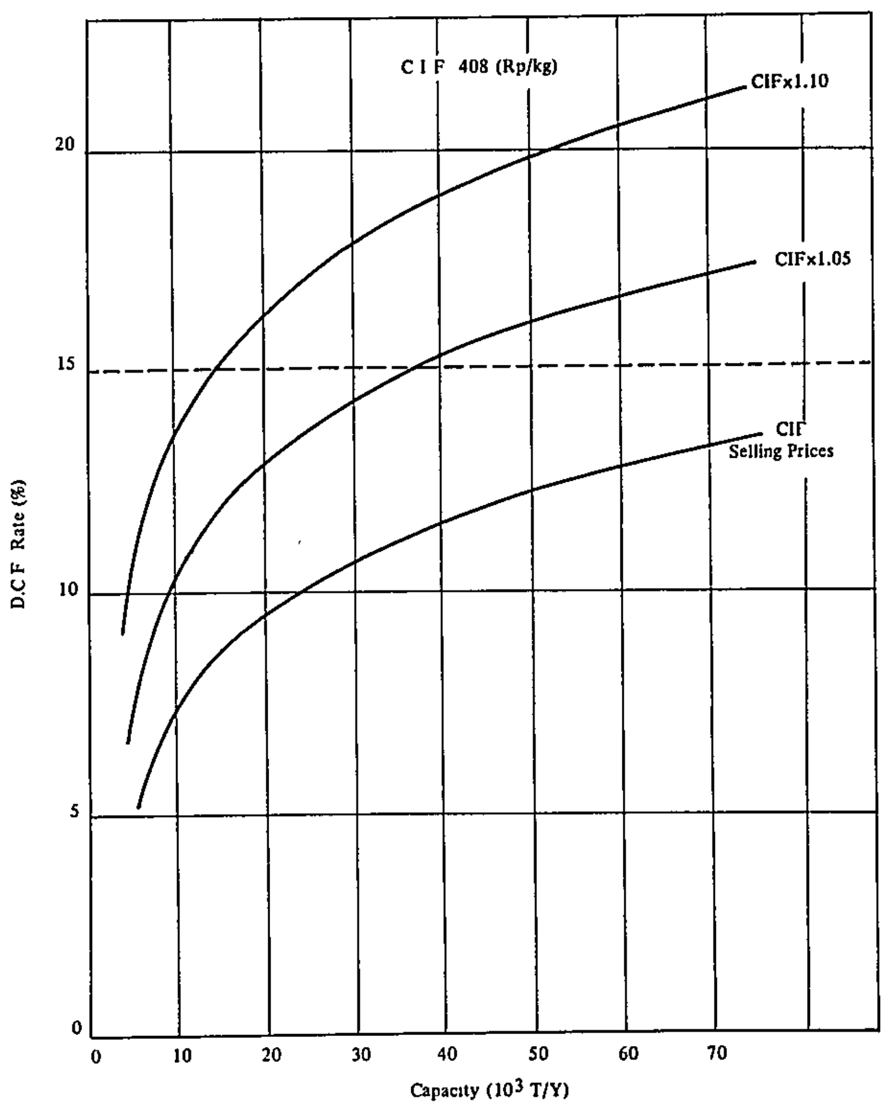


Fig. V-21 Scale and Profitability of Polyester SF Production



7. Timing of construction and the scale of production

As has already been discussed, the following can be considered for the construction of a synthetic fibre plant.

(A) A factory to manufacture one type of fibre only, and

(B) a plant to manufacture several types of synthetic fibres.

Plant (A) would not be suitable for Indonesia if the minimum economic production capacity is 15,000 to 20,000 T/Y. This observation has been made on the basis of the fact that the present status of transportation in Indonesia is insufficient as the production would have to be concentrated on one area. The exception in this case may be the production of polyester SF, the demand for which is high. On the other hand, plant (B) would be suitable for Indonesia if the scale of the plant is well balanced to meet demands for each type of synthetic fibre in the West, East and Central Java. In this case the scale of the plant would become sufficiently large and the transportation problem would be solved. In view of this observation, type (B) plant shall be scrutinized further in the following paragraphs.

Only the basics are treated in this report regarding the timing of construction of a plant and the production scale thereof and the plants for which the project documents have already been submitted officially or the plants which are presently under construction shall be excluded from the scope of this discussion due mainly to the fact that all of these plants are of a small production scale.

Priority of plant construction should be given in the order of polyester SF, nylon FY and polyester FY. The reason for giving top priority to a polyester SF plant is that this material has the highest extent of demand and the polyester SF processing facilities are being maintained the most satisfactorily. The plant should be built in West Java as the processing facilities in this area are expected to be developed considerably in two to three years and also this area is close to the major consumption markets. The production scale of polyester SF at this plant should be at least 15,000 to 20,000 T/Y, and the completion of construction should be as early as possible. The completion time will, however, be during the years 1975 to 1976 due to the time required for the construction. The demands for polyester FY should be 15,000 T/Y and that for nylon FY should reach 20,000 T/Y by the time the construction has been completed, so that efforts should be made to domestically produce these items to cover approximately 50% of the demand. It is desirable to install production facilities which are capable of turning out 5,000 to 8,000 T/Y of polyester FY and further, 10,000 T/Y of nylon FY, as the said plant will be equipped with a polymerization process, thereby being capable of producing 15,000 to 18,000 T/Y of production altogether in the form of filament.

It is advantageous to arrange the production facilities for filaments in an aggregate, as the filament producing process will then be capable of turning out both polyester FY and nylon FY. By so arranging the plant, the production scale can be made larger and, at the same time, it will be possible to cope with varieties in the expected demands and the fluctuations thereof. In the meantime, it would also be necessary to promote the substantiation and expansion of fibre processing facilities in order to cope with the enhancement of the synthetic fibre rate in the Indonesian textile industry. Then the construction of the second synthetic fibre plant on a large scale should be carried out in East Java, after the completion of the first large scale synthetic fibre plant in West Java. The timing of construction of the second plant in East Java should be two years after completion of the first. The production target should be set to cover approximately 70% of the demands by such a construction.

The second plant should be projected to have a production scale capable of turning out 15,000 T/Y of polyester SF, 7,000 to 9,000 T/Y of nylon FY and 5,000 to 7,000 T/Y of polyester FY.

As the third step, another construction should be planned in Central Java two years after the completion of the second plant with a production target aimed at covering approximately 80% of the demands for synthetic fibre. The scale of this third plant in Central Java should be projected on the same level as the second plant in East Java.

Fig. V-22 to V-24 show the relationship between the demands and the production amount of synthetic fibres when produced under the foregoing plans.

The project described above is obviously of a general nature indicating merely the outline of what is recommended to be undertaken. The reason for the above discussion being such is that, as has already been mentioned, the construction of a staple fibre and filament yarn production plant would be meaningless unless and until the substantiation, reinforcement and expansion of fibre processing facilities are achieved. The synthetic fibre processing facilities presently existing in the Indonesian textile industry are by no means sufficient. As has already been mentioned, the required investment for the development of fibre processing facilities will be three to five times as much as that required for the staple fibre and filament yarn production. It is therefore strongly recommended that, on the part of the government of Indonesia, positive policies be undertaken for the expansion of the synthetic fibre processing facilities.

Fig. V-22 Demand and Production Amount of Nylon FY

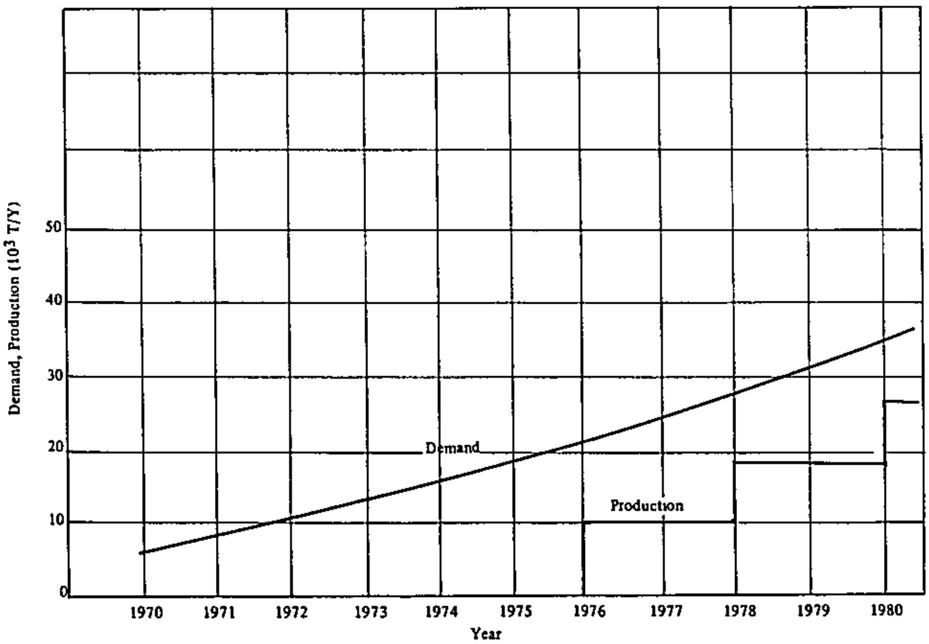


Fig. V-23 Demand and Production Amount of Polyester FY

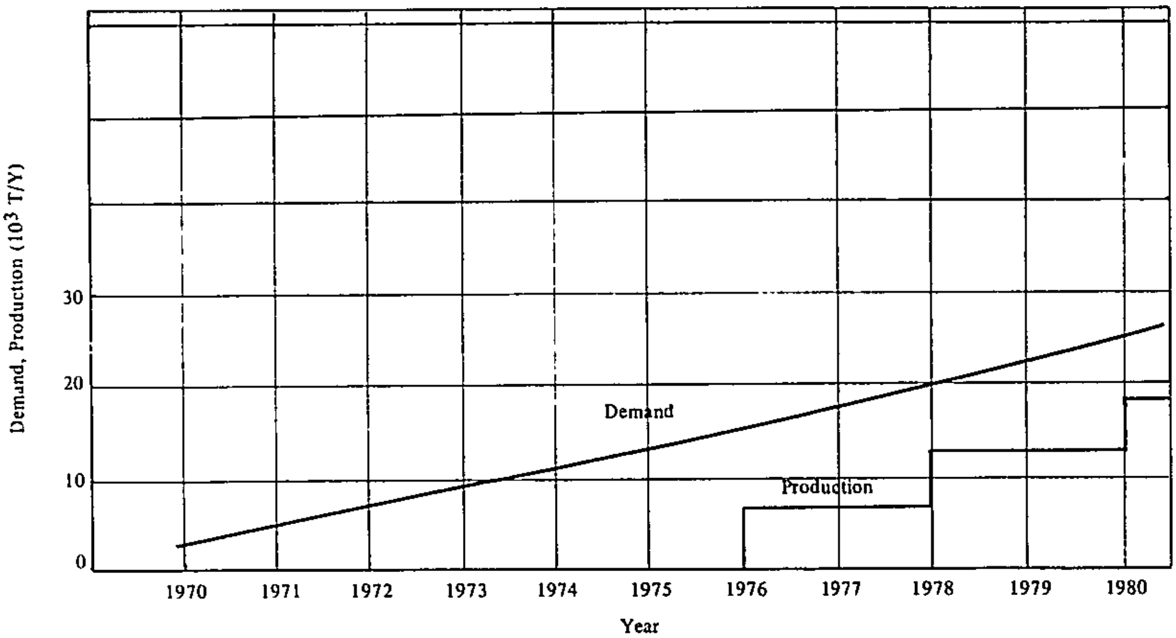
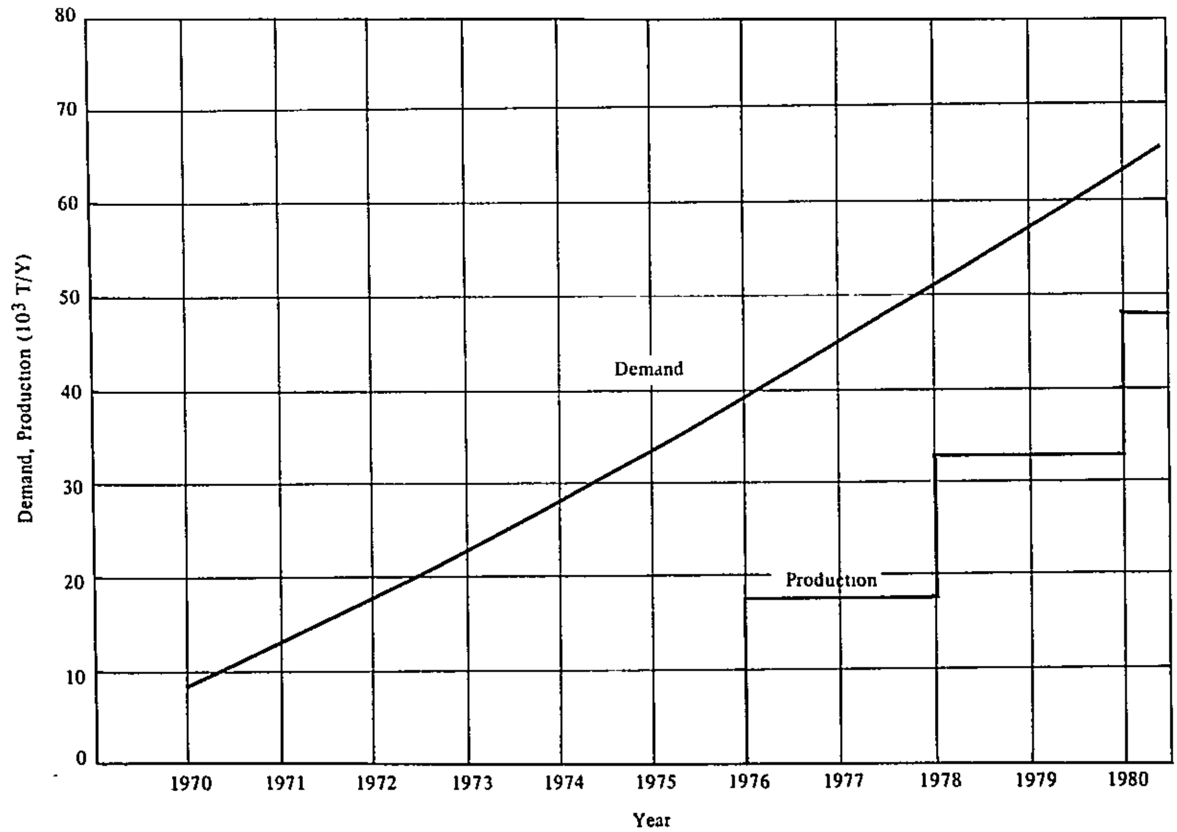


Fig. V-24 Demand and Production Amount of Polyester SF



VI. Synthetic Fibre Raw Materials

1. Introduction

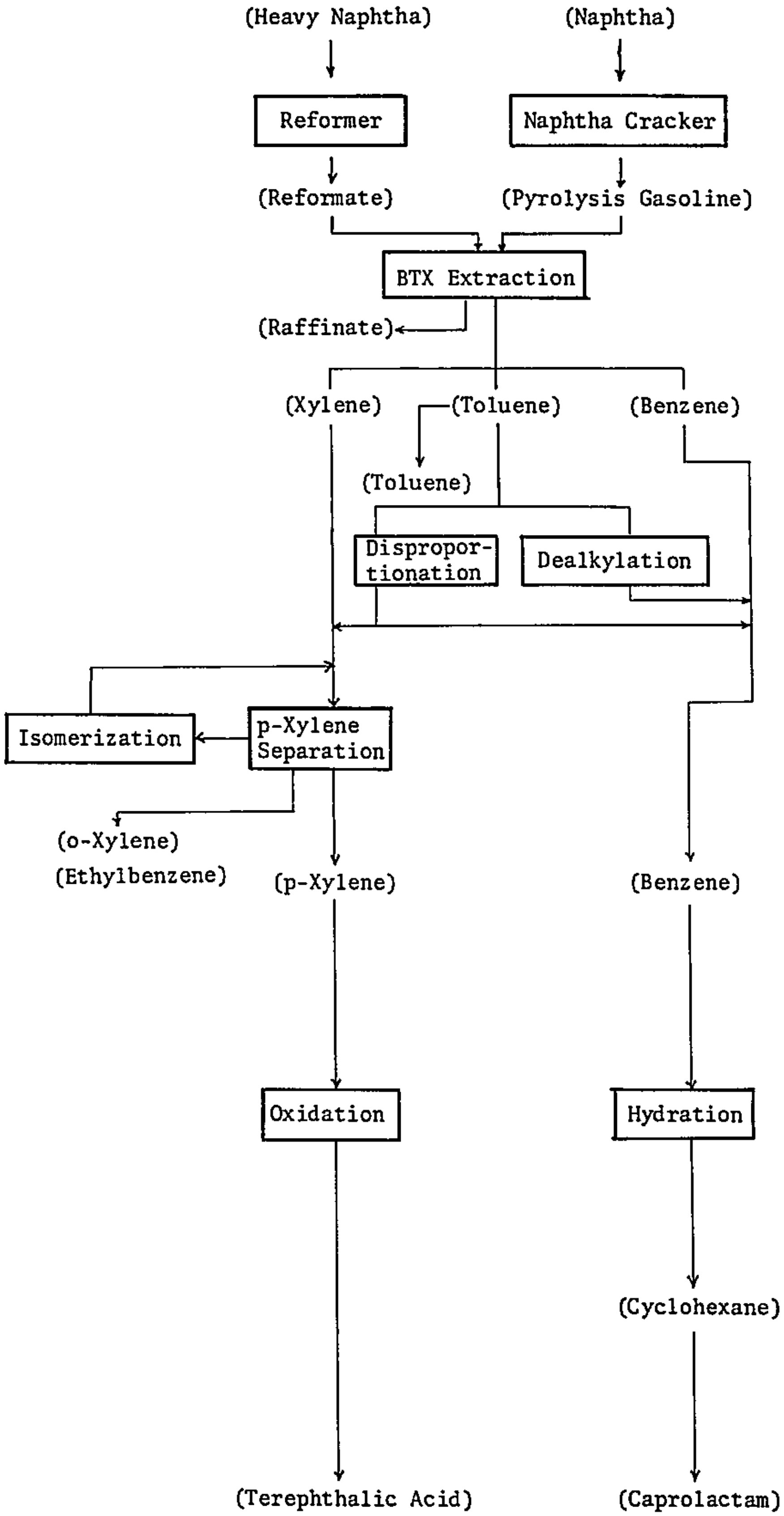
The demands for the synthetic fibres in Indonesia, as was previously discussed, mainly consist of the demand for nylon and polyester. The demand for the acrylic fibres is extremely small, therefore, the raw materials for nylon and polyester will be the main items to be discussed here. In this chapter the feasibility and the economic assessments regarding the construction of plants in Indonesia will be càrried out on the assumption that caprolactam is used as the raw material of nylon and the terephthalic acid for the polyester. However, concerning the B.T.X. which is the raw material of monomer, an explanation of the outline of the process alone will be made and the relative problems will be defined.

Fig. VI-1 illustrates the outline of the production covering the whole process. The raw materials of the polyester consist of TPA, DMT and ethylene glycol. As was discussed in the chapter on the synthetic fibre industries, there are two available methods for the esterification, i.e., the direct esterification method and the DMT method. However, it is evident that the direct esterification method will be employed in the future due to the fact that this method is the most economical. Therefore direct esterification of TPA alone is discussed here. The ethylene glycol is produced by means of oxidizing ethylene. However, only the two methods are available if the ethylene glycol is to be procured in Indonesia, i.e. construction of a petro-chemical complex from which the ethylene glycol is procured and the importation of ethylene glycol. It is evident that production of ethylene glycol by using imported ethylene would be disadvantageous, economically. Therefore, the importation of ethylene glycol will not be discussed in this report.

2. The Outline of the Monomer Process

There are several processes available for producing caprolactam, i.e. the phenol method by using phenol as the basic material and the SNIA method by using toluene as the raw material, however, the cyclohexane method by employing cyclohexane as the basic material is the method most internationally accepted in recent years. Therefore, this method will be mainly discussed in this report. At present, there are several methods available in this connection, i.e. the DSM method, the BASF method, the INVENTA method and the PNC method, all of which have almost the same extent of international competitiveness and all of which are employed for the production of caprolactam by using cyclohexane as the basic material. As these processes are considered to be equally acceptable, the economic assessment results will be indicated in terms of mean values applicable to all the processes. For the P-TPA production, two methods exists, i.e. one which employs p-xylene as the basic material and another which uses toluene or phthalic acid anhydride as the raw material. However, according to the worldwide trend, it seems that the method using p-xylene as the raw material will be the only method employed. At present, the available methods for the production

Fig. VI-1 Outline of Synthetic Fibre Raw Material Production Processes



of terephthalic acid by using p-xylene as the raw material are the AMOCO method, the MOBIL method and the TORAY method. The processes of these methods are considered equally acceptable, and therefore the economic assessment will be made in terms of mean values which are applicable to all the processes.

3. Raw Material Costs

The cost situations regarding caprolactam and the terephthalic acid have already been discussed in the chapter on the synthetic fibre industry, and will therefore not be covered in this chapter.

Fig. VI-2 illustrates the trend regarding the Japanese domestic prices and the Japanese import prices of cyclohexane and p-xylene. These materials are being imported into Japan. It is therefore reasonable to assume that for Indonesia these materials are available at approximately the same prices as the CIF Japan prices. The domestic price in Japan of cyclohexane was equivalent to 36.4 Rp/kg. in 1972 and the CIF Japan price of same was 47.2 Rp/kg. Therefore, the Indonesian price of cyclohexane will be calculated on the basis of the Japanese domestic price. On the other hand, the Japanese domestic price of p-xylene was 76.8 Rp/kg. and the CIF Japan price was 60.6 Rp/kg. The Indonesian price of p-xylene will therefore be calculated on the basis of the CIF Japan price level.

The benzene and xylene prices are both less than 27 Rp/kg. and Fig. VI-3 illustrates the price trends of these materials which are the raw materials of the cyclohexane and p-xylene. Therefore, it seems that there is no further room for price reductions of these materials. Considering all the above conditions, the future price of cyclohexane (including CIF, the trader's commission and other charges) is set at 50 Rp/kg. and that of p-xylene at 67.4 Rp/kg. However, it is probable that monomer plants will be constructed in the vicinity of oil refineries or chemical plants, so that the price mentioned above does not include the domestic inland transportation charges. The prices of sulphuric acid and ammonia, both of which are the sub raw materials for caprolactam production, are at present 11 Rp/kg. and 31 Rp/kg., respectively, in Indonesia.

4. Economic Assessment of Monomer

All the economic assessment calculations have been carried out by means of the Discount Cash Flow Method. In this case, the target selling price was set at the CIF price to be paid upon effecting importation into Indonesia. The CIF prices of caprolactam and P-TPA were taken at 199 Rp/kg. and 172 Rp/kg. respectively (CIF Indonesia). These prices are equal to the sum of Japanese prices shown in Table. V-12, the Freight and the Insurance premium. As typical examples, Table. VI-1 and VI-2 illustrate the cost calculations of a 30,000 T/Y caprolactam plant and of a P-TPA plant of the same capacity. (The costs of building and construction amount to approximately 10% of the total plant cost.)

Fig. VI-2 Trend of Prices of p-Xylene and Cyclohexane (Japan)

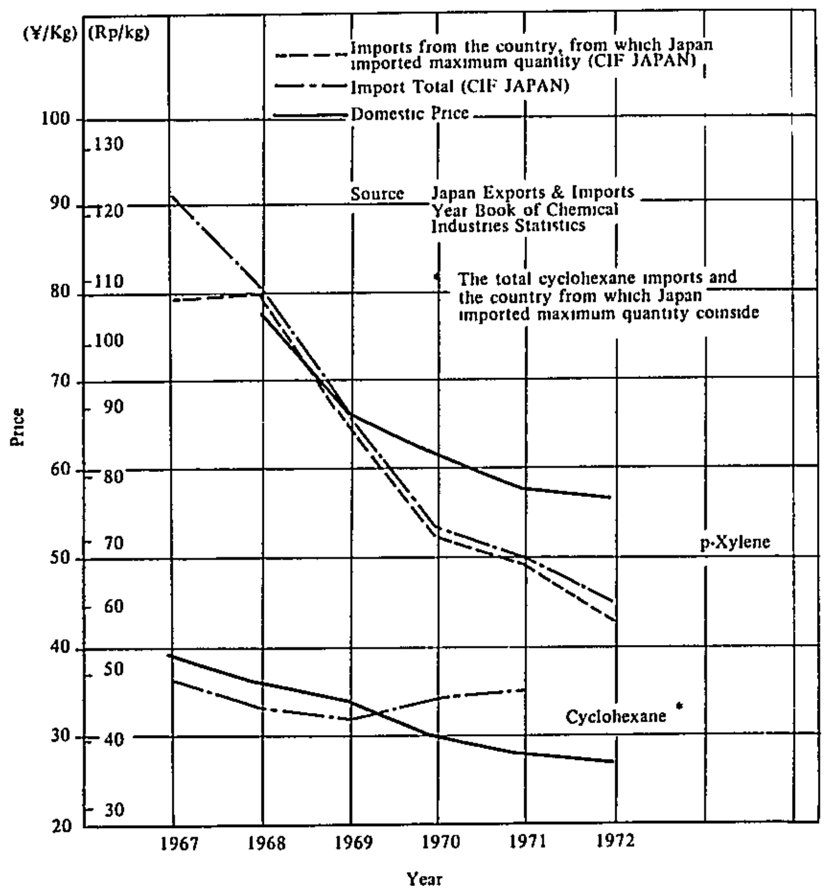


Fig. VI-3 Trend of B T.X. (Benzene, Toluene and Xylene) Prices

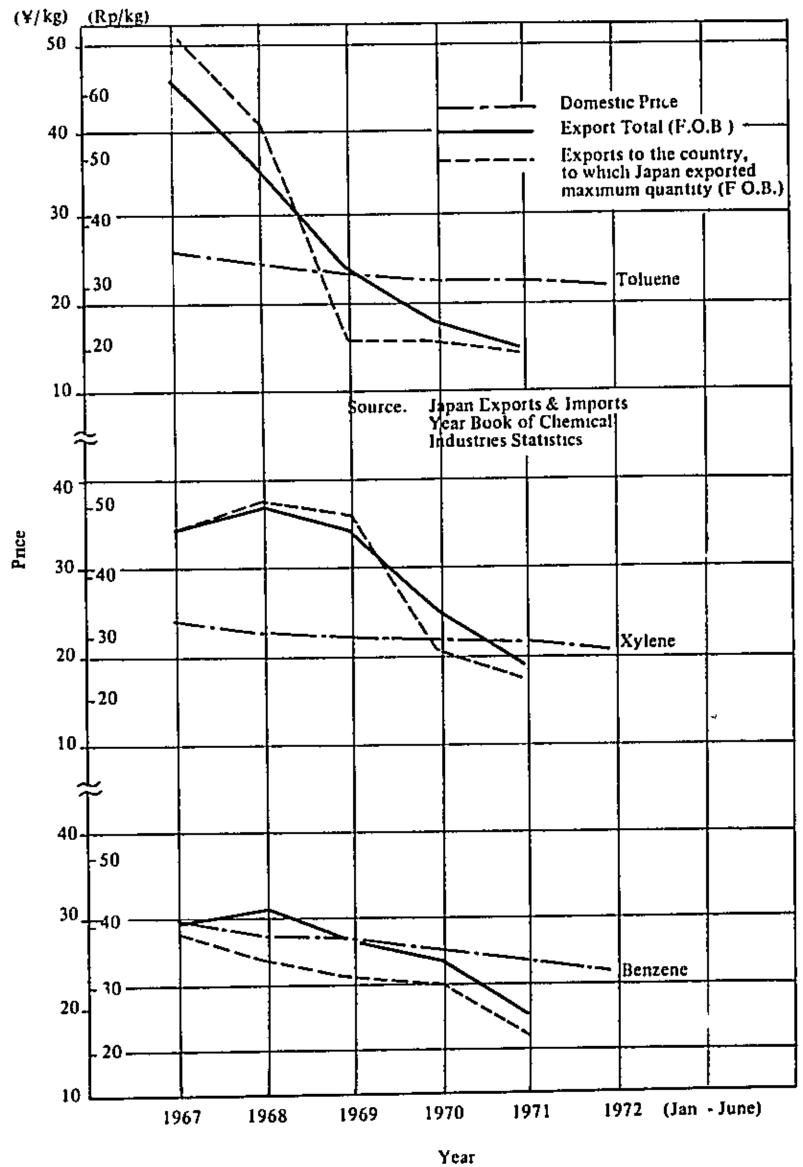


Table VI-1 Production Cost of Caprolactam (Indonesia)

		Consumption (/kg)	Price (Rp)	Cost (Rp/kg)
Variable Cost				
Raw Materials				
Cyclohexane	(kg)	0.91	50	45.4
Ammonia	(")	0.81	31	25.1
Sulphuric Acid	(")	1.1	11	12.2
Others		-	12.1	12.1
Ammonium Sulphate Recovery	(")	2.3	-13.5	-31.4
Total		-	-	63.4
Utilities				
Utilities Total		-	-	19.9
Variable Cost Total				83.3
Fixed Cost				
Labor		70 men, 485 10^3 Rp/man.Y		1.1
Depreciation				
Total Investment		11,251,000 10^3 Rp		31.3
Engineering Fee		1,125,000 10^3 Rp		7.5
Sub-Total		12,376,000 "		38.8
Start-Up Cost		104,000 "		0.7
Interest during Construction		563,000 "		3.8
Total		13,043,000 "		43.3
Maintenance				7.5
Plant Overhead				1.1
Fixed Cost Total				53.0
Running Royalty				6.7
Production Cost				143.0
Distribution				0
General Administration				14.3
Total Production Cost				157.3
Interest				
Interest on Total Fixed Capital				15.9
Working Capital		674,000 10^3 Rp		
Interest on Working Capital				2.7
Total				18.6
Total Production Cost including Interest				175.9
Total Capital Investment		13,717 10^6 Rp		

Table VI-2 Production Cost of P-TPA (Indonesia)

(30,000 T/Y)

	Consumption (/kg)	Price (Rp)	Cost (Rp/kg)
Variable Cost			
Raw Materials			
p-Xylene (kg)	0.67	67.4	45.1
Others	-	-	21.6
Raw Materials Total			66.7
Utilities			
Utilities Total	-	-	16.2
Variable Cost Total			82.9
Fixed Cost			
Labor	76 men, 485 10^3 Rp/man.Y		1.2
Depreciation			
Total Investment	7,977,000 10^3 Rp		22.2
Engineering Fee	798,000 "		5.3
Sub-Total	8,775,000 "		27.5
Start-Up Cost	103,000 "		0.7
Interest during Construction	399,000 "		2.7
Total	9,277,000 "		30.9
Maintenance			5.3
Plant Overhead			1.2
Fixed Cost Total			38.6
Running Royalty			6.7
Production Cost			182.2
Distribution			0
General Administration			12.8
Total Production Cost			141.0
Interest			
Interest on Total Fixed Capital			11.3
Working Capital	654,000 10^3 Rp		1.3
Interest on Working Capital			1.3
Total			13.9
Total Production Cost including Interest			154.9
Total Capital Investment	9,931 10^6 Rp		

4-1. Scale of Production and Economy of Operation

Fig. VI-4 and VI-5 show the relationship between the production capacity of caprolactam and the costs and the relationship between the capacity of P-TPA production and costs, respectively. Fig. VI-6 and VI-7 illustrate the relationship between the production capacity and the DCF rate, using the CIF price (selling price) as the parameter. As these figures clearly illustrate, when approximately 15% is taken as the target DCF rate, the minimum economic scale of the plant to be constructed in Indonesia would be at a capacity of 30,000 to 40,000 T/Y, with the imposition of a minimum 10% import duty on caprolactam and the P-TPA. In the case of such plants, unlike the esterification plants of spinning plants, the economic efficiency largely depends on the production scale. Therefore, it is recommended that, instead of constructing a small scale plant, a plant with a capacity of at least 30,000 to 40,000 T/Y should be constructed when the domestic demands have grown to a certain extent.

4-2. Changes in Various Prices and Economic Efficiency

As the basic conditions, the caprolactam production and the P-TPA production were taken at 30,000 T/Y each. Fig. VI-8 and VI-9 illustrate the variation in the DCF rate when the CIF price (selling price), plant costs and raw material costs change independently within the range of ± 20% and also when they change simultaneously within the same range.

The CIF price (selling price) is the factor which conspicuously affects the economic efficiency of both caprolactam and P-TPA. A 10% increase in the CIF price corresponds to a 5% decrease in the DCF rate. Both the changes in the raw material costs and in the plant costs affect the DCF rate to approximately the same extent. A 10% change in these costs corresponds to a 2% shift in the DCF rate. When the CIF price, material costs and plant costs change simultaneously, a 10% increase in these costs correspond to a 1% increase in the DCF rate.

As mentioned above, the production scale and the CIF price (selling price) are the factors which largely affect the economic efficiency of a synthetic fibre raw material production plant. Therefore, with regard to the construction of such a plant, it is recommended that the Indonesian government displays its leadership to embody the construction of a more economic large-scale plant and protect the enterprise by establishing adequate customs import duties after the construction.

5. Feasibilities and Problems of Construction

As mentioned in the chapter pertaining to the economic assessment, it is feasible for a synthetic fibre raw material production plant to be constructed in Indonesia. However, there are several problems which are left untreated in the chapter on the economic assessment. They are as follows.

5-1. General Problems

In order to develop the synthetic fibre industry, it is also necessary to develop the basic chemical industries, the industries related to the synthetic fibre industry, and the machinery and equipment industries, all of which are closely geared to the synthetic fibre industry. The development of the synthetic fibre industry alone will cause difficulties in the economic efficiency. With

Fig. VI-4 Production Scale and Total Cost (incl. Interest) of Caprolactam (Indonesia)

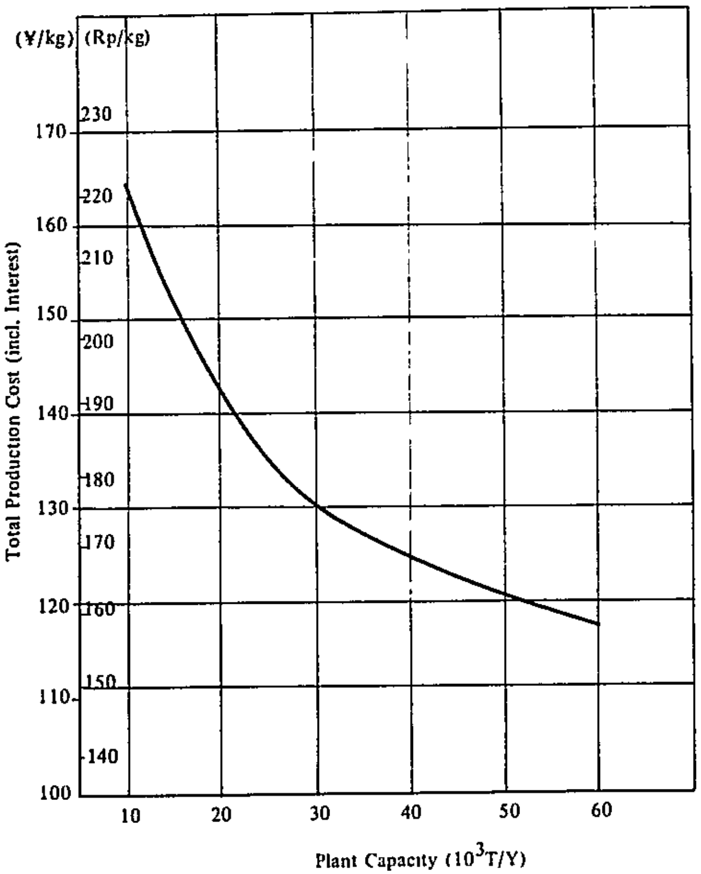


Fig. VI-5 Production Scale and Total Cost (incl. Interest) of P-TPA (Indonesia)

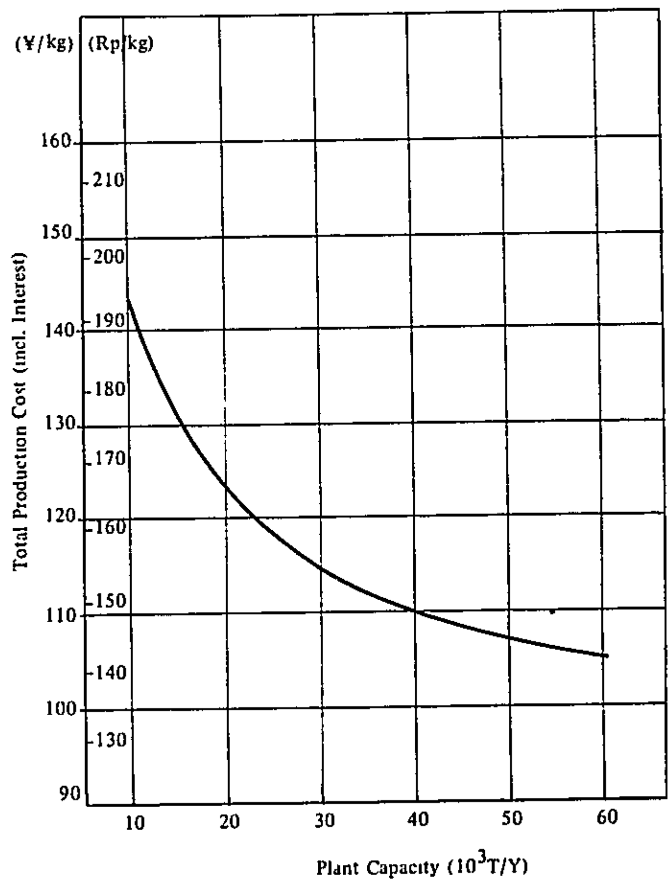


Fig. VI-6 Scale of Production and DCF Rate of Caprolactam (Indonesia)

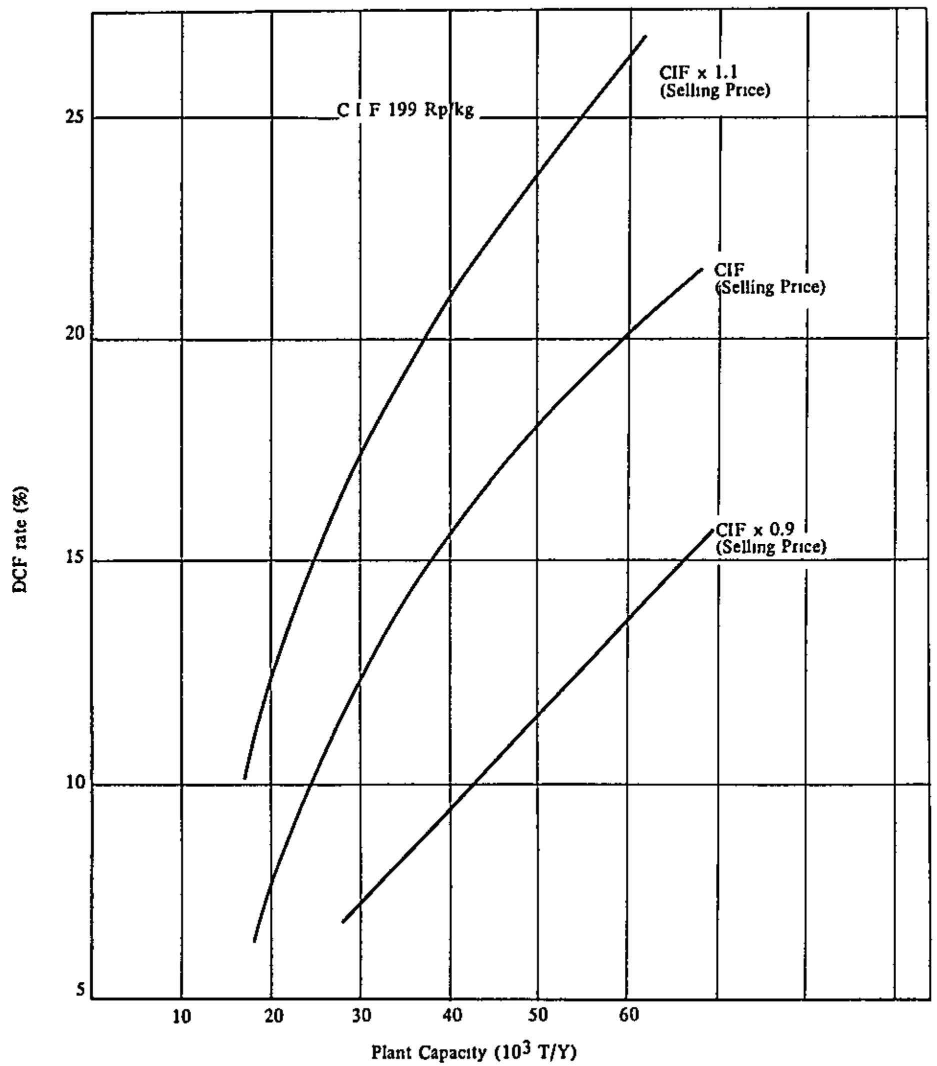


Fig. VI-7 Scale of Production and DCF Rate of P-TPA (Indonesia)

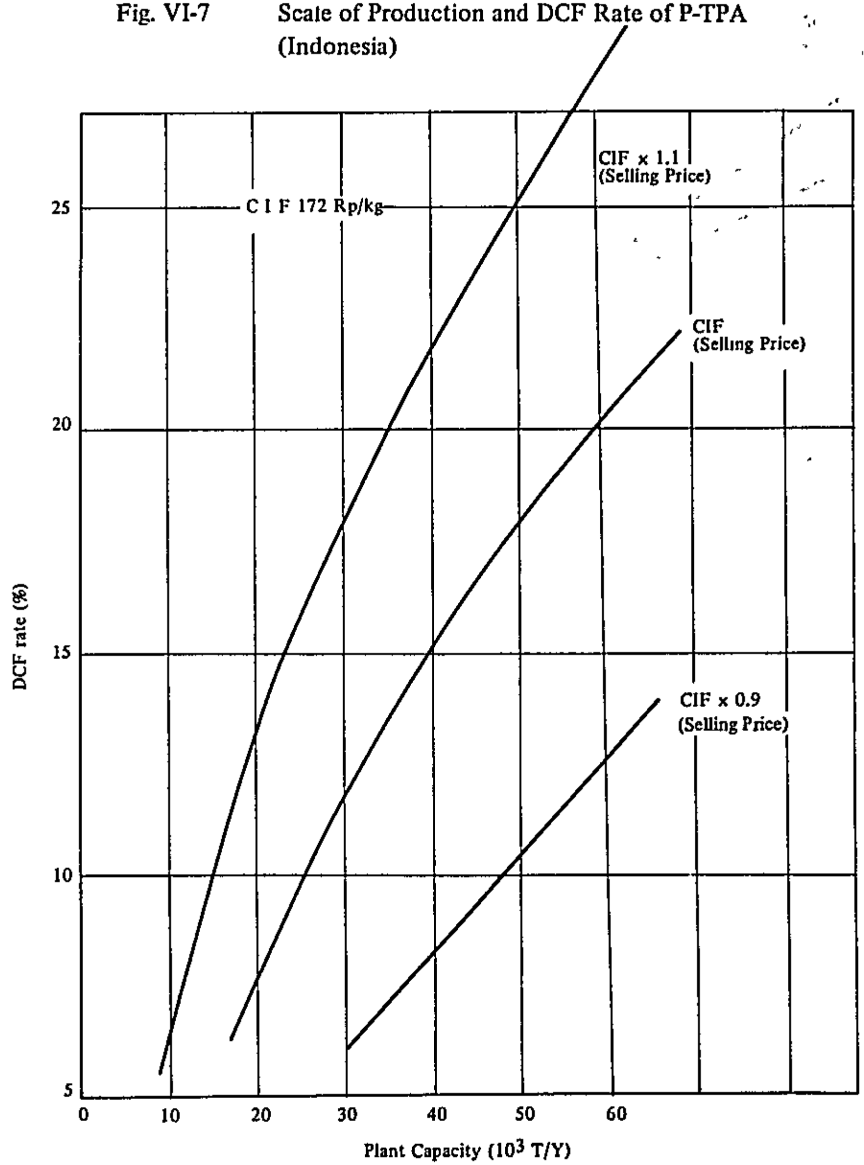


Fig. VI-8 Change in Price and DCF Rate in Caprolactam Production

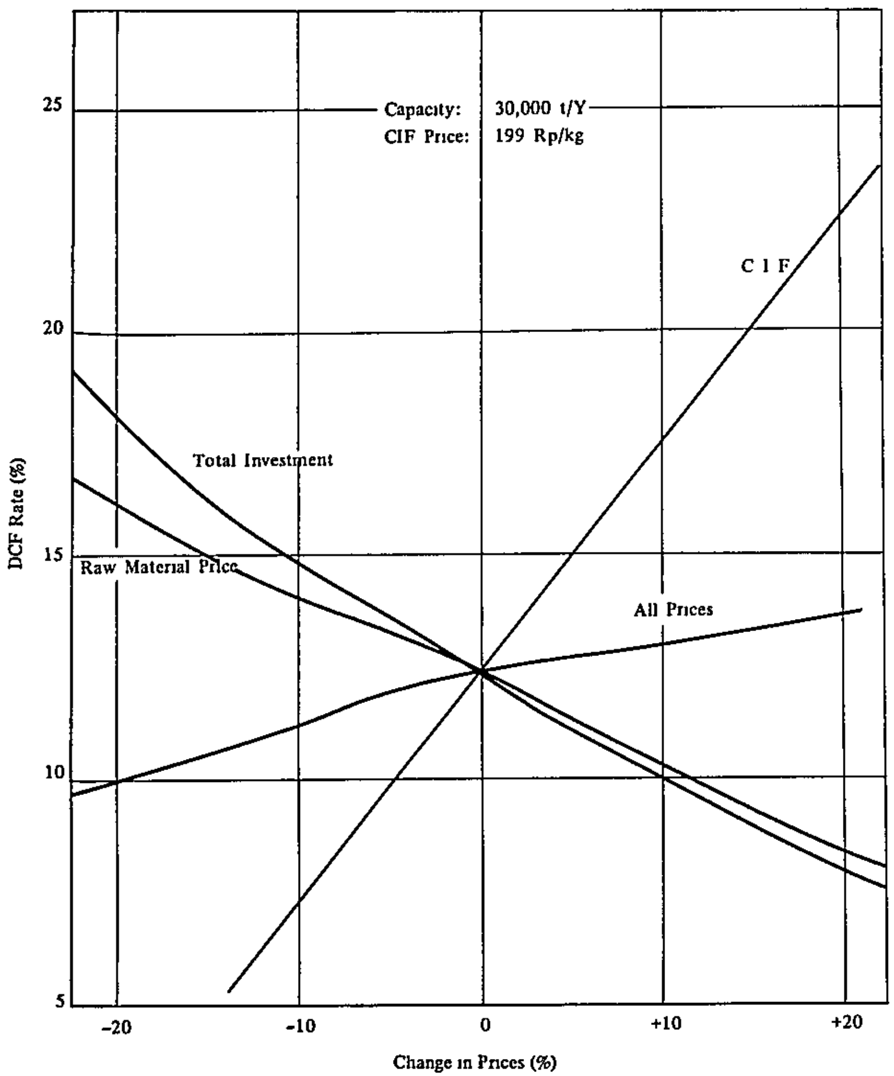
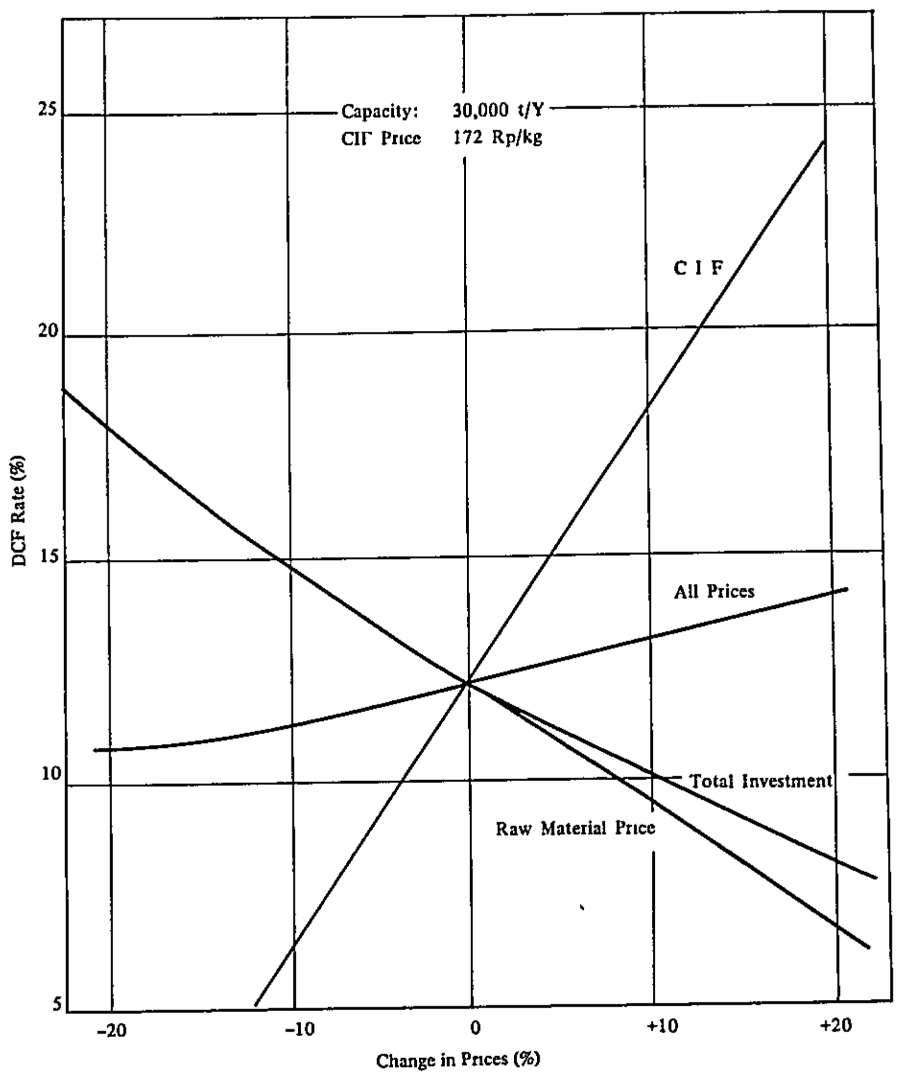


Fig. VI-9 Change in Price and DCF Rate in P-TPA Production



reagrd to the plant site conditions, it would be necessary to substantiate the roads and harbour facilities, the work of which would cost large sums of money. However, it should also be noted that the substantiation of these facilities will bring about extremely favourable incidental effects. When contemplating the development of the synthetic fibre industry, it is desirable to plant the formation of a continuous, self-supporting and self-sufficient system under which naphtha and BTX can be advantageously combined. It goes without saying that the construction of such a system is imperative in the long run, however, as will be mentioned later, there is no immediate possibility of installing a reformer for the raw material production. Therefore, the most feasible method to start the production at the present stage is to import p-xylene and cyclohexane as the basic materials. Given a situation where the foreign currency reserve must be expended for the procurement of either the finished textile products, woven fabrics, staple fibre, filament yarn or raw material monomer, it seems to conform with the Indonesian national interests to effect such procurements for the importation of items which pertain to a lesser extent of additional value when procured.

On the basis of the investigation results obtained by the present survey team, it has been concluded that there is no fundamental impediment in Indonesia for the construction of raw material plants. As will be discussed later, if plant sites are to be selected in the vicinity of an oil refinery, Sumatra may be suitable, however, the plant site will be more advantageously selected in mainland Java. From the standpoint of the industrialized countries, the extremely low land acquisition in Indonesia will be a great advantage. There are many suitable plains available in Indonesia as possible sites for the chemical industry and many shoals are also available for future use as reclaimed land. The electric power cost in the case of a small scale spinning plant is somewhat high on account of the diesel generation. However, considering the present cost of fuel oil, it seems feasible to generate electric power more economically by means of a back pressure turbine combined with the boilers which are used in the plant. The fuel oil cost at present seems, however, slightly on the high side for an oil producing country. As to industrial waters, good-sized rivers flow through all the available candidate sites and if the water is used cyclically by installing cooling towers, there would be no difficulty in this regard. Concerning the labour force, chemical plants generally require better trained operators than in the case of spinning plants. However, judging from the present situation where there are fertilizer plants in Gresik and Pusri and in view of the fact that a number of oil refineries are being operated, there would be no difficulty for the recruitment of trained operators. Regarding the pollution problems, there is no serious possibilities except for one or two cases at the present stage, however, the problems may arise in the thickly populated area of mainland Java. It must be noted that there would be no serious difficulty in constructing such plants due to the fact that the skill in controlling pollution problems is improving year by year and also that there is a good chance that the most advantageous process in this respect will be selected for the construction. The procurement of building materials must depend mainly upon imports for the time being. With regard to the maintenance and servicing of the plant, it must be noted that the existing fertilizer plants mentioned above are being well taken care of by their maintenance factories. Taking into consideration the forthcoming improvements in the levels and skillfulness of Indonesians in general, no serious shortcomings would be present in connection with the above points. However, it is highly recommended that the government take necessary measures such as favourable import duties, in order to cope with such problems as the imported machines and parts being rather more expensive than in the advanced countries, partly due to the cost of transportation.

5-2. Caprolactam

Under the present situation, whatever process is adopted an extremely large extent of sub raw materials will be required and a great extent of by-produced materials will be generated. The sub raw materials are ammonia, sulphuric acid, caustic soda and hydrochloric acid, all of which are the so-called basic materials. The by-product is ammonium sulphate. At present, due to the improvement of each process, in view of the balance of demand and supply of chemical fertilizers in the world, the decrease of the by-produced ammonium sulphate is undertaken. It is therefore very difficult to forecast exactly the nature of the future process. For the time being, however, as there are no processes other than the presently available ones, the prime factor in the feasibility of a caprolactam plant is whether these sub raw materials are economically and easily available and whether the by-products are saleable at reasonable prices. These sub raw material procurement problems and the by-product problems are highly important. The most serious problem here pertains to the ammonium sulphate which is generated in large quantities. The construction of a 40,000 ton capacity plant signifies the generation of the by-product ammonium sulphate of 100,000 T/Y. This quantity of ammonium sulphate may not seem significant for the scale of agriculture of Indonesia, however, it nevertheless has a bearing upon the agricultural policy and the plan of developing the fertilizer industry of Indonesia and therefore should be regarded as a problem to be scrutinized in a general framework. For reference, in Japan all ammonium sulphate has already been replaced by the by-produced ammonium sulphate.
The problem to be solved is the one pertaining to the sub raw materials such as ammonia, caustic soda, hydrochloric acid etc. The problems of caustic soda and hydrochloric acid would not be serious because of the fact that the quantity used is small. Ammonia will have to be produced by synthesis of the natural gas or naphtha, however, the minimum economic scale of an ammonia plant is 1,000 T/D to 1,500 T/D. Therefore, unless ammonia produced on this scale is employed, no competitive synthetic fibre raw material can be obtained. However, in such a case this quantity of ammonia cannot be consumed the synthetic fibre raw material plants alone, hence the necessity for scrutinization of fertilizer plant in combination with the synthetic fibre raw material plants from a global viewpoint. Also it is generally said that the minimum economic scale for a sulphuric acid plant is 500 to 800 T/D. This amount will also be too excessive for synthetic fibre plants to consume, therefore it is necessary to study the feasibility together with the fertilizer and basic chemical production plants. These chemicals which are now produced in Indonesia are fairly costly when compared with the international price level. This seems partly due to the fact that the production scale is small. It is important to foster the basic chemical industries as well as the synthetic fibre industries in the future. At present, there is no surplus production capacity either for ammonia or sulphuric acid so that none can be allocated for the production of caprolactam. Therefore, it should be noted that the feasibility is valid only in the case of the simultaneous fostering and development of the related industries. It must be noted that investments in the production of caprolactam including the industries related thereto are fairly large.

5-3. P-TPA

There are no significant obstacles to hinder the construction of a TPA plant. There is ample feasibility in producing the TPA due to the fact that TPA production, compared with caprolactam production, uses fewer sub-raw materials, sub-products and generates less waste so that restriction to production is not great. Also, there is a fair extent of demand for polyester.

6. Demand for Monomer and Period for Plant Construction

On the assumption that caprolactam and P-TPA production to cover all the future production of the synthetic fibres which are to be produced in Indonesia in the future is required to be undertaken domestically, Fig. VI-10 to 11 shows the demand for monomer under such a circumstance. Actually, the demand will be less than the values in Fig. VI-10 and 11 due to the importation of raw materials. However, if the monomer produced in Indonesia can effectively compete with the increase of imports, the demand shown in the figures can then be fully expected. Regarding polymer, filament yarn and staple fibre, quality differences are found among manufacturers, however, with the monomer being a chemical product, no quality difference is to be found. Therefore, if the Indonesian government protects these industries by imposing adequate import duty, the demand for the monomer to cover all the production of filament yarn and staple fibre will be generated. It is expected that the demand for P-TPA as the raw material for carrying out the polyester SF and FY production, will attain approximately 40,000 tons in 1978 and approximately 60,000 in 1980. As has already been mentioned, compared with caprolactam, P-TPA requires fewer sub-raw materials and generates less by-products so that no serious problem in industrializing the production in Indonesia exists. As mentioned in the chapter concerning the economic evaluation, a plant with 30,000 to 40,000 T/Y can produce P-TPA at a price competitive with imported products, if a 10% import duty is levied. Therefore, it is possible that in 1978 a P-TPA plant with 40,000 T/Y will be constructed. Moreover, it is expected that in 1980 the construction of another plant with a 30,000 to 40,000 T/Y capacity will be feasible. On the other hand, the demand for caprolactam, as compared with P-TPA, is not sufficiently high so that the achievement of 30,000 T/Y production may be possible in 1980. As previously mentioned, the basic chemicals such as sulphuric acid, ammonia, etc. are required to produce caprolactam. However, an economical disadvantage would be obvious if these basic chemicals were to be produced mainly for turning out caprolactam. Therefore, it is recommended that the construction of a caprolactam plant and the construction of a fertilizer plant should be projected jointly. It is desirable to effect a study with a projection to construct a 30,000 T/Y capacity plant. Due to the above-mentioned fact, mutual relationships are present in the chemical industries. The basic advantages which Indonesia has, namely the abundance of cheap labour, cannot be easily turned into actual advantage in this field of chemical industries. Therefore, it is necessary to study practical ways and means to solve the problems of how to foster the chemical industries in general, with emphasis upon the points to acquire the advantages of favourable industry sites, employment of superior large processes on a large scale and the effective raw material utilization as well as the ideal integration of the location and formation of the production sites.

7. Outline of the Basic Raw Materials for Synthetic Fibres

The definition of the "production of basic raw materials for synthetic fibres" in this discussion shall be the "production of naphtha upto cyclohexane and p-xylene". It is possible to consider that regarding the cyclohexane the hydrogenation process for benzene can be separately classified. However, the hydrogen used in the hydrogenation process can be obtained at the lowest cost

Fig. VI-10 Demand Amount for Caprolactam

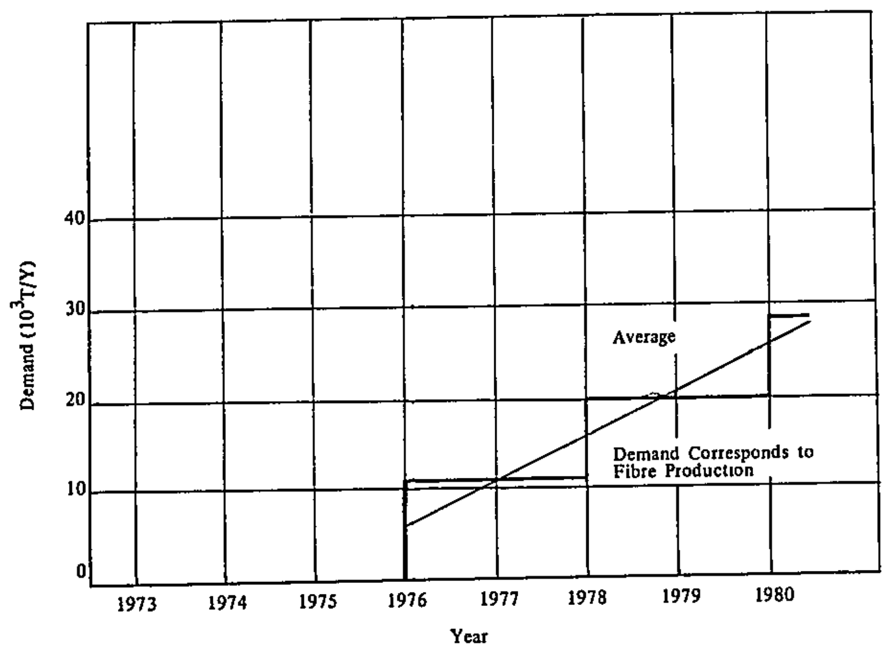
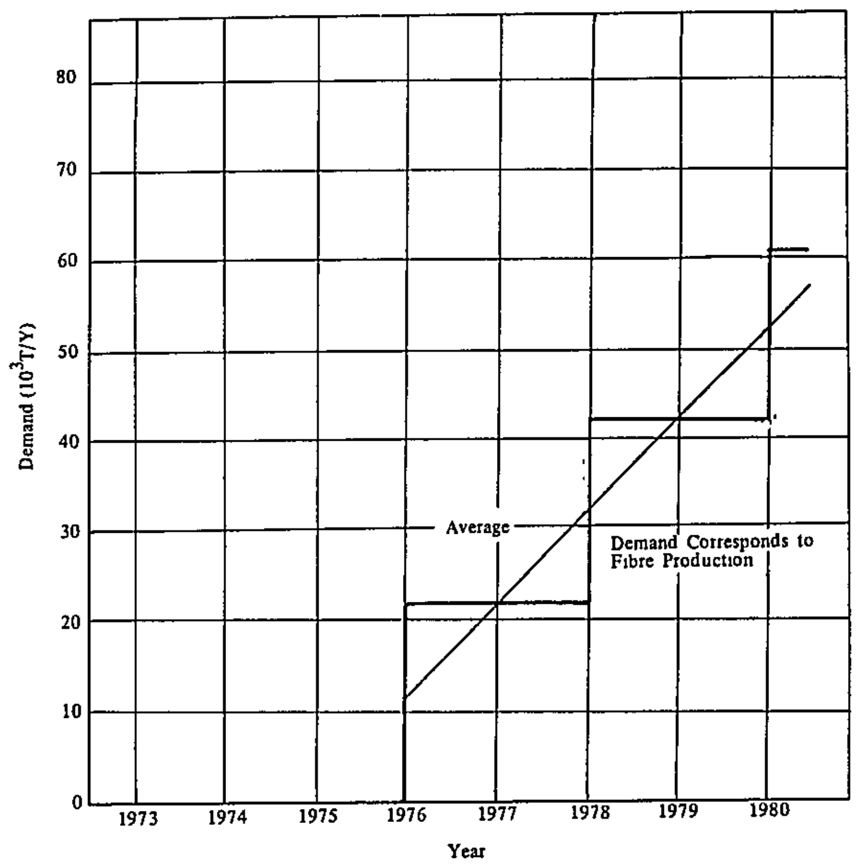


Fig. VI-11 Demand Amount for Terephthalic Acid



if the off-gas of the reformer is utilized. If the hydrogenation process is not integrated in the plant, it would be necessary to obtain the hydrogen by cracking natural gas for example. Such a case would be disadvantageous cost-wise unless undertaken on a large scale. In the case of Indonesia this process should be included in an integrated process for the basic raw materials.

There are two categories for the petro-chemical basic raw materials for synthetic fibres, i.e. the reformate source materials derived from the catalysis reformates and the pyrolysis source materials derived from the naphtha cracking. The following paragraphs will cover the explanation upon these sources.

Table. VI-3 illustrates the amount of the demand for benzene and p-xylene for use as synthetic fibre raw materials. The demand figures have been obtained by converting the extent of demand for monomer.

Table V1-3 Demand Amount of Benzene and p-Xylene (for Synthetic Fibre)

(ton)

Year	Benzene	p-Xylene	Total
1976	8,000	15,000	23,000
1978	17,000	28,000	45,000
1980	25,000	41,000	66,000

7-1. Reformer Source

The reforming process was originally developed to improve the octane value of engine fuel gasoline. Even now, most of the processes are operated for this purpose. The raw material generally employed here is called heavy naphtha. The aromatic compounds are generated and the contents thereof increase when the raw material is treated by the reforming process. This reformate compared with the pyrolysis gasoline, produces synthetic fibre raw materials having a lesser extent of ethyl-benzene content. Therefore the most suitable synthetic fibre raw materials can be obtained from the reformates. The reformates are therefore assuming the main portion as the basic raw materials for synthetic fibres.

7-2. Pyrolysis Source

It would be necessary to construct a naphtha cracking plant on a large scale if the pyrolysis gasoline is utilized as the raw material in Indonesia. In other words, it would be necessary to build a so-called petro-chemical industry centre to produce various types of petro-chemical derivatives in Indonesia. Moreover, the ethyl-benzene content in xylene increases when utilizing the pyrolysis gasoline. Further, prior to the extraction of the aromatics, a process for the hydrogenation would be required. These are the anticipated disadvantages in the case of employing the pyrolysis source. Therefore, the reformer sources generally assume the main role as the raw material source.

7-3. Material Balance in the Production of Synthetic Fibre Basic Raw Materials

7-3-1. Reformer Source BTX

It is commonly accepted that the minimum economic scale of a naphtha reforming plant for producing BTX is 10,000 to 15,000 BPSD, however, as the utilization amount of BTX in Indonesia is small a reformer of 10,000 BPSD was taken as an example in Table. VI-4 to illustrate the material balance. It has been

Table VI-4 Material Balance in the Production of Reformates

	Components	Quantity (MT/Y)	
Feed	Heavy Naphtha 10,000 BPSD	434,000	
Products	H	8,200	
	C_1	9,800	
	C_2	16,300	
	C_3	25,100	
	C_4	29,500	
	C_5	29,600	
Reformates	$C6^+$ Paraffin + Naphthene	61,200	315,500
	B	19,500	
	T	99,400	
	C8 AROMA	106,100	
	$C9^+$ AROMA	29,300	
	Total	434,000	

calculated that the price of the 320,000 T/Y reformate which is to be produced by such a process is 1.25 to 1.30 times as much as that of the fed naphtha. The fraction which is extracted from the components greater than C6 shown in Table. VI-4 by means of an extracter, is illustrated in Table. VI-5. It is expected from the "Macro" point of view that the forecasted consumable quantity of BTX will be 220,000 T/Y in 1980, as against the required quantity of benzene and p-xylene of approximately 70,000 T/Y. The maximum yield of BTX of a reformer is approximately 50% which implies that only 16% of the fed quantity, i.e. 32% of the total BTX can be used as the raw material for synthetic fibres. Only 11% of the fed quantity would be consumed if the scale of the reformer is 15,000 BPSD. It is therefore reasonable to forecast that the feasibility of constructing a reformer for providing the synthetic fibre raw materials will be low until 1980, in view of the fact that thereafter the minimum scale of the reformer will be enhanced. However, there is no example even in the so-called industrialized countries where all the BTX is destined for use as the synthetic fibre raw material. A combination with the raw materials for synthetic resin is usually undertaken.

Table VI-5 Extracted Composition of Aromatics (Raw Material Reformates)

	Components	Quantity (MT/Y)	
Feed	Reformate	315,500	
Products	B	19,500	
	T	98,700	221,300
	C8 AROMA	103,100	
	$C9^+$ AROMA	26,100	
	RAFFINATE	68,100	
	Total	315,500	

Therefore, the feasibility of the construction of a reformer depends on whether or not the effective utilization of the derivatives can be made. The effective utilization of the derivatives may make the construction of a basic raw material plant feasible in 1980.

7-3-2. Pyrolysis Source BTX

Scrutinizations will be made in the following paragraphs regarding a case where in Indonesia the petro-chemical derivatives including plastic materials, etc. are in demand and where a naphtha cracker is constructed. In this case, the scale of a competitive naphtha cracker is deemed to be of a 200,000 T/Y capacity, however, the quantity of pyrolysis gasoline which will be by-produced at that time will be approximately the same as that of ethylene. Therefore, approximately 200,000 T/Y of pyrolysis gasoline will be produced. The component of such gasoline contains a high extent of aromatics; 80% at the most and approximately 67% on average. Table VI-6 illustrates the composition. The

Table VI-6 Composition of Pyrolysis Gasoline (Ethylene - 200,000 T/Y)

Benzene	6.19
Toluene	2.54
Ethylbenzene	1.22
p-Xylene	0.21
m-Xylene	0.43
o-Xylene	0.21
BTX Total:	10.8
C_9 AROMA	1.22
C_{10} AROMA	1.38
Aromatics Total	13.4
Naphthene, paraffine	6.6
Total:	20

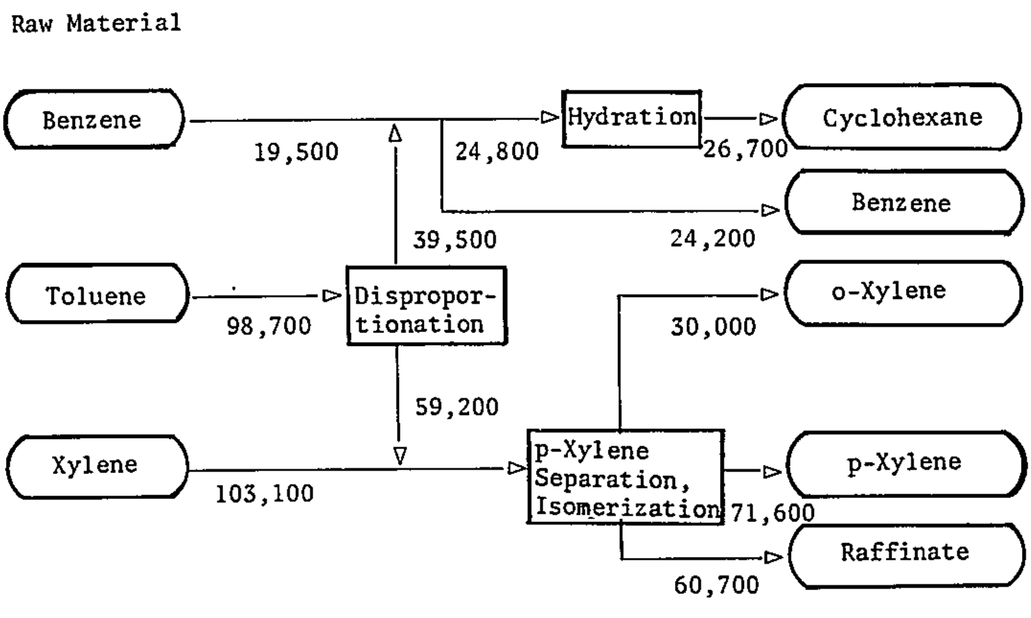
benzene, which will be obtained in the amount of approximately 60,000 T/Y by means of simple separation, will be ample as the raw material for nylon, however, p-xylene on the other hand will be considerably short in amount. Moreover, a large amount of ethyl-benzene will be generated so that the hydrogenation will be called for if the pyrolysis gasoline is to be used as the synthetic fibre raw materials. These are the obvious disadvantages of this method. Further, it seems inadequate to use the pyrolysis source materials as the synthetic fibre raw materials, in view also of the rate of nylon vs. polyester. Therefore, also in the case of Indonesia, the major raw materials for synthetic fibre will be derived from the reformer source as in the case of all the other synthetic fibre producing countries of the world.

7-3-3. Production of Cyclohexane and p-Xylene (Reformer Source)

The production at Pladju, as an example of naphtha which is procured in Indonesia, achieves the aromatic content of 9.5% maximum (6.1% average, 3.5% minimum) so that the Pladju naphtha is suitable as the aromatic raw material. As an example, Table. VI-7 illustrates a flow diagramme made out on an assumption that a reformer is constructed in 1980. The pre-requisite conditions here

Table VI-7 Production Flow of Basic Raw Materials for Synthetic Fibre (Crude Oil, Reformates)

(T/Y)



are that naphtha of 10,000 BPSD is fed under the composition shown in Table VI-4 so that the toluene in BTX is fed to the disproportionation process to supplement the shortage of benzene, while the shortage of p-xylene is supplemented by the isomerisation. If benzene can be exported or can be disposed of as an adequate raw material for the styrene monomer at a reasonable price, and if the o-xylene can also be exported or consumed as a raw material for the phthalic acid also at a reasonable price and, further, if raffinate can be utilized as the blending component of gasoline, there would be a feasibility for the construction of a reformer provided that the utilization is possible concerning the remaining light fraction of approximately 120,000 T/Y and the aromatics of higher than C9 aroma of approximately 90,000 T/Y. It is desirable that any further scrutinization than the above be undertaken after all the assumptions mentioned are clarified, due to the fact that the operation economy and efficiency will be further improved in proportion to the extent of the improvement in the actual achievements in the fuel evaluation and the naphtha evaluation figures.

7-3-4. Fund for Financing Construction

Table VI-8 shows the outline of a reformer of 15,000 BPSD and the required fund for the construction for reference.

Table VI-8 Construction Cost of Synthetic Fibre Basic Raw Material Plant

Process	Production	Investment 10^8Rp
Reformer	15,000 (BPSD)	32
Extraction & Separation	15,000 (")	16
Cyclohexane	30,000 (T/Y)	4
p-Xylene (Separation, Isomerization)	70,000 (T/Y)	39
Aux. Facilities		57
Total		148

8. Problems Pertaining to Industrialization

At a basic raw material plant, a maximum 40% to 50% of the fed naphtha can be utilized for the production of synthetic fibre raw materials. Therefore, it is desirable to construct a plant in the vicinity of an oil refinery due to the extreme importance of the effective utilization of the other derivatives as well as to the similarity of the nature of the plant to an oil refinery.

This follows that the location is limited to Eastern Sumatra (Palembang), Middle Sumatra as well as to Tjilatjap where an oil refinery construction is projected.

For the time being in Indonesia, the construction of only one basic raw material plant is feasible. The adequate time for constructing such a plant will be 1980. Therefore, the location should be selected from these candidate sites mentioned above, by taking into account the projects for the petrochemical plant constructions. As has already been mentioned, the problems pertaining to the production of the synthetic fibre raw materials should be studied from integral points of view. The problems will boil down to a question of whether a petrochemical complex including the basic raw material plant be constructed or not. In the event of constructing such a complex, a large amount of investments would be called for. Therefore, the project should be studied on the basis of long-term considerations including the regional development factors as well. Such a project should not be affected by short-term profit considerations or should never be left in the hands of private enterprises. It may be pointed out that the chemical industries in Indonesia being on an early stage of development, the advantages are present in that the projects can be worked on from the basic and unaffected status. Further, the aromatics complex which should begin with the construction of a reformer is to mainly produce the synthetic fibre raw materials, so that by 1980, it is expected that a large amount of production will be possible. As it is possible to import the basic raw materials for synthetic fibre production on the international prices, the construction of several small scale plants should be avoided and the construction of a large scale plant should be put off until 1980 when the domestic demands will be on a considerable level. However, the feasibility studies on the plastic material industry should be continued, as the olefinic complex will be inevitably connected with the synthetic fibre industry. It is recommended that an over-all integrated project be formulated by taking the best advantage of Indonesia as being a petrol producing country.

9. Plant Sites

Regarding the sites for a synthetic fibre plant (for polymerization and spinning) and for a synthetic fibre raw material plant (for monomer, basic raw materials), mentions have been made rather simply in each one of the foregoing chapters. In this present chapter, the interrelations of the sites covering the production of the basic raw materials to the filament yarn and staple fibre will be studied.

The flow diagram from the basic raw materials to the filament yarn and staple fibre is as follows.

(Naphtha) -- (B.T.X., including cyclohexane and p-xylene) --

(Monomer) -- (Polymer) -- (Filament Yarn and Staple Fibre)

Naturally, it is the most desirable to construct all the above-mentioned plant in one single site in order to reduce the extent of transportation of materials. However, as there is almost no site suitable for both the procurement of raw material (naphtha) and the selling of the products (filament yarn and staple fibre), the plants will have to be constructed separately. The plants up to the production of polymer are the so-called chemical plants and it is possible to separate the flow at this point regarding the plant sites. However, concerning the serious effect of the production conditions of polymer upon the qualities of filament yarn and staple fibre, it is the most advantageous to combine the polymer plant with the plants for producing filament yarn and staple fibre. The BTX plant, regarding the procurement of the materials and the disposal of the by-products, should be constructed in the vicinity of a petroleum plant or a petrochemical plant. A polymer plant can be built adjacent to the BTX plant or constructed independently. It is necessary to determine the arrangements for each case considering the ease in the procurement of the raw materials and the disposal of the by-products.

As to the arrangement of the plants, it is possible to construct a monomer plant combined with a line "from naphtha to BTX (including cyclohexane and p-xylene)" or with a line "from polymer to filament yarn and staple fibre". Otherwise, a monomer plant can be constructed independently.

The cost of transportation is one of the main factors which decides the site location. The transportation costs will be lower for the raw materials and becomes more expensive as the material to be transported takes a form closer to filament yarn or staple fibre. Apart from the transportation cost problems, there are other general plant site problems for instance, the harbour facilities, the road and railroad network problems, geographical features of the land, ground layer and bearing, industrial water availability, labour force procurement problems, the prices of the land and the difficulties in procuring the lands and the potential of the area development. The candidate site locations in Indonesia seem to be as under, considering all the conditions mentioned above.

9-1. Basic Raw Material Plant

As has already been discussed, in view of the present situations, it is possible to nominate the Eastern Sumatra area (Palembang), Middle Sumatra and Tjilatjap where an oil refinery construction is scheduled. It would be around 1980 when a raw material plant can be constructed, and it is recommended that the time of construction be examined afterwards in connection with the location of the petro-chemical industry.

9-2. Filament Yarn and Staple Fibre Plant

It is recommended that the first plant be constructed in Western Java where a high extent of consumption is present and the processing facilities are available, the second in Eastern Java (near Surabaja) and the third in Middle Java.

9-3. Monomer Plant

As to P-TPA, there is a chance that two plants will be constructed by 1980. Therefore, Western Java seems to be suitable for the first plant construction. It is because of the fact that the first filament yarn and staple fibre plant is recommended to be built in Western Java, that a basic raw material plant is strongly recommended to be constructed in Sumatra or Tjilatjap and also that fact that there would be no problem in procuring the sub raw materials and in disposing of the by-products when producing P-TPA, unlike in the case of caprolactam. Surabaja or Tjilatjap is probably suitable for the second plant location for filament yarn and staple fibre production where the harbour facilities are favourable. Examinations in detail will be required on the actual project execution stage in order to decide which one of these two locations is more suitable. As the main raw materials are to be transported by tankers, it would be necessary to have well-equipped harbour facilities. However, as far as these two sites are concerned, the harbour facility problems are not serious. Judging from the present situations, Surabaja is suitable for the caprolactam plant which is recommended to be constructed in 1980. As chemical plants are already operated in this district, there is a good background for the development of chemical industry. The harbour facilities in this area are well equipped. In particular, ammonia, sulphuric acid and caustic soda for use as the sub raw materials are now produced here, so that it is possible to regard Surabaja as being suitably situated. However, as mentioned before, a caprolactam plant is recommended to be constructed in 1980 and if new fertilizer plants are to be constructed elsewhere, it is also recommended that comparison studies between such an area and Surabaja be undertaken in view of the procureability of the sub raw materials and the relationship with the filament yarn and staple fibre plant.

VII. Rayon Industry

1. Trend of Demand

In the Indonesian textile industry, rayon staple fibre (hereinafter called rayon SF) and rayon filament yarn (hereinafter called rayon FY) are now being used. For the demand trend of these items please refer to the chapter pertaining to the demand forecast, and Table VII-1. As is evident from the table, the demand for rayon FY has so far been low and no future growth is expected due to the fact that it is forecasted that the spun fabrics will continue to assume the main portion of the textile market.

Table VII-1 Demand for Rayon in Indonesia

10^3 T/Y

Year	F Y	S F
1967	0.71	4.01
1968	0.48	4.28
1969	0.45	4.93
1970	0.8	4.1
1971	1.0	5.1
1972	1.1	6.3
1973	1.2	7.6
1974	1.4	9.0
1975	1.6	10.5
1976	1.8	12.1
1977	2.0	13.8
1978	2.2	15.6
1979	2.5	17.7
1980	2.9	20.0

Note : The maximum forecast figures are stipulated from the year 1970 onward

Regarding this point, comments were made by the Indonesian government that the authorities are not interested in the industrial scale production of rayon FY and the survey team considers this comment quite reasonable.

Therefore, as it is considered that scrutinizations concerning the feasibility of the industrial scale production of rayon FY would be meaningless, the focus in this report shall be placed on the feasibility studies of industrial scale production of rayon SF.

1-1. Demand for Rayon SF

Table VII-2 shows the forecast demand on rayon SF up to 1980, the figures of which have been obtained through the demand forecast already discussed.

Table VII-2 Forecast on Demand for Rayon SF

(t/y)

	Upper	Median	Lower
1970	4,080	4,080	4,080
71	5,110	5,070	5,020
72	6,300	6,190	6,080
73	7,580	7,380	7,190
74	8,980	8,670	8,360
75	10,460	10,000	9,560
76	12,070	11,440	10,840
77	13,830	13,000	12,210
78	15,630	14,560	13,550
79	17,660	16,310	15,040
80	19,960	18,260	16,690
Average Growth Rate	17%	16%	15%

Fig. VII-1 illustrates the demand forecast, in contrast to the rates of growth of the total textile materials, i.e., 11%, 12% and 13% per year, for the total fibre demand as against the rayon SF which is expected to grow with rates of 15% to 17% per year along with the growth in the demand for the polyester/rayon blended yarn. As has been mentioned previously, these forecast figures have been computed on the assumption that the demand ratio between the synthetic fibre filament yarns and staple fibres is approximately 1 : 1 and if the knitted goods using filament yarn are not accepted by the Indonesian market, an additional 1% p.a. average growth in demand is also considered possible.

1-2. Trends and the Forecast on Rayon SF Prices

In order to forecast the future trend of the CIF price of rayon SF, Table VII-3 was compiled to show the basic figures for the scrutinization based upon the FOB Japan price of the commodity. Fig. VII-2 illustrates this trend.

Table VII-3 Trend of Price of Rayon SF (Actual)

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972 1)
Prices ¥/Kg	158.5	158.0	166.9	164.4	155.5	114.1	162.3	182.4	167.7	176.1	177.8

1) Average from Jan. to June

Source : Japan Exports & Imports

By utilizing these data, however, excluding the data for 1967 where the price was abnormally low, the future trend forecast on the price was conducted by means of the regression analysis method. The results of the analysis are indicated in Fig. VII-2 by a dotted line. In accordance with the obtained forecast formula, it seems that the FOB Japan prices of the rayon are increasing at an annual rate of ¥2/kg (2.7 Rp/kg), however, as will be discussed later, it is

Fig. VII-1 Forecast on Demand for Rayon SF

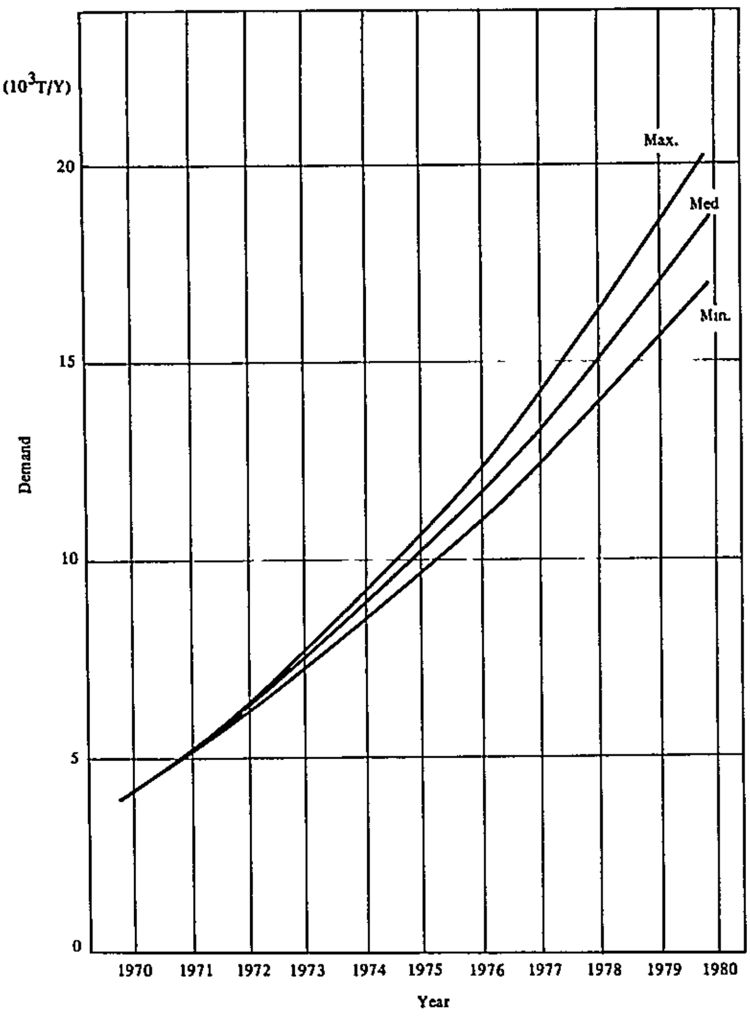
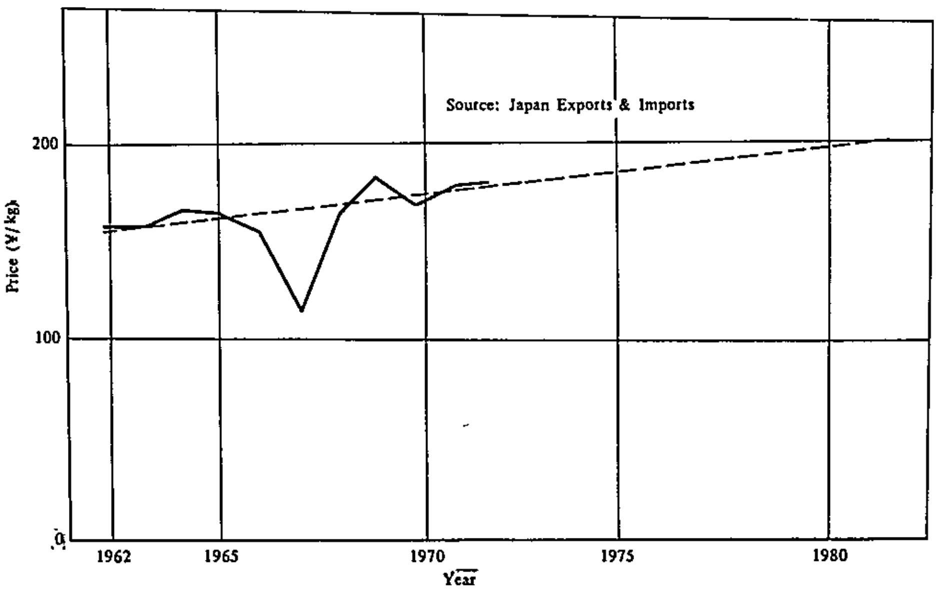


Fig. VII-2 Trend of FOB Price of Rayon SF



generally said that the CIF Japan price of pulp for some time to come will rise at the annual rate of US$9.6/ton (=¥3/kg, 4Rp/kg) so that, if the consumption of pulp as against rayon SF is taken at 1.06, this pulp price increment will reflect upon the rayon SF price to the extent of ¥3.2/kg (4.3 Rp/kg) at cost. This implied the necessity for the ¥3.2/kg (4.3 Rp/kg) cost increment caused by the pulp price increment to be absorbed in some way by other cost items, however, in view of the present status of the cost structure of the rayon industry, such an absorption would appear impossible. Therefore, it is considered that the rayon SF price forecast figures obtained by means of the above-mentioned forecast formula are not realistic.

Therefore, scrutinizations were made concerning the selling prices of the rayon SF in Japan, and the FOB price trend of the Alaska Pulp Co. and in addition other past histories of the rayon SF situation were made. A forecast on the basis of such results was undertaken.

1-2-1. The Market Price Trend of Rayon SF

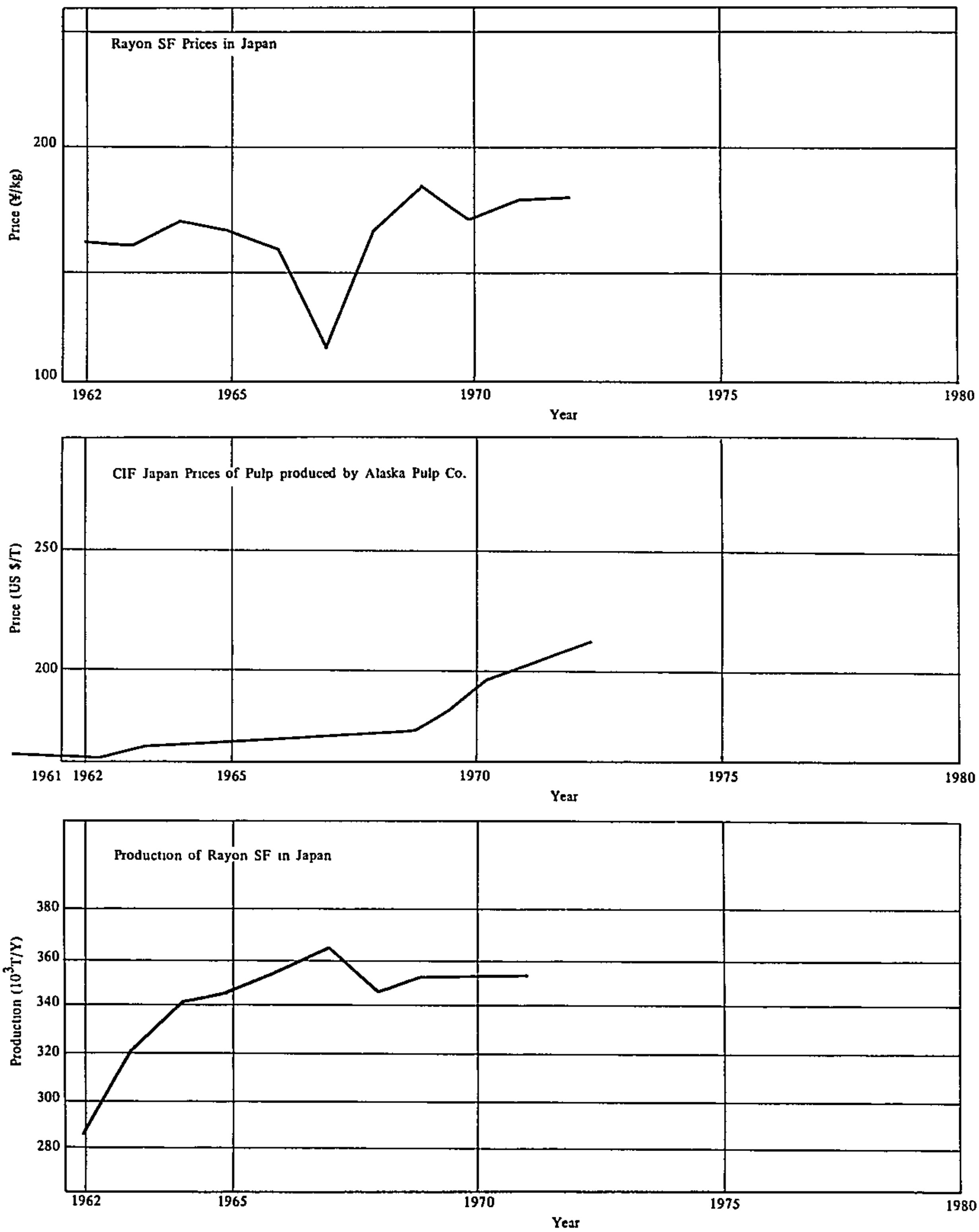
Fig. VII-3 shows the rayon SF selling prices, the CIF prices of the Alaska Pulp Co. products and the rayon SF production amount in Japan from 1962 to present day. As is evident from this figure, up to 1966, stabilization of the price level was maintained and the production grew, however, in 1967, the over-supply of synthetic fibres caused the general price deterioration and, being affected by such overall price decreases, the rayon SF price also showed a decrease.

At this period, a number of manufacturers suspended the rayon SF production or many others effected reduction in production capacity so that a general reduction in the total production capacity in Japan was brought about, thereby causing a general recovery in the price level.

However, the general decrease in the price level of synthetic fibres invited the introduction of man-made fibre blended spun products into the market which had thus far been dominated by rayon SF. This resulted in the disappearance of the market for goods made of 100% rayon SF and at present, the position of rayon SF has been reduced to such an extent that it is marely utilized as one of the blending components for synthetic fibre products. Therefore, as far as the future rayon SF production is concerned, it is expected that the production amount will vary in accordance with the production trend of synthetic fibre SF such as polyester SF, etc. Also, as far as the price trend is concerned, an estimate is made that the rayon SF price level will gradually approach the optimum level of approximately 10% less the price of the synthetic fibre, whilst assuming the position of being one of the blending components into synthetic fibre SF materials.

This estimation was based on the following reasons. The major shortcoming of the 100% synthetic woven of knitted goods is that they do not have moisture absorbency. This shortcoming is ameliorated by blending either cotton or rayon into synthetic fibre. Therefore, although it is theoretically possible to forecast a higher price level for the rayon SF than the price level for synthetic fibre depending upon the situation of the supply and demand balance, unlike cotton, rayon can be utilized only as a blending component for synthetic fibre. The above estimation is made that eventually, and at best, the 10% less the synthetic fibre price level will be the maximum limit for the price increase of rayon SF. It must also be noted that the rayon blended goods are, when compared with the

Fig. VII-3 Relation among Prices of Rayon SF, Pulp and Rayon Production Amount



cotton blended goods, inferior in quality, (i.e., lack stiffness and are therefore prone to deformation) so that rayon SF as the blending component material will not increase in price as much as cotton could. Thus, it is reasonable to expect that the eventual price of rayon SF will attain somewhere in the vicinity of the median point between the present cotton price and the rayon SF price. Regarding the price trend of rayon SF from 1969 onward, it must be noted that an acute price increase was present in the pulp price as is evident from the price quoted by the Alaska Pulp Co. The reason for this fact was that, along with the advent of the pollution control problems, the additional plant investment became necessary thereby affecting the cost upward. Further, as will be discussed later, several pulp manufacturers became unpayable in their production due to the cost increment in procuring the raw materials for producing pulp so that these manufacturers began to reduce their production scale and on the other hand, some other manufacturers began to expand their production facilities around this period so that renovation of production facilities was undertaken in the industry as a whole, thereby also inducing the increment in the cost of pulp production. Due to this fact, the rayon SF price began to show an upward trend from 1970 onward, which is still prevelant today. This trend is expected to last at least another five years.

1-2-2. Price Forecast

The above-discussed points may be summarized as follows.

1) For forecasting the price trend of the rayon SF, this can be classified into three periods.

   Up to 1970 : Normal price increase was present except for 1966 where the level was extremely low which should be discarded as basic data due to the above mentioned background.

   1970 - 1977: Rayon price increment was present due to an increase in the pulp price.

   1977 - 1980: Normal price increase.

2) Concerning the ceiling price for rayon SF, the following deductions may be possible.

   (1) ¥210 (283 Rp/kg) - ¥230/kg (310 Rp/kg):

   This price range has been estimated on the basis of the polyester SF price range (¥237 (319 Rp/kg) - ¥255/kg (344 Rp/kg).)

   (2) ¥220/kg (296 Rp/kg):

   The above was deducted from the cotton price. The recent cotton price in Japan is ¥260/kg (350 Rp/kg), while the rayon SF price is ¥180/kg (243 Rp/kg). The above being the basic data, the level of ¥220/kg (246 Rp/kg) is considered to be the ceiling level.

3) Fig. VII-4 illustrates the price forecast compiled by means of the regression analysis method regarding the period-wise classification made in above 1).

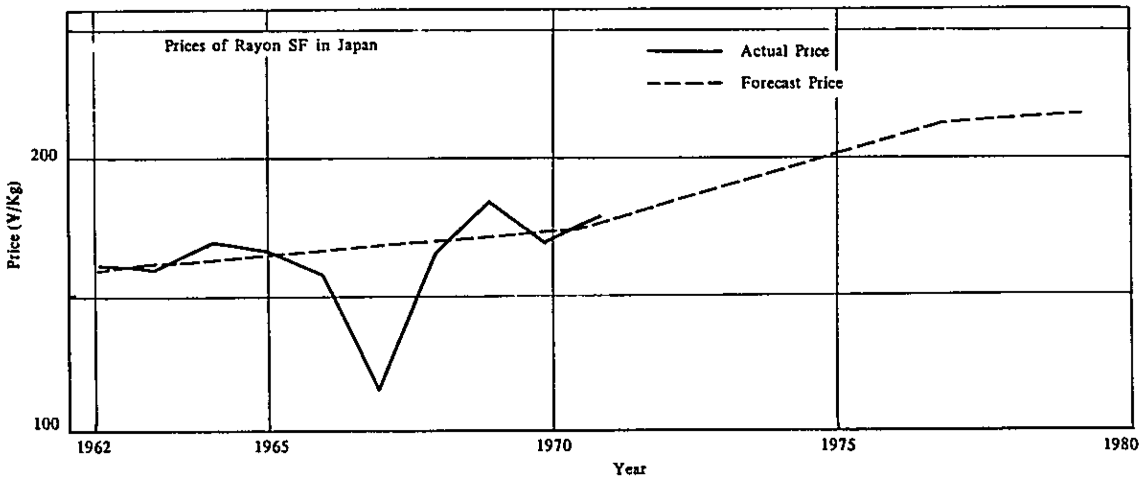
(1) The price increase of the rayon SF for the period from 1962 to 1970 was ¥1.7/kg (2.3 Rp/kg) per year and the pulp price increment was US$1.2/ton (¥0.4/kg, 0.5 Rp/kg) per year.

(2) For the period from 1970 to 1977, the rayon SF price increase is ¥5.9/kg (7.9 Rp/kg) per year and that of pulp is US$9.6/ton (¥3/kg, 4.0 Rp/kg). The above results are illustrated in Table VII-4. As is evident from this table the rayon price in 1980 is within the limit of the ceiling level discussed in above 2) and it is anticipated that the price will continue to increase from 1980 onward. At the time of computing the CIF Indonesia prices, the following assumptions were made.

- The insurance premium was taken at 0.5% of the FOB price.

- The freight charges were assumed to increase by the rate of 5% p.a. starting at the level of 1972.

Fig. VII-4 Forecast on Prices of Rayon SF and Pulp



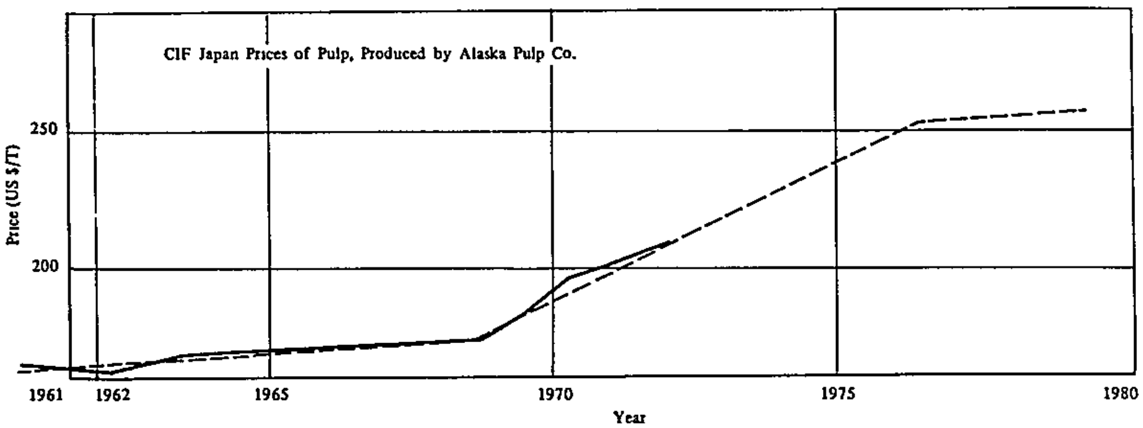


Table VII-4 Forecast on Price of Rayon SF

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
FOB JAPAN	¥/Kg	167.7	176.1	177.8	186.2	192.1	198.0	203.9	209.8	211.5	213.2	214.9
Insurance	"	-	-	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1
Freight	"	-	-	20.8	21.8	22.9	24.1	25.3	26.5	27.8	29.3	30.7
CIF Indonesia	"	-	-	199.5	208.9	216.0	223.1	230.2	237.3	240.4	243.6	246.7
CIF Indonesia	RP/kg	-	-	269	281	291	301	310	320	324	328	332

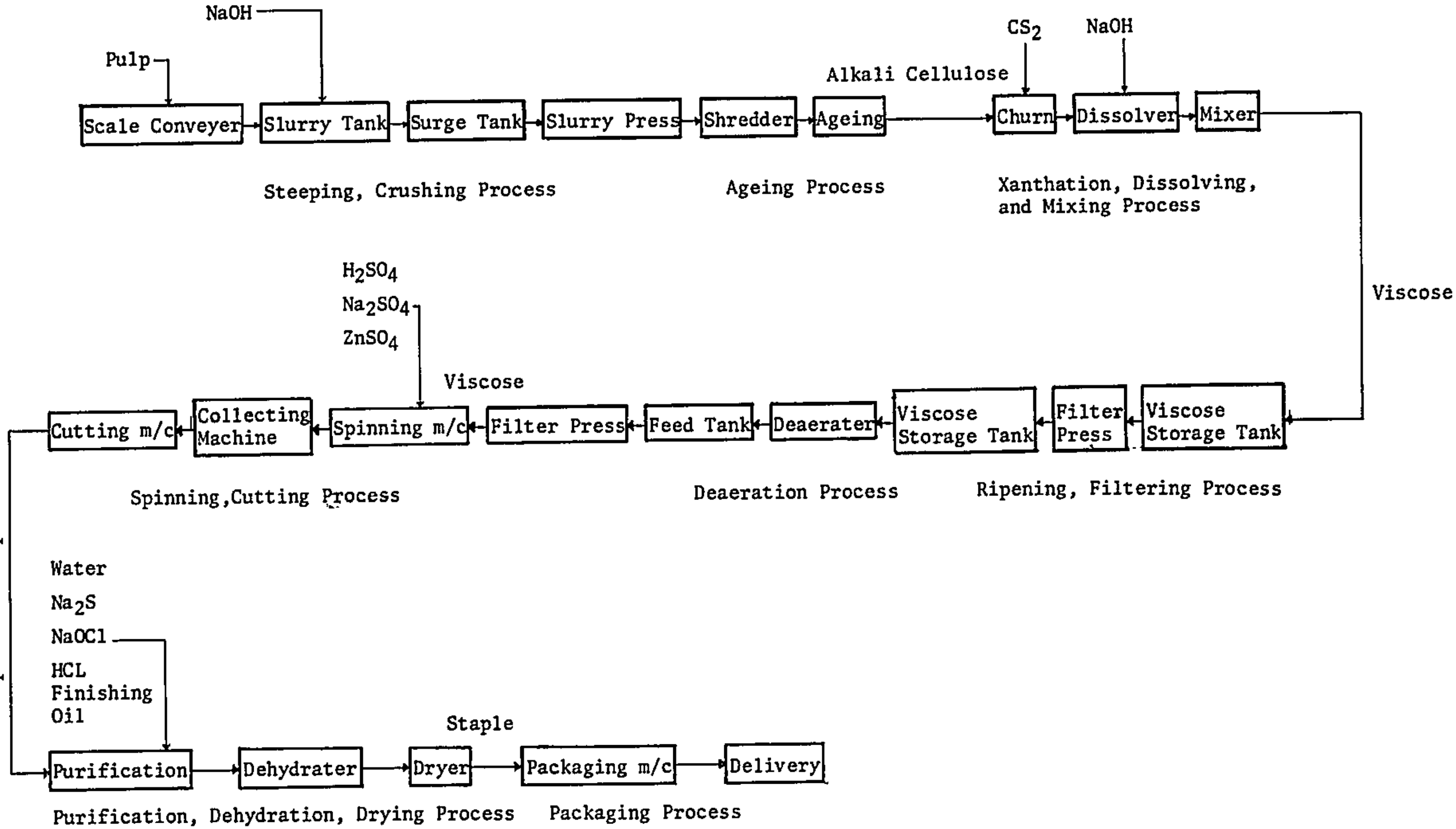
1-2-3. The Problems Pertaining to the Price Forecast

As the effects of the pulp price on the rayon SF production are significant, it is extremely difficult to carry out any meaningful forecast upon the rayon price levels if the forecast on the pulp price cannot be obtained with reasonable accuracy. Views and opinions of experts were sought concerning the forecast on the price of the dissolving pulp (hereinafter called DP) during the course of the present survey, however, as will be discussed later, the DP production industry is now facing a turning point internationally so that no satisfactory statement was obtainable. In accordance with comments made by Rayonier Inc. personnel, they anticipate that for some time to come, the pulp price will continue to increase by US$15 to US$16 per ton. Therefore, in this report, although the above-mentioned forecast was estimated on the basis of past trends and backgrounds of the industry, no clear concept was obtainable on how long the uptrend in the pulp price would continue from 1970 onward so that it is strongly recommended that a series of surveys be conducted concerning the world-wide market in order to ascertain the future uptrend of pulp prices and the levelling off of the presently existing rapid price increase, during the course of the promotion of the domestic production of pulp. If a conclusion is drawn on this point, clarification will be made regarding the maximum price level of the rayon SF and also regarding when such maximum price level will be attained.

2. Scrutinization of Rayon Production Techniques

As has already been explained, rayon manufacturers in industrialized countries, who are the supply sources of rayon SF, are presently considering the suspension of rayon production or are making an attempt to maintain status quo in the scale of production. For this reason, very few research and developments on rayon technologies are being carried out, as the number of research engineers and technicians in this field is very small. All the recent technological developments in the rayon industry are either for the improvement in material handling or for the introduction of automation technique for the purpose of coping with the increasing labour costs, rather than in the form of developing processes or high efficiency equipment. This being the circumstance, the conventional processes which are employed by the leading rayon producers have been chosen for the basis of the present feasibility studies. Fig. VII-5 illustrates the outline of the above-mentioned circumstance.

Fig. VII-5 Diagram of Viscose Rayon SF Production Process



3. Scrutinization on the Status of Raw Materials, Sub Raw Materials, Utilities and By-products

3-1. Pulp

An assumption was made here that the importation of DP into Indonesia will be conducted as the feasibility studies of the DP industry was not included within the scope of this survey.

It may be a policy of the government of Indonesia, in view of domestic resource exploitations, to utilize as raw materials as various types of tropical woods densely grown in the country, or straw or other harbs or even pines and cedars which are available in Northern Sumatra and Kalimantan, however, during the initial stage of industrialization, it seems that the only possible way is to start the rayon production by importing pulp materials from overseas. The reasons for such a conclusion are as follows.

(1) The possibility of full utilization of tropical woods has been studied and the industrialization thereof has been attempted by the developed countries. A certain degree of success has been achieved on a laboratory level, however, no industrial scale application has been proved.

(2) Concerning the possibility of utilization of needle-leaved trees which are not yet exploited in Indonesia and which are said to be available in Sumatra and Kalimantan, no detailed survey has been made as to confirm whether these trees are economically useable.

(3) No plantation of needle-leaved trees has been undertaken so far.

It seems to be effective for the development of the rayon industry in Indonesia to establish stable operation techniques first of all and then to gradually mix the domestic DP with the imported pulp. Therefore, feasibility studies concerning the development of rayon industry by using the imported pulp as the raw material may be worth conducting. Quantitative studies were made as to the researches so far made in Indonesia concerning DP and to the present status and the possibility of industrialization of DP production in Indonesia, the details of which will be explained in the later part of this report for reference.

3-1-1. Present situation of the pulp industry in the world

As an assumption was made that the DP is to be imported during the initial stage, the trends of supply and demand of DP were studied on a world-wide basis.

The trends of DP supply and demand in the year 1970 are as shown in Table VII-5. If Indonesia is to seek DP supply sources among the countries enumerated in this table, the USA and Canada should be selected in view of the export potential and of the distance from Indonesia. Unless production suspension due to unpayability of rayon production operation should take place, the DP producers in countries closer to Indonesia, such as Japan, Taiwan, etc. should be regarded as having no extra export potential. South Africa, the largest DP exporter in Africa, does not have any capacity to supply DP to Indonesia, as the most of the DP produced there is being exported to the U.K. The trend of the

Table VII-5 Production, Import, Consumption and Export of Dissolving Pulp in 1970

(10^3 ST/Y)

Country	Production	Import	Consumption	Export
U.S.A.	1,716	277	1,124	869
Canada	460	7	134	333
Sweden	346	0	44	302
Finland	311	0	58	253
Norway	109	2	31	80
Germany, Fed. Rep.	242	154	376	20
Austria	104	17	101	21
France	114	95	209	1
Italy	79	119	197	2
Spain	50	35	85	0
Brazil	67	15	91	0
Japan	611	205	815	1
South Africa	239	0	2	237
Yugoslavia	69	16	50	35
Taiwan	35	9	26	17
India	60	68	128	0
Korea, Rep. of	0	8	8	0
United Kingdan	0	409	409	0
Total	4,612	1,436	3,888	2,171

Source : A Japanese trading company

production of DP in the above-mentioned countries for the years 1965 to 1970 are shown in Fig. VII-6 for further scrutinizations, and Table VII-6 shows the actual production figures in 1971 and the future production capacities in 1973 regarding the leading DP producers of the world.

As is evident from these data, only two American companies are planning the production increment, while others are either showing unpayability in their operation or have discontinued production due to pollution problems, and so the DP supply will become tighter and the prices may increase accordingly.

It seems that the USA is the only feasible source from which to import DP into Indonesia.

In Addition to the above, there are four DP plants now operating in the USSR which are located in Krasnoyarsk, Baikal, Komsomolsk and Bratsk. The production capacity of each of these operations is said to be 100,000 to 200,000 T/Y of DSP and DKP. As it seems that these pulp plants have export potential, it may be possible to receive supply from these Russian Producers.

Table VII-6 Production Capacity of Leading DP Producers (Except centrally controlled countries)

(10³ T/Y)

MAKER	MILL	GRADES	CAPACITY 1) (-1971)	INCREASE/ DECREASE	CAPACITY (1973-)
(United States)					
Alaska Lumber & Pulp Co., Inc. 2)	Sitka	DSP, BSP	180		180
ITT-Rayonier Inc.	Port Angeles	DSP, BSP	145		145
- " -	Grays Harbor	DSP, BSP	155		155
- " -	Fernandina	DSP	145		145
- " -	Jesup	DKP, BKP	245	+170	415
International Paper Co.	Natchez	DKP, BKP	370		370
Buckeye Cellulose Corp.	Foley	DKP, BKP	260		260
Ketchikan Pulp & Paper Co., Inc.	Ketchikan	DSP	200		200
Weyerhaeuser Co.	Cosmopolis	DSP, BSP	130	+70	200
- " -	Everett	DSP, BSP	100	-100	-3)
			1,930	+140	2,070
(Canada)					
Rayonier Canada Ltd. 2)	Port Alice	DSP, BSP	140		140
Canadian International Paper Co.	Hawkesbury	DSP, BSP	80		80
- " -	Kipawa	DSP, BSP	140	-140	-3)
Columbia Cellulose Co, Ltd.	Prince Rupert	DSP	210		210
			570	-140	430
(Sweden)					
Billeruds A.B.	Kyrkebyns	DSP	42	-42	-3)
- " -	Slottsbrons	DSP, BSP	53	-53	-3)
Mo Och Domsjo A.B.	Domsjo	DSP, BSP	145		145
Iggesunds Bruk A.B.	Iggesund	DSP, BSP	80		80
Svenska Cellulosa A.B.	Svartvik	DSP	50		50
Uddeholms A.B.	Skoghall	DSP, BSP	135		135
			505	-95	410
(Finland)					
Kaukas A.B.	Kaukas	DSP, BSP	85	-85	-3)
Serlachius A.B.	Lielahti	DSP, BSP	85		85
Rauma-Repola Oy.	Rauma	DSP	140		140
			310	-85	225
(Norway)					
Borregaard A/S	Sarpsborg	DSP, BSP	140		140
Saugbrugsforeningen	Halden	DSP	60		60
			200		200

MAKER	MILL	GRADES	CAPACITY (-1971)	INCREASE/ DECREASE	CAPACITY (1973-)
(West Germany)					
Zellstoffabrik Waldhof	Mannheim	DSP, BSP	230		230
Schwabische Zellstoff A G	Ehingen	DSP, BSP	50		50
			280		280
(Austria)					
Lenzinger Zellulose und Papierfabrik A.G.	Lenzing	DSP, BSP	80		80
Borregaard Industries Ltd.	Hallein	DSP, BSP	80		80
			160		160
(France)					
Societe Industrielle de Cellulose D'Alizay (S.I.C.A.)	Alizay	DSP	80		80
(Italy)					
Societe Agricola Industriale Cellulose Italiana (S.A I.C I.)	Torviscosa	DSP	75		75
(South Africa)					
The South African Industrial Cellulose Corp (PTY) Ltd	Umkomaas	DSP	200		200
(Formosa)					
Formosa Chemicals and Fiber Corp	Changhua	DSP	40		40
(Japan)					
Jujo Paper Co., Ltd	Akita	DSP, BSP	140		140
Sanyo-Kokusaku Pulp Co, Ltd	Iwakuni	DSP, BSP	140		140
	Gotsu	DSP, BSP	110		110
Kojin Co., Ltd	Toyama	DSP, BSP	61		61
	Saiki	DSP, BSP	74		74
Nippon Pulp Industry Co, Ltd	Yonago Nichinan	DKP, BKP DKP, BKP	DKP 55		DKP 55
			580		580
(Others)			200		200
Total			5,130	-180	4,950

Note . BSP . Bleached Sulphite Pulp
DSP . Dissolving Sulphite Pulp

Source : A Japanese trading company

(1) Cooking basis
(2) Supply source for Japan
(3) Scheduled for suspension due to unpayability or pollution problems

3-1-2. Trend of future demand and prices of DP

The world's DP market has been stably evolving since the Scandinavian countries reduced the DP production in 1966. In 1970, a sharp increase in the synthetic fibre production was undertaken all over the world. As a result, over-production and price depreciation of synthetic fibre took place so that the rayon price was also affected. The price increase in DP and the advancement of the obsoletion of production facilities deteriorated the competitiveness of the producers so that the American, European and Japanese rayon manufacturers were compelled to evacuate from the rayon production. Due to this circumstance, the demand for DP was reduced and the market softened consequently in 1971. It is forecast that the rayon production in the industrialized countries of the Free World will tend to either decrease or maintain status quo due to the increment in the labour costs and the investments for pollution control. On the other hand, in Yugoslavia, Bulgaria and East Germany, the rayon production has been increasing. Consequently, these countries are becoming rayon exporters rather than importers. The fact that the rayon production in the developing countries is also gradually increasing implies that it is unlikely that the demand for DP will further decline in the future. Even though occasional fluctuations may take place, the DP price is expected to show a basic up-trend, along with the increase in the prices of the material woods, labour cost and increment in the production costs due to the necessity for pollution control investments.

It is highly difficult to forecast on the pace of the price increase of DP due to the fact that, as mentioned above, the distribution of rayon production capacity is shifting on a world-wide scale, thereby bringing the industry to a turning point. As to the production of DP, some producers have found their operation unpayable so that they are compelled to discontinue the production and, others are planning to reduce their production capacity. On the other hand, some companies, Rayoniers of the USA being one of them, have announced production facility expansion on the expectation of 4 to 5% p.a. growth in the rayon consumption which should be created by the increment in price and decrease in turn out of cotton.

The trend of import prices of DP from Alaska into Japan is shown in Fig. VII-7 in order to forecast the price trend of pulp. As is evident from this figure, the sudden and vast price increase of pulp from 1969 to 1970, following slight lift in 1963, took place. It is still believed, however, that the profit calculation of Alaska Pulp Co. and by Japanese DP producers was in deficit in spite of this vast price appreciation. Another vast increase in the DP price is highly likely in the future, as a further cost increase will be inevitable if the investment for pollution control is to be effected. Therefore, in this study, as mentioned in the rayon price forecast, the regression analysis was undertaken for the forecast of the price up to 1977 on the basis of the actual price trend during 1960 to 1970 and on the assumption that the planned price increase of US$16/T will be effected in January 1973. It was also assumed that the price increase will take place after 1978 with the same tendency as that existed before 1969 as shown by a dotted line in the figure.

Fig. VII-6 Trend of DP Production in the World

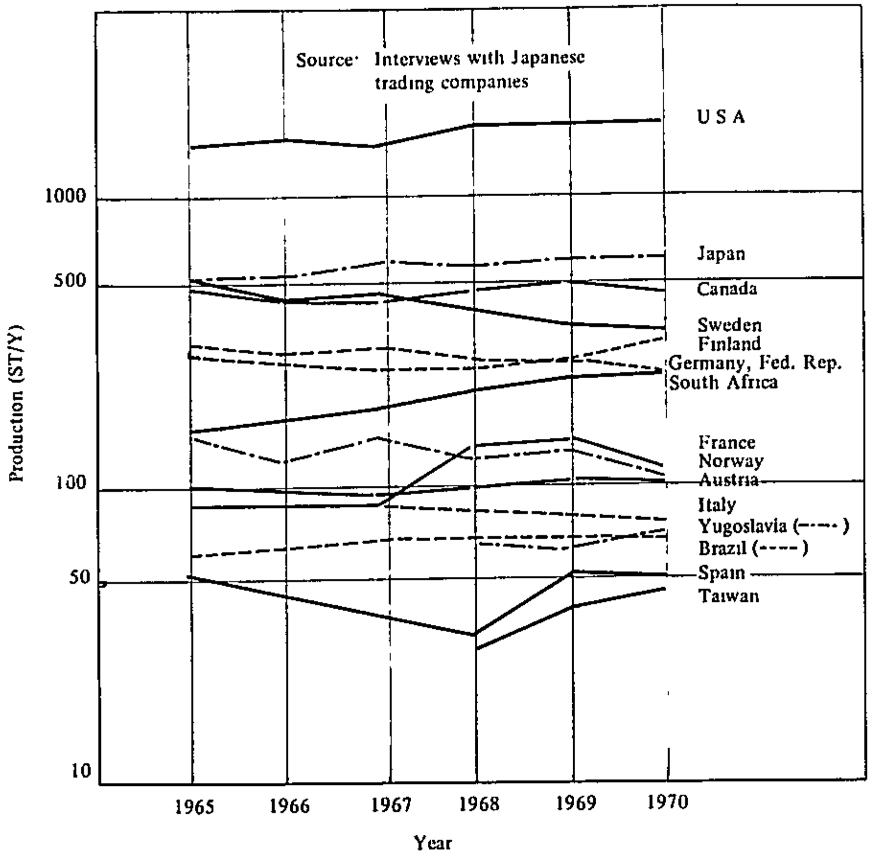
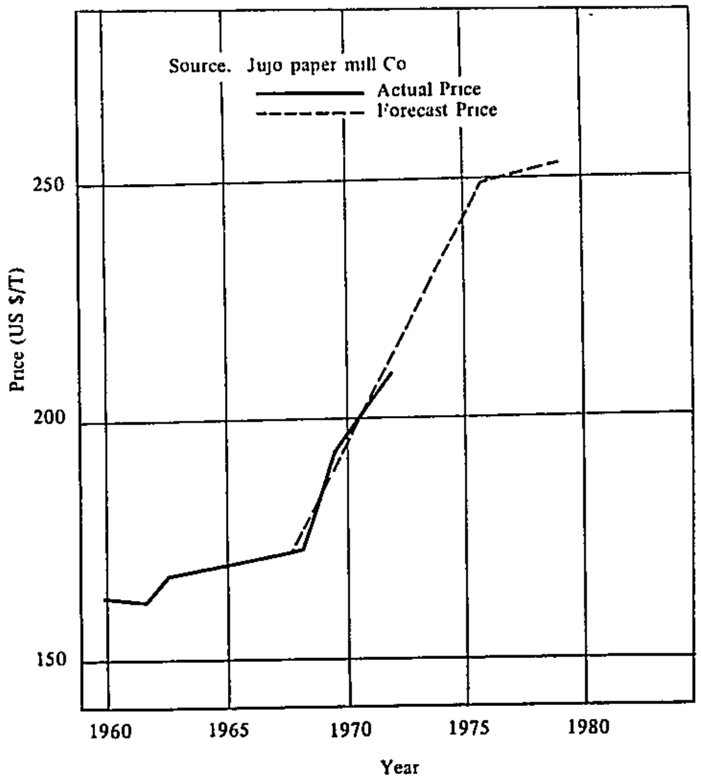


Fig. VII-7 Trend of CIF Japan Price by Alsaka Pulp Co.



3-1-3. Purchasing price of pulp in Indonesia

If the prices of DP estimated up to 1980 are obtained from Fig. VII-7, the trend of CIF prices in Japan is as shown in Table VII-7 in dotted lines. The CIF Indonesia price and the delivered-to-plant prices were obtained from the CIF prices in Japan, both of which are shown in the table. The basis for the calculations are as follows.

Table VII-7 Forecast on Price of Rayon Pulp

		1972	1973	1974	1975	1976	1977	1978	1979	1980
CIF Japan	US$/t	194	210	221	230	240	250	251	252	254
I & F (Alaska-Japan)	"	11.5	12.1	12.7	13.4	14	14.7	15.4	16.5	17
FOB Alaska	"	182.5	197.9	208.3	216.6	226	235.3	235.5	235.5	237
Insurance	"	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.2
Freight (Alaska - Indonesia)	"	42.6	44.7	46.9	49.3	51.7	54.3	57.0	59.9	62.9
CIF Indonesia (US$)	"	226	243.6	256.2	267	278.8	290.8	293.7	296.6	301.1
CIF Indonesia (Rp)	RP/kg	93.8	101.1	106.3	110.8	115.7	120.7	121.9	123.1	125
Bank Charge	"	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6
Material Handling Cost	"	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
M P O	"	5.6	6.1	6.4	6.6	6.9	7.3	7.3	7.3	7.5
Import Duty, Import Sales Tax	"	-	-	-	-	-	-	-	-	-
Price	"	104.6	112.4	117.9	122.7	127.9	133.2	134.5	135.7	137.8

(1) Insurance premium was estimated at 0.5% on FOB price.

(2) It was assumed that the ocean freight cost will increase by 5% every year.

(3) Various charges in Indonesia were calculated as follows.

Banking charges: 0.5% on CIF price

Unloading charges: 4.7 Rp/kg

MPO and other charges: 6% on CIF price

No import duty and import sales tax was accounted in the calculation.

3-1-4. Specifications of DP

Pulp used as raw materials for rayon can be classified into two categories, i.e., dissolving sulphite pulp (hereinafter called DSP) and dissolving kraft pulp (hereinafter called DKP). The specifications of DSP and DKP are shown in Table VII-8 and VII-9.

The DP produced by Alaska Pulp Co. and Rayonier Inc. comply with these specifications.

Table VII-8 Specifications of DSP

Bale Moisture	6.5 - 7.5%
Dust	50 mm^2/m^2 >
Ash	0.10% >
Resin	0.25% >
α - Cellulose	> 89.8%
β - Cellulose	6.5% >
CaO + MgO	0.045% >
Cu - Number	1.4 >
Relative Viscosity 1)	4.6 ±0.1

1) This figure corresponds to 21 c.p. of TAPPI Viscosity

Table VII-9 Specifications of DKP

Bale Moisture	6.7 - 7.5%
Dust	30 mm^2/m^2 >
Ash	0.08% >
Resin	0.35% >
α - Cellulose	> 93.0%
β - Cellulose	5.0% >
CaO + MgO	0.030% >
Cu-Number	0.7 >
Relative Viscosity 1)	3.6 ±0.1

1) This figure corresponds to 21 c.p. of TAPPI Viscosity

3-1-5. Types of pulp to be imported

DSP is presently the major type of the DP material among others. The extent of DP utilization is 80% of the total consumption in the world. The USA and Japan are the only countries where DKP is being used. In the USA, approximately 50% of the total DP consumption is taken up by DKP. The reasons for the wide application of DSP are that DSP has the advantage of having a high aptitude to be used as the raw material for rayon SF due to its strong reaction characteristics, and that the DSP utilization has advantages in view of costs as there are many plants equipped with the conventional facilities working on the basis of the SP method.

On the other hand, DSP has a weak point in that the tensile strength of yarn made of DSP is inferior to that of DKP yarn. This point can be further clarified by the fact that only KP is being used as the raw material for tire-cords, staple fibres for special application and for acetate in the USA. It is recommended that the KP method, which is explained in the later part of this report, be applied for the DP production in Indonesia for the purpose of establishing a stable engineering of rayon production. For this purpose, the industry of Indonesia should start the importation of NDSP as the raw material at the initial stage, in view of the fact that NDSP is easily available and involves less problems in handling. Then the operation can turn to gradual replacement of the importation with the domestic production of the pulp materials.

3-1-6. Situation of DP utilization at Japanese rayon plants (for reference)

The situation of the utilization of various DP materials by rayon producers in Japan will be described in the following paragraphs for the purpose of reference. The DSP material made from the Japanese domestic hard-wood of broad leaved trees (hereinafter referred to as LDSP) and the NDSP materials imported into Japan are being used as the raw materials for rayon by the Japanese producers. The total amount of importation of NDSP reached 183,300 tons in 1971. The break-down of the percentages of the DSP imported from overseas were, 82% from the USA, 10% from Canada, 5% from Taiwan and 3% from the USSR. Of the above-mentioned total importation, 6% was KP which was used for producing staple fibres, tire-cords and acetates after the importation from both the USA and the USSR. The material imported from Taiwan was LDSP, the quality of which was inferior to that obtained from other sources. Also, the application of this material has been limited to specific producers in Japan. The pulp materials imported from the USA were mainly NDSP produced in Alaska. The extent of the utilization rates of the pulp materials by the rayon manufacturers in Japan are as follows.

	NDP	LDP
For manufacturing filaments:	50 - 60%	40 - 50%
For manufacturing staple fibre:	0 - 30%	70 - 100%

Most of the NDP utilized in Japan was the imported NDSP. (It is accepted that it is necessary to use NDP as a blended component material to some degree for the rayon production for the purpose of obtaining the required quality and to effect efficient operation for production.) The Japanese rayon producers are using the domestic LDP with the exception of the LDP imported from Taiwan. Normally, mangrove and rubberwoods are mixed into the pulp for staple fibre production to an extent of 0 to 50% in the case of mangrove and 0 to 10% in the case of rubber-woods. It is generally noted that if the tropical wood materials, especially the mangrove material, are blended, the ash content and the CaO as well as MgO contents becomes higher when analysed and due to these contents, the pressability of alkali cellulose becomes better in view of the viscose processability, however the filtration characteristics of viscose will be affected.

3-2. Caustic soda

3-2-1. Present situation of the caustic soda industry of the world

Concerning the production of caustic soda mainly by means of the electrolysis of salt, the production capacity has gradually been increased according to the trend of demand for caustic soda and chlorine, both of which are produced simultaneously by this process.

The industry has been experiencing hardship in seeking the field of chlorine application. However, the era of chlorine shortage has advanced along with the establishment of the polyvinyl chloride industry. Since then, the situation has changed and the industry then had to seek the fields of the caustic soda utilization until recently. In 1971, all the PVC manufacturers were forced to effect production reduction adjustment due to the world-wide over-production of plastics. This affected the PVC production industry, so that the present status of the industry in a consequential stagnation.

Due to these circumstances, caustic soda manufacturers are suffering now from the problem of the chlorine over-production, as the demands for caustic soda is expected to steadily increase in the future in the field of pollution control.

3-2-2. Caustic soda production in Indonesia

Concerning the present situation of the caustic soda supply in Indonesia, it was noted that P. N. Soda located in Waru near Surabaja is the only supplier in the country. The capacity of this supplier is 10 T/D. All the other caustic soda production in Indonesia is undertaken within the plants of caustic soda consuming industry (e.g., paper mills) with small-scale production equipment in order to supply for their own consumption. Therefore, the importation of caustic soda in large amounts is undertaken in order to meet the total demand in Indonesia.

P. N. Soda is making a plant expansion plan for the increment of caustic soda production capacity four times the present level by the end of 1975, so that there is a possibility that, on the basis of P. N. Soda's plan as described in Table VII-10, some supply can be obtained from this plant when completed, provided that suitable industries which can consume the by-produced chlorine be established by then.

Table VII-10 Expansion Projects for P.N. Soda

	1971	1972	1973	1974	1975
Caustic Soda Plant Capacity t/d	10	10	20	20	40

The following are the possible cases for obtaining the supply source of caustic soda in the event that a rayon plant is constructed in Indonesia.

Case A To purchase solid caustic soda

Case B To purchase liquid caustic soda from P. N. Soda

Case C To construct a caustic soda plant within the rayon plant for the self-supply independently from P. N. Soda

It is needless to point out in this connection that the establishment of chlorine utilizing industry such as PVC monomer production is necessary in the event that either Case B or Case C is to be employed.

As is well known, the chemical industry is one of the industries in which the so-called scale merit is significant, and it is to more advantage therefore to achieve a larger scale production plant. Therefore, Case B seems to be the most economical means than the others. It should be noted, however, that the establishment of caustic soda supply source within a rayon plant may be more advantageous in view of cost than to purchase soda from P. N. Soda due to the fact that the selling price of P. N. Soda is 75 Rp/kg (with 100% conversion), while the production cost estimated for the self-supply source is approximately 40 Rp/kg (50 Rp/kg, when 10% ROI is expected). The calculation of caustic soda costs in the case of the self-supply source was based on the estimation that the proportional costs are to be imposed upon the caustic soda, while the fixed costs are to be borne by both caustic soda and chlorine.

3-2-3. Cost

1) Delivered-to-plant cost of imported caustic soda

The present CIF price of solid caustic soda is US$160/T. Table VII-11 indicates the delivered-to-plant prices of such casutic soda in terms of Rupiah. The price (82 Rp/kg) is equivalent to three times the selling price to rayon manufacturers in Japan. This high cost is a great disadvantage for the rayon industry in which a large amount of caustic soda has to be used. (The selling price in Japan is 30 Rp/kg.) The price of caustic soda of 40% NaOH which is being produced by P. N. Soda is 30 Rp/kg so that the price for 100% NaOH caustic soda should be 75 Rp/kg as above mentioned.

Table VII-11 Delivered-at-Plant Price of Caustic Soda (100% NaOH)

CIF Indonesia (US$)		160 US$/t
CIF Indonesia (RP)		66.4 RP/Kg
Bank Charge	0.5%	0.3 "
Material Handling Cost	1,382.77 RP/ton	1.4 "
Import Duty	10%	6.6 "
MPO & Others	6%	4.0 "
Import Sales Tax	5%	3.3 "
Price		82.0 "

2) Costs of caustic soda to be produced by in-plant facilities

(1) Pre-requisite conditions

As will be explained later, the normally adopted production capacity for one line is 25 T/D in the case of rayon SF production. The construction of a rayon plant should therefore be scrutinized on the basis of a production capacity of either 25 T/D or 50 T/D on the initial stage in order to cover the demand up to 1980. For reference, however, calculations were also made for the cases of 100 T/D and 150 T/D concerning the caustic soda production costs on the in-plant basis. In view of the scale merit, the production scale of a chemical plant should be as large as practicable. Therefore, it is recommended that, instead of building small-scale facilities for caustic soda production, a large centralized plant be constructed to cover the domestic caustic soda consumption. The conditions for the calculations of the production costs of caustic soda by means of the self-supply production are as shown in Table VII-12. The following paragraphs will explain the details of the conditions.

Table VII-12 Basis for Production Cost Calculation of Caustic Soda

(Capacity, Investment)

Capacity of Rayon Plant	t/y	9,125	18,250	36,500	54,750
" (per day)	t/d	25	50	100	150
Caustic Soda Consumption[1]	"	15	30	60	90
Capacity of Caustic Soda Plant[2]	"	17	33	66	100
Total Investment[3]	10^6Rp	943	1,617	2,493	3,639

1) Caustic soda consumption in rayon production is 600 g/kg rayon

2) 330 Working days per year

3) Total investment includes Utilities Cost.

Consumption and Prices of Raw Materials, Chemicals, Utilities, By-Products and Labor

	Consumption (/kg)	Prices
Sodium Chloride (kg)	1.565	6 RP/kg
Chlorine "	0.88	To bear fixed costs only
Chemicals "	-	2.45 RP/kg
Fuel "	1.29	7 RP/kg
Pure Water (m^3)	0.0027	80 RP/kg
Labor Cost (15 t/d)	15 men	323 10^3 RP/man.Y
(30 ")	28 "	
(60 ")	53 "	
(90 ")	76 "	

A. Method to be adopted

a) The Mercury -Electrolysis Method

There are two available methods besides the Mercury Electrolysis Method, i.e., the Electrodialysis Method and the Ammonia Soda Method. It seems, however, to advantage that the Mercury Electrolysis Method be adopted due to the following reasons, although the pollution problems which may be caused by the Mercury Electrolysis Methods due to the utilization of mercury have been publicly commented on recently.

i. The electrolysis methods are mostly adopted in place of the Ammonia Soda method all over the world due to the fact that the by-produced ammonium chloride from the Ammonia Soda is not effectively useable.

ii. It is possible to obtain caustic soda of higher purity and concentration (50%) by the Mercury Electrolysis Method rather than by the Electrodialysis Method. Therefore, the caustic soda which is obtained by the Mercury Electrolysis method is suitable as the sub raw material for rayon production.

iii. The processes of producing caustic soda employed in Indonesia so far are mostly the Mercury Electrolysis Method and therefore, there are many experienced technical workers under this method.

B. Cost

Industrial salt:

The unit cost of industrial salt produced in Indonesia and now employed in each plant in the country is at 6 Rp/kg. This cost is fairly high when compared with the international price level. Therefore, it is assumed that this cost figure will not increase in the future.

Chlorine:

There is no field for the utilization of chlorine by-produced in this process. Therefore, the only way is to react it with calcium hydroxide and dispose of it. Therefore, if the disposing costs are included, the caustic soda becomes extremely expensive. Thus, it is assumed in the calculation that the utilization of chlorine will have been developed by the time the rayon plant is constructed. Also, calculations were made on the assumption that the chlorine absorbs the fixed cost portion only. (At present in Indonesia, the selling price of chlorine of the P. N. Soda to the paper mills is 137 Rp/kg. However, as this price is extremely high, it is regarded inadequate that this selling price be adopted as the by-produced chlorine price in the case of production in Indonesia.)

b) Cost calculation

Table VII-13 illustrates the cost of caustic soda and the price before tax and with 10% ROI by taking the above-mentioned conditions into account. However, the calculation by the DCF rate was not undertaken here.

Table VII-13 Production Cost of Caustic Soda

Capacity		15	30	60	90
Total Production Cost (Incl. Interest)	(Rp/kg)	39.3	37.2	34.3	34.0
Total Production Cost (before tax)	(")	49.0	45.6	40.9	40.4

3-3. Carbon Disulphide

Carbon disulphide is in the liquid state with 1.3 specific gravity and approximately 46°C boiling point under normal temperature and pressure. Further, a gas into which this material and air are mixed is very explosive and inflammable. The inhalation of the gas will affect the nerve system severely. Therefore, carbon disulphide is an extremely dangerous chemical. In view of this fact, long-distance transportation from overseas, especially the handling of this material under high atmospheric temperatures in tropical regions is not recommended. Therefore, scrutinizations in this report will be made on the assumption that a plant with the required scale will be built in the same site as the rayon plant. For reference, the import prices are added on the assumption that the importation of this material is undertaken.

3-3-1. Pre-requisite Conditions for Cost Calculation

Conditions were set as shown in Table VII-14. The following paragraphs will explain such pre-requisite conditions.

Table VII-14 Calculation Basis for Production Cost of Carbon Disulphide

(Capacity, Investment)

Capacity of Rayon Plant	t/y	9,125	18,250	36,500	54,750
" (per day)	t/d	25	50	100	150
Carbon Disulphide Consumption1)	"	2.75	5.5	11	16.5
Capacity of CS_2 Plant2)	"	3.0	6.1	12.1	18.2
Total Investment3)	10^6 RP	311	544	934	1,288

1) Carbon disulphide consumption in rayon production is 110 g/kg rayon

2) 330 Working days per year

3) Total investment includes utilities cost

Consumption and Prices of Raw Materials, Chemicals, Utilities, By-Products and Labor

	Consumption (/kg)	Prices
Sulphur (kg)	0.95	12.5 RP/kg
Charcoal (")	0.21	7.5 "
Heavy Oil (") (Raw Material)	0.28	7 "
Fuel (")	0.14	7 "
Labor Cost (3.0 t/d)	5 men	323 10^3 RP/man.Y
" (6.1 ")	10 "	
" (12.1 ")	18 "	
" (18.2 ")	26 "	

1) The Adopted Method

Retort Method

At present, carbon disulphide is mostly produced by the electric furnance method in the industrialized countries, however, the Retort Method is to be adopted in this plant due to the following reasons.

(1) The operation of this method is easier

(2) The production quality is stable

(3) The Retort Method is suitable for small-scale production

2) Cost

Sulphur:

It is required that the sulphur used as a raw material for carbon disulphide should have above 99.8% purity. It is necessary to use imported sulphur due to the fact that at present, the sulphur produced in Indonesia is low in purity. At present, the CIF price in Indonesia of sulphur is US$25/T. Table VII-15 shows the prices at which the sulphur is procured at the plants on the assumption that the CIF prices will not change in the future.

Table VII-15 Delivered-at-Plant Cost of Sulphur

CIF Indonesia (US$)		25 US$/t	
" (RP)		10.4	RP/kg
Bank Charge	0.5%	0.1	"
Material Handling Cost	1,382.77 RP/t	1.4	"
Import Duty	0%	-	-
MOP	6%	0.6	"
Import Sales Tax	0%	-	
Price		12.5	RP/kg

Charcoal:

The required quality of charcoal is shown in Table VII-16
As it is expected that charcoal with the same quality can be produced in Indonesia, the assumption is made that the domestically produced charcoal is to be used. The prices of charcoal, which were surveyed in Indonesia was 7.5 Rp/kg. The price of charcoal was calculated on the assumption that it would not increase in the future.

Heavy oil:

The data, 7.0 Rp/kg, which were secured during the onsite surveys will be used.

Table VII-16 Quality Standards of Charcoal

Hardness	> 7
Fixed Carbon	83% >
Ash	2.5% >
Moisture	10% >
Volatile Matter	5% >
Grain Size	Contents of size 15 mm are less than 10%

3-3-2. Cost Calculation

Table VII-17 shows the cost of carbon disulphide, by taking the above-mentioned conditions into consideration. The production cost including interest and the prices before tax in the case of 10% ROI obtained from this table are also shown in Table VII-17.

Table VII-17 Production Cost of Carbon Disulphide

Capacity (t/d)	3	6.1	12.1	18.2
Total Production Cost (Incl. Interest) (Rp/kg)	67.7	62.0	56.0	52.9
Price (Before Tax) (Rp/kg)	96.7	87.5	77.9	73.0

The price in the case of importation for reference: Table VII-18 shows the prices at which carbon disulphide is being procured at the plants after the importation from Japan.

Table VII-18 Delivered-At-Plant Cost of Carbon Disulphide

CIF Indonesia (US$)		300 US$/t
CIF Indonesia (Rp)		124.5 RP/kg
Bank Charge	0.5%	0.6 "
Material Handling Cost	1,382.77 RP/t	1.4 "
Import Duty	0%	-
MPO & Others	6%	7.5 "
Import Sales Tax	0%	-
Price		134.0 RP/kg

Note : Import duties and import sales tax are both taken at 0. As it is assumed that this material can be deemed as being the same category as pulp for special raw material for rayon production

3-4. Sulphuric acid

3-4-1. The production of sulphuric acid in Indonesia

During the present on-site surveys, it was observed that the P. N. Petrokimia at Gresik near Surabaja having a 12,000 T/Y facility operation was suspended due to the shortage in demand for sulphuric acid. Apart from this fact, it was noted through information that there are two small-scale sulphuric acid production plants with an operation ratio of less than 50% near Djakarta. However, as will be mentioned below, the quantities of sulphuric acid necessary for 25 T/D and 50 T/D production of rayon are 19.7 T/D and 39.4 T/D respectively. If new plants are to be constructed, it would be necessary to build a 22 T/D scale and a 45 T/D scale plant. The capacity of P. N. Petrokimia would be insufficient for a 50 T/D rayon production plant, however, it is able to supply the acid to a 25 T/D rayon production plant. Therefore, the possibility of utilization of this source was studied. (By the time of the 50 T/D plant construction, a corresponding sulphuric acid plant will have been constructed.)

3-4-2. The required amount of sulphuric acid

The capacity of rayon production		25 T/D	50 T/D
The required amount of sulphuric acid			
	(50 Bé)	31.3 T/D	62.5 T/D
	(100 %)	19.7 T/D	39.4 T/D

3-4-3. Cost

The cost of sulphuric acid investigated at P. N. Petrokimia is 11 Rp/kg for the concentration of 50 Bé. In this report, this figure shall be used for the time being, however, this cost of sulphuric acid is approximately equal to a level twice as high as the corresponding Japanese cost of ¥4/kg (5.3 Rp/kg). While it is possible that quantity of sulphuric acid consumption in Indonesia will increase in the future, it may considerably impede upon the development of the Indonesian chemical industry, unless efforts for a cost reduction are made as soon as possible. For instance, the cost of conc-sulphuric acid in the case of being imported was preliminarily calculated in Table VII-19. The cost of 14.5 Rp/kg CIF Indonesia is extremely high.

Table VII-19 Delivered-at-plant Cost of Sulphuric Acid

CIF Indonesia (US$)		35 US$/t
CIF Indonesia (Rp)		14.5 RP/kg
Bank Charge	0.5%	0.7 "
Material Handling Cost	1,382.77 RP/t	1.4 "
Import Duty	15%	2.2 "
MPO & Others	6%	0.9 "
Import Sales Tax	5%	0.7 "
Price		20.4 "

This is because of the fact that exclusive ships for the transportation of sulphuric acid are called for.

3-5. Sodium sulphate

3-5-1. Cost

A large quantity of hydrous sodium sulphate is by-produced in the production process of rayon. The 25 T/D and the 50 T/D scale production, which are the objects of this study, will by-produce 35 T/D and 75 T/D of hydrous sodium sulphate respectively. With regard to the by-produced hydrous sodium sulphate, it is assumed to be sold to paper mills after the removal of water of crystallization and to be used as a sub raw material for paper manufacture, or, to be utilized for detergents, dyeing and glass manufacturing industries. The present purchasing price is 29 Rp/kg at these plants, however, there is a trend or recovering sodium sulphate inside paper mills in order to prevent pollution so that the price has been sharply falling down because of the decrease in demand. It seems that the importing price will eventually fall to the level of 20 Rp/kg. In such a case, it is possible to deem the price of hydrous sodium sulphate at 4.2 Rp/kg.

3-5-2. Demand

As mentioned above, if the by-produced sodium sulphate is used as a sub raw material in paper mills, the following would ensue.

The number of paper mills where the KP method is adopted, the design capacities and the production quantity in 1971 are shown in Table VII-20. Further,

Table VII-20 Plants Producing Paper Pulp under the KP Process

	Capacity	Production in 1971
(East Java) Banjuwangi	9,000 t/y	7,022
(South Sulawesi) Gowa	9,000 "	1,700
Total	18,000 "	8,722

the presently projected paper mills include the P. T. Gunung Ngadeg with a 90,000 T/Y capacity. The quantity of by-produced hydrous sodium sulphate in the case of a 25 T/D rayon plant is, as mentioned before, 35 T/D, which is equivalent to 15.5 T/D (5,660 T/Y) when converted into sodium sulphate anhydride. The quantity of sodium sulphate anhydride necessary for the production of pulp by means of the KP method is approximately 35 kg. per ton of pulp and when all the existing Indonesian pulp plants operate fully, 630 T/Y of sodium sulphate anhydride will become necessary. In the event where the P. T. Gunung Ngadeg is placed under operation, another 3,150 T/Y of sodium sulphate anhydride would be required, thereby calling for a total of 3,780 T/Y of sodium sulphate anhydride. In addition, the demand from the detergents, the auxiliary agents and glass industries will also exist so that it is reasonable to assume that all the hydrous sodium sulphate by-produced in a 25 T/D rayon plant will be consumed.

The above-mentioned consumption quantity of sodium sulphate has been taken from the figures of Japanese pulp plants equipped with sodium sulphate recovery equipment. With the conventional production process, the above-mentioned sodium sulphate amount would not be sufficient even for paper mills alone.

4. Scrutinization of Site Selection Problems

It is necessary to scrutinize the plant site selection problems from the following view points.

(1) The procurement of utility water and the drainage of waste water.

(2) The procurement of labour force for operation and construction.

(3) The repair of plant facilities

(4) The delivery of machinery and equipment into sites

(5) Transportation of products and raw materials

(6) The welfare facilities

Of the above-mentioned, the procurement of utility water and the drainage of waste water are rather unique and inevitable problems for the rayon industry. A site which does not afford solutions to these problems is completely outside the scope of selection.

4-1. Procurement of utility water and drainage of waste water

As to the environmental conditions, abundant and good quality water is indispensable in order to industrialize rayon production. The quantity of process water necessary for the production of rayon is 0.9 m^3 for 1 kg of rayon. Therefore, 25 T/D and 50 T/D production of rayon SF will require 22,500 T/D (0.26 T/sec.) and 50,000 T/D (0.52 T/sec.) of water respectively. In addition, water of 0.6 m^3 per kilogramme of rayon is required as utility water, etc., thereby calling for a total of 1.5 m^3 of water for the production of 1 kg of rayon.

Thus, with regard to the 25 T/D and 50 T/D rayon production, water as much as 37,500 T/D (0.43 T/sec.) and 75,000 T/D (0.87 T/sec.) will be necessary respectively. Further, the process water is required to possess such qualities as illustrated by Table VII-21. During the present survey, a visit was paid to the

Table VII-21 Specification of Process Water for Rayon Industries

P H		6.3 - 7.0
Turbidity		1 >
Total Hardness ($CaCo_3$)	P.P.M	28 >
Iron (Fe_2O_3)	"	0.05 >
Silica (SiO_2)	"	2 >
Calcium (CaO)	"	12 >

Institute of Hydrology Engineering in Bandung in order to study the rivers which may have sufficient water both in view of the above-mentioned quantity and quality.

Studies were also conducted regarding the situations of underground water at the Geological Survey of Indonesia. As a result of these investigations, it was clarified that the rivers of B-Solo, Brantas, Seraju, Tjimanuk, Musi, etc. are available. As the investigation concerning underground water has not as yet been sufficiently undertaken in Indonesia, the idea of utilizing underground water as a utility water source had to be discarded. Table VII-22 shows the results of further studies of the water quality of each of the above-mentioned rivers. As is evident from the comparison of Table VII-21 with Table VII-22, it is necessary to treat waters of these rivers if any of the rivers are to be used as the water source for the rayon industry. Particularly, the water to be employed in the viscose preparation process should be treated thoroughly by a water softening apparatus or should be processed by ion exchange. The conditions for the selection of the plant sites in view of water intake and the drainage of waste water are therefore as follows.

Table VII-22 Water Quality of Major Rivers in Indonesia

Name of Rivers	B.Solo	Brantas	Seraju	Tjimanuk	Musi
Region	East Java	East Java	Central Java	West Java	South Sumatra
City		Surabaja	Tjilatjap	Tjirebon	Palembang
PH	7 7.5 - 8	6.1	-	-	7 4
Turbidity	7.9	2.2	8.8	6.6	25
Hardness	177.3	171.81	79.48	107 16	25
($CaCO_3$)	12.5	34.58	17.85	18.62	10
Cl_2 Fe_2O_3 (PPM)	-	2.20	26.81	10.73	Fe^{3+} 0.9
SiO_2 (")	-	30.0	15.0	25.0	22.0
CaO (")	58.1	65.27	32.79	34.79	-
MgO	21.2	22.19	8 40	18.45	-
SO_4	2.4	15.0	13.6	18.4	0
Electric Conductivity (μV/cm)	350	569	317	370	84
$KMnO_4$ Consumption(PPM)	-	6.35	11.95	8.79	-

(1) No plant or mill which may exhaust water containing harmful substances should exist on the up-stream of a river of the water intake point of the projected rayon plant.

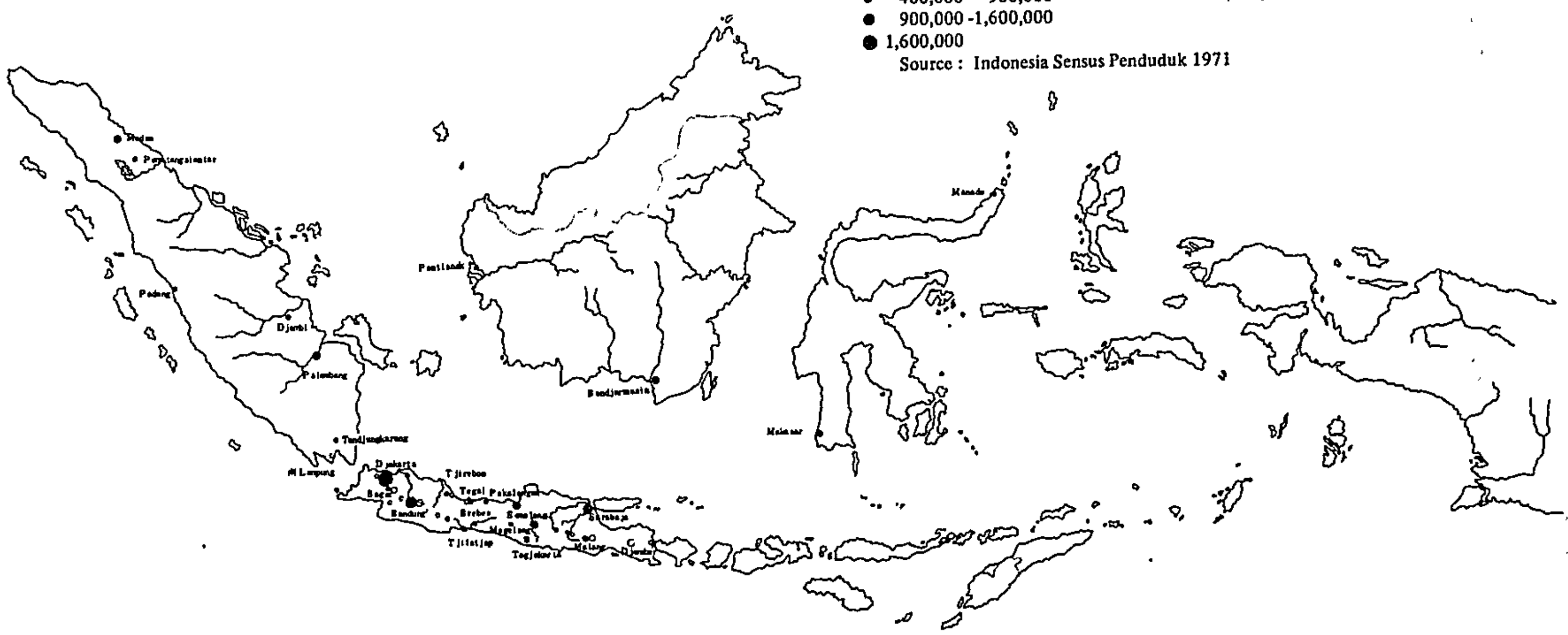
(2) Sea water must not rise up to the water intake point at high tide.

(3) No farm land should be forced to use the drained water along the down-stream of the river into which the waste water drainage is to be made from the projected plant.

4-2. Procurement of labour force

Concerning the procurement of labour force, Fig. VII-8 shows the distribution of population. Black circles in the figure indicate cities in which the population is more than 100,000 and the white circles show the districts where the population is more than 1,000,000. The size of the circles represents the extent of the population. If the candidate sites mentioned above were to be selected on the basis of these figures of population, the ones would be Surabaja from the viewpoint of having a high extent of population and Tjilatjap and Tjirebon by reason of having a high extent of peripheral area population.

Fig. VII-8 Population Distribution



4-3. Repair of plant facilities

In view of the facilities for repairing plant machinery and equipment, the Surabaja area where many plants already exist would be advantageous. However, there are projects including the construction of an industrial park in Tjilatjap so that it is also feasible to regard Tjilatjap as one of the prospective candidate sites.

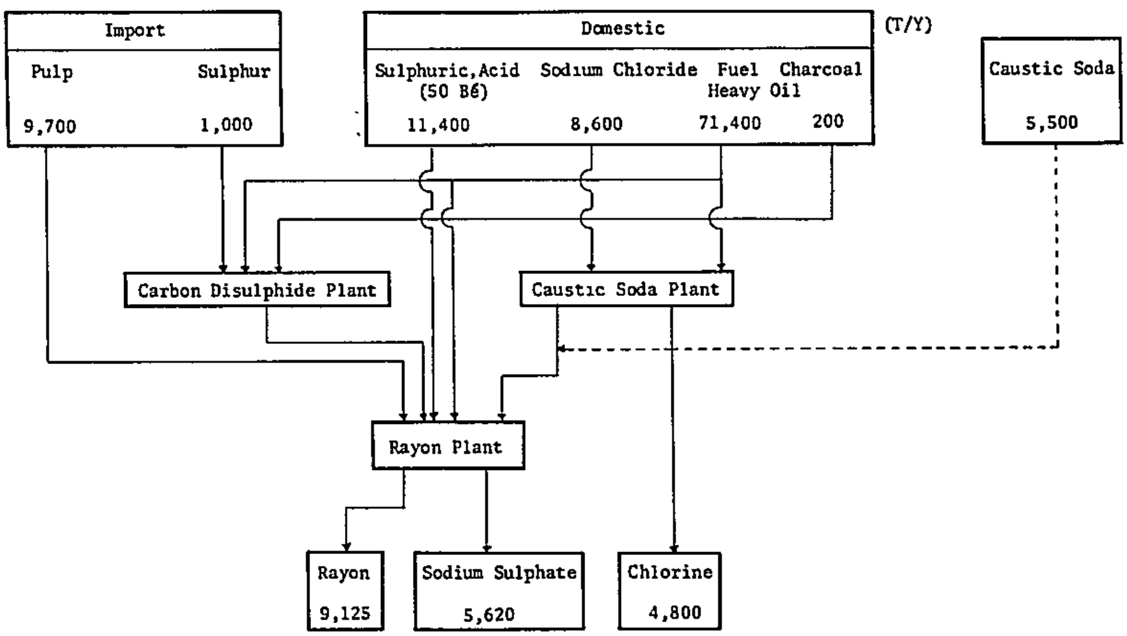
4-4. Delivery of machinery and equipment into site

When constructing a rayon plant, it is probable that most of the required machinery and equipment should be procured from abroad. It would therefore be necessary to have a harbour equipped with adequate facilities for unloading the machinery and equipment. Further, as some inadequacy in road and bridge conditions are present, there would be a certain extent of problems in the inland transportation of the cargoes. Regarding the plant site selection, it is necessary to select a location close to a harbour with sufficient facilities. From this point of view, both Surabaja and Tjilatjap satisfy this requirement. In this connection, Tjirebon seems to be an unsuitable harbour in view of the lay of the land.

4-5. Transportation of raw materials and products.

In the case of a rayon plant, the quantities of raw materials delivered into the site and the products delivered out of the site are as indicated by Fig. VII-9. The transportation of DP, sulphuric acid and fuel will call for the use of harbour facilities. (Caustic soda shall also be included in this category if imported.)
A rayon plant should be located close to the ocean because of the fact mentioned in 4-4 and also in view of the drainage of waste water, so that, from this point of view, all the proposed sites seem to be under the same condition as far as the delivery of machinery and equipment into site is concerned. As to charcoal, due to the small amount required, it seems that there would be no serious problem.

Fig. VII-9 Material Movements in a 25T/D Rayon Plant



Therefore, it is necessary to study the transportation problems of such raw materials as sulphuric acid and salt and such sub raw materials as hydrous sodium sulphate and chlorine and finally rayon, the product.

As the frequency of loading and unloading will be identical regardless of where the site is located, the charges concerning the loading and unloading shall be excluded from the scope of site selection comparison studies. The tank truck and ordinary trucks are to be the means of transportation.

4-5-1. Transportation of sulphric acid

It is assumed that sulphuric acid will be purchased from P. N. Petrokimia and the following estimation has been made.

Plant Site	Distance (Km)	Transport Amount (T/Y)	Unit Cost	Transportation Cost (million Rp/Y)
Surabaja	-	11,400	1,100 Rp/ton	13
Tjilatjap	560	11,400	10 Rp/km.t	64
Tjirebon	540	11,400	10 Rp/km.t	62

4-5-2. Transportation of Salt

It is assumed that salt will be obtained from areas near Surabaja.

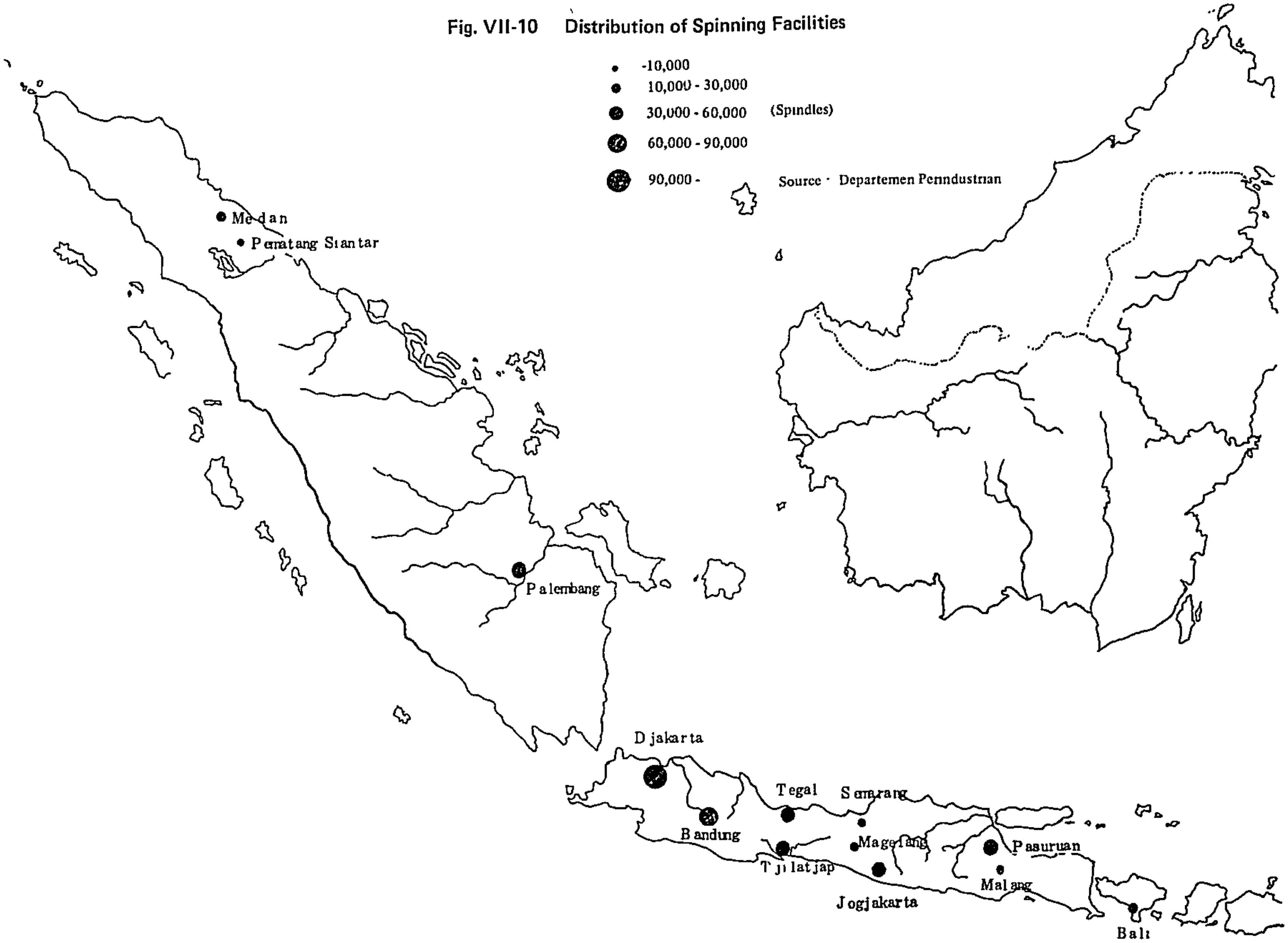
Plant Site	Distance (Km)	Transport Amount (T/Y)	Unit Cost	Transportation Cost (million Rp/Y)
Surabaja	-	8,600	1,100 Rp/t	10
Tjilatjap	560	8,600	10 Rp/km.t	48
Tjirebon	540	8,600	10 Rp/km.t	46

4-5-3. Rayon

Fig. VII-10 illustrates the distribution of spinning facilities at present in Indonesia. The centres of the spinning facility concentration are Djakarta, Bandung, Tjilatjap Jogjakarta and Pasuruan. In these districts, there are government owned plants such as Patal Tjipadung, Pata Bekasi, Patal Setjang and Patal Grati, producing blended yarn of polyester and rayon. On the assumption that blended yarn of polyester and rayon will continue to be produced in these districts also in the future, the following consumption figures of rayon SF will be established.

Djakarta	2,000 T/Y
Bandung	2,000 T/Y
Tjilatjap	1,500 T/Y
Jogjakarta	1,625 T/Y

Fig. VII-10 Distribution of Spinning Facilities



Pasuruan	2,000 T/Y
Total:	9,125 T/Y (= 25 T/D)

In this case, the following are the transportation costs calculated by changing the plant sites.

Product Destination (Million Rp/Y)

Plant Site	Djakarta	Bandung	Tjila-tjap	Jog-jakarta	Pasuruan	Total
Surabaja	25	20	13	9	2	69
Tjilatjap	13	7	0.2	5	18	43.2
Tjirebon	7	4	4	7	18	40

Note: Transportation unit cost, 15 Rp/km.t

4-5-4. Sodium sulphate

On the assumption that sodium sulphate will be supplied to paper mills which produce rayon pulp by the KP method and to the paper mill which is projected to be constructed in Tjilatjap, the following will be the amount of supply from the rayon plant to each paper mill in the district. The assumption was also made that all the other industries in which the consumption is expected are located in Djakarta and Surabaja.

Banjuwangi	315 T/Y
Gowa	315 T/Y
Tjilatjap	3,150 T/Y
Djakarta	1,000 T/Y
Surabaja	840 T/Y
Total:	5,620 T/Y

	Banjuwangi	Gowa	Tjilatjap	Djakarta	Surabaja	Total
	315	315	3,150	1,000	840	
Surabaja	1.4	0	26.4	12.6	0.2	40.6
Tjilatjap	4.2	0	0.5	6.6	7.1	18.4
Tjirebon	3.9	0	9.5	4.1	6.8	24.3

Note: In million Rp/Y
Unit transportation cost, 15Rp/km.t

An assumption was made in the case of the above that the ocean freight charges are on the same level as the land transportation charges.

4-5-5. Chlorine and caustic soda

Chlorine is mainly used for the production of PVC monomer. The transportation cost considerably depends on the site location of the projected PVC plant, however, it is assumed that at present, only one plant is expected to be constructed in Indonesia for PVC monomer production. Therefore, consideration on the chlorine has been excluded from the scope of the present discussion. However, the transportation cost in this respect is rather high as compared with that mentioned previously, so that it will be an important factor in deciding the site location of the chlorine and caustic soda plant.

4-5-6. The total transportation cost

The following figures are the total transportation cost covered in 4-5-1 through 4.

Surabaja	133 million Rp/Y
Tjilatjap	174 million Rp/Y
Tjirebon	173 million Rp/Y

Therefore, Surabaja is the best located from the viewpoint of transportation cost.

4-6. Welfare facilities

It is considered that the second largest city in Indonesia, Surabaja is best equipped from the viewpoint of welfare facilities. However, Tjilatjap has a plan of building an industrial park and, although at present Tjilatjap has some problems in view of the welfare facilities, the problems will be solved in the future.

4-7. Pollution problems

The present day rayon plants are equipped with carbon disulphide recovery and waste water treatment devices for pollution prevention and efforts have been made not to cause any problem in the local community as much as practicable. Even so, it is desirable not to construct a plant in or around heavily settled communities.

4-8. Integration of scrutinizations

As mentioned previously, various conditions for the studies of the site selection problems have been rather generally covered. (It should also be noted that the transportation cost scrutinization was also generally made and therefore it is recommended that further studies be made.)

Table VII-23 shows the integration of the so far under taken studies. As is evident from this table, at present, Surabaja seems to be the best situated site. However, considering the future development, it is also reasonable to expect that Tjilatjap is also a possible candidate.

Table VII-23 Overall Judgement on Plant Sites

	Surabaja	Tjilatjap		Tjirebon
		Present	Future	
Labor	①	③	②	②
Maintenance	①	②	①	③
Transportation (Equipment)	①	①		③
Transportation (Products, Raw Materials)	①	②	①	③
Living Environment	①	②		③
Pollution	③	①		②
Judgement	①	②	①	③

Note : The circled numbers indicate the order of advantage.

As mentioned in the foregoing, there are several unforeseeable factors as follows and on the final stage, much more detailed studies should be undertaken.

(1) The plant site of the projected PVC monomer production.

(2) Sufficiency of water amount of Brantas and Seraju rivers when other industries calling for a large amount of water (e.g., paper mills) also carried out the water intake. Possibility of other industrial plant construction on the up-stream of the water intake river involving a danger of harmful substance drainage.

(3) Whether or not the necessary caustic soda is to be procured from P. N. Soda.

(4) Questions as to the site location of the polyester/rayon blended yarn plant in the future.

5. Rayon Production Facilities

Table VII-24 shows the costs of rayon production equipment and of the utility facilities. The price figures in the machinery item include the main machinery, spare parts and components, materials and the cost of construction. For reference, the costs of the facilities of CS_2 production and the facilities for the caustic soda production are also shown, including utility and building costs. The costs of facilities, i.e.; the plant cost, illustrated in Table VII-24 were preliminarily calculated by a certain Japanese engineering firm for the purpose of the present survey, however, the accuracy of estimations used for the first stage feasibility studies are ± 25% approximately and the scrutinization was not made in fine detail. The rayon production facilities include the process machinery for producing 25 T/D as one line and the processes for the sulphuric acid recovery and carbon disulphide recovery as well as the waste water treatment equipment.

6. Preliminary Cost Calculation and Scrutinization on Economy

6-1. Production cost

Fig. VII-11 shows the estimate of the demand (showing the maximum (A) and the minimum (B)) and the production scale of a rayon plant. As previously mentioned, the unit of the construction was taken at 25 T/D. Therefore, illustration is made for the cases of 25 T/D (1) and for 50 T/D (2).

6-1-1. Methods of construction and plant facility expansion judging from this figure, it is reasonable to assume that at present the scale of the production of the rayon plant to be constructed should be either with a 25 T/D or a 50 T/D capacity. In other words, in the case of facility expansion of a plant, there are three commonly accepted patterns available in determining the timing of the expansion construction.

Fig. VII-12 illustrates these three patterns. When adopting the first method, the products exceeding the demand must be allocated for export. Therefore, it is imperative that the cost of production should have the international competitiveness. (Cases of employment of this method expansion is therefore rather seldom.) The second method is a generally adopted pattern. When surplus production taken place, the excess is often utilized as the stock portion to cope with occasional shortage of products and also often exported.

The third method is adopted when the products produced no sufficient competitiveness against imported items. In this last case, the shortage in production is supplemented by importation.

The second of the third method is usually adopted and it is recommended that either one of these two be adopted in Indonesia.

From this point of view, it seems sufficient at this stage to scrutinize two cases of production capacity of the projected plant, i.e., 25 T/D and 50 T/D, in view of the fact that the forecast demand amount for 1980 is approximately 50 T/D.

On the other hand, it is expected that the projected rayon plant would be in operation in 1976 even if the plant is to be constructed at the soonest practicable timing. Therefore, it seems sufficient that the costs in two cases, i.e., for 25 T/D and 50 T/D in the period from 1976 to 1980 are preliminarily calculated. Table VII-25 illustrates the basis for the cost calculations. Table VII-26 and Fig. VII-13 show the results of the cost calculations and the CIF prices for each year during the period.

Table VII-24 Plant Construction Cost

(10^6 Rp)

Capacity		25 t/d	-25%	50 t/d	-25%	100 t/d	-25%	150 t/d	-25%
Rayon									
Main	Machinery & Equipment	6,070	4,553	10,727	8,045	19,348	14,511	27,334	20,500
	Building	890	667	1,608	1,206	2,900	2,175	4,098	3,073
	Total	6,960	5,220	12,335	9,251	22,248	16,686	31,432	23,573
Aux.	Machinery & Equipment	1,020	765	1,679	1,260	2,689	2,017	3,574	2,681
	Building	90	68	114	86	182	137	242	182
	Total	1,110	833	1,793	1,346	2,871	2,154	3,816	2,863
Total	Machinery & Equipment	7,090	5,318	12,406	9,305	22,037	16,528	30,908	23,181
	Building	980	735	1,722	1,292	3,082	2,312	4,340	3,255
	Total	8,070	6,053	14,128	10,597	25,119	18,840	35,248	26,436
Carbon Disulphide	Capacity	3 t/d		6.1		12.1		18.2	
		311		544		934		1,288	
Caustic Soda									
	Capacity	17 t/d		33		66		100	
	Machinery & Equipment	849		1,455		2,244		3,275	
	Building	94		162		249		364	
	Total	943		1,617		2,493		3,639	
Engineering Fee		400		670		1,145		1,550	

Fig VII-11 Production Scale and Time of Plant Construction

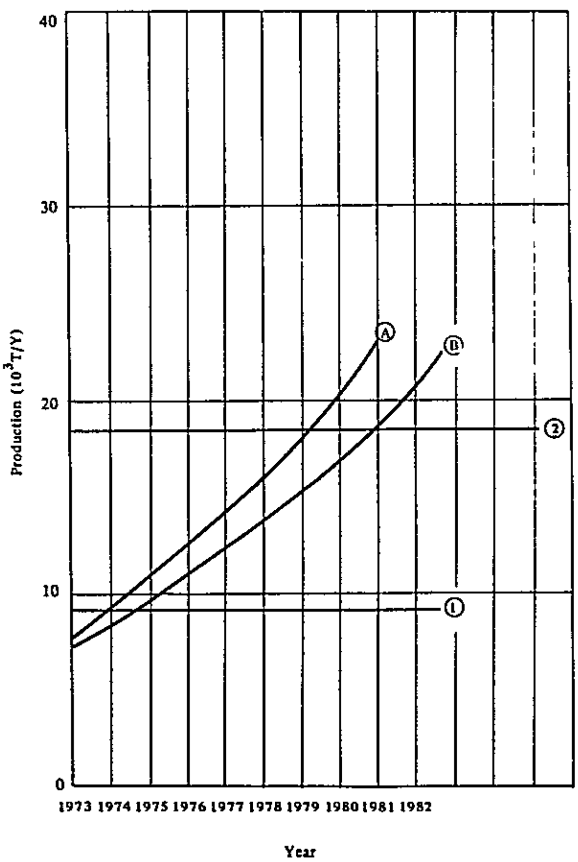


Fig. VII-12 Patterns of Construction and Expansion of Production Facilities

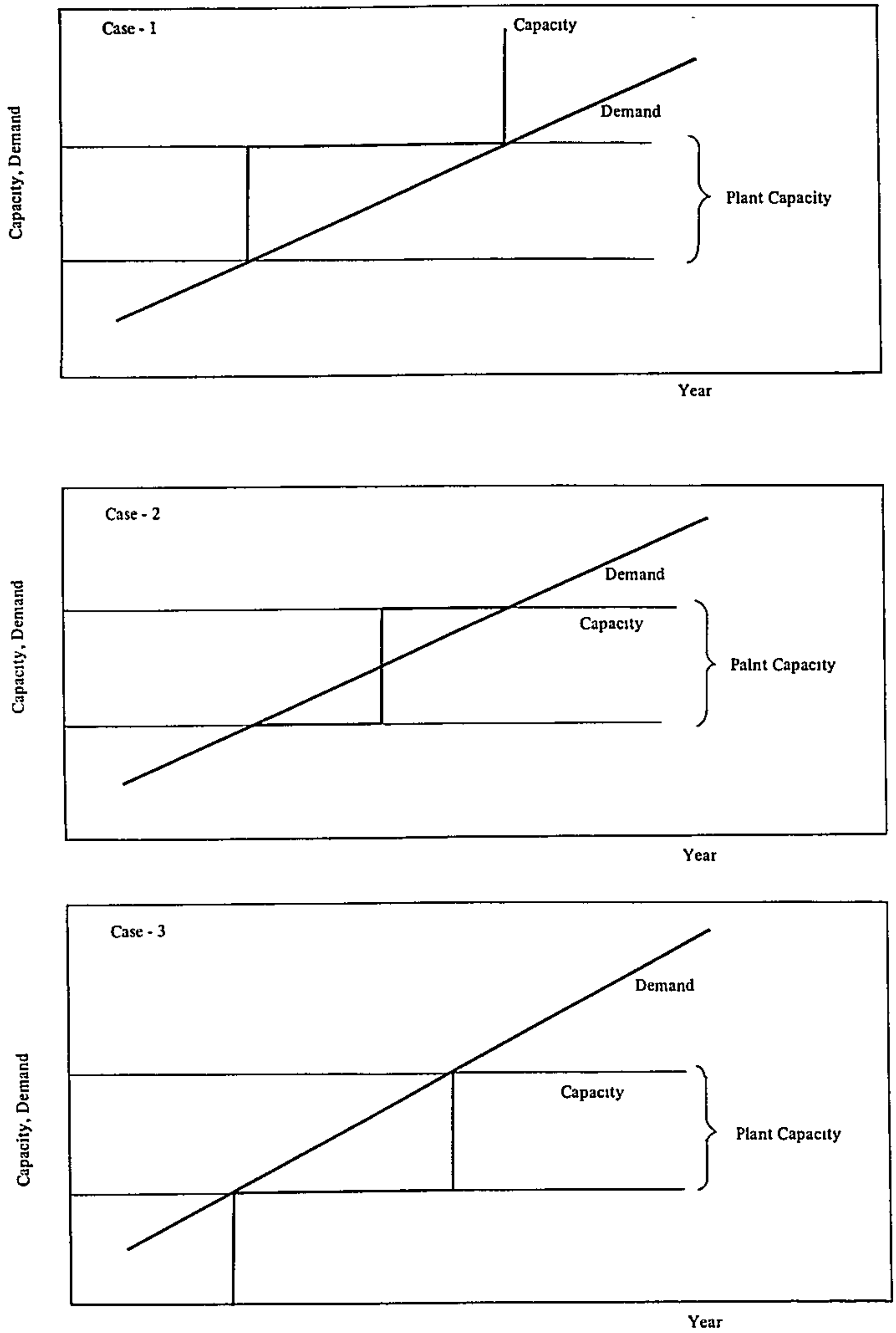


Table VII-25 Basis for Production Cost Calculation of Rayon SF

(Capacity, Investment)

Capacity of Rayon Plant	t/y	9,125	18,250
" (per day)	t/d	25	50
Capacity 1)	"	28	56
Investment Equipment	10^6 Rp	7,090	12,406
Building	"	980	1,722
Engineering Fee	"	400	670

1) 330 Working days per year

(Consumption and prices of Raw Materials, Chemicals, Utilities, By-Products and labor)

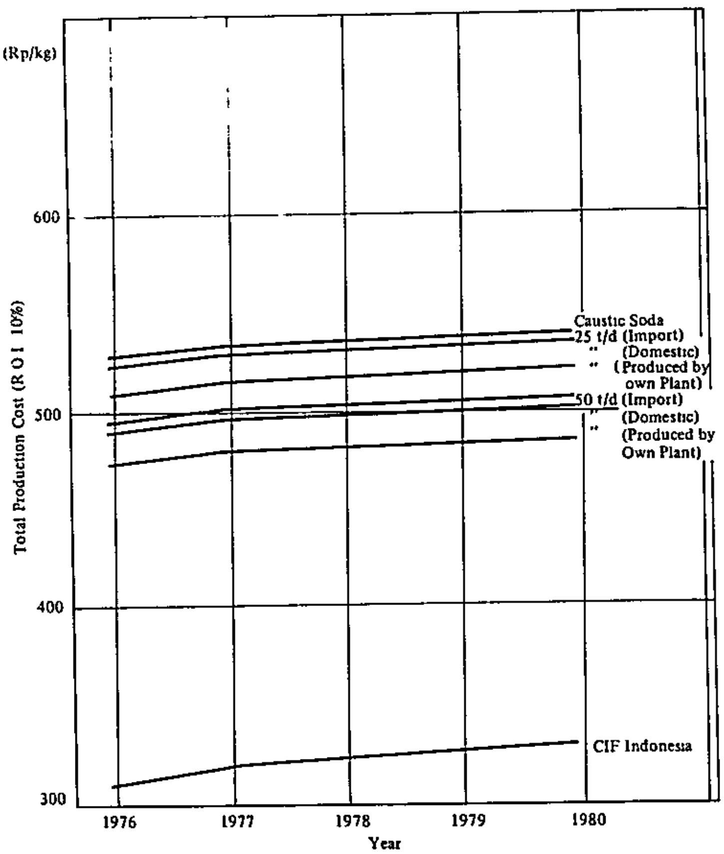
		Consumption (/kg)	Prices			
Pulp	(kg)	1.06	Ref. Table IV-7			
			25 t/d	50 t/d	Import	Domestic Production
Caustic Soda	(")	0.60	49.0 RP/kg	45.6 RP/kg	82 RP/kg	75 RP/kg
Carbon Disulphide	(")	0.11	96.7 "	87.5 "	-	-
Sulphuric Acid	(")	1.25	11 RP/kg			
Sodium Sulphate	(")	-1.40	4.2 RP/kg			
Chemicals		-	9 RP/kg			
Packing		-	8 RP/kg			
Fuel	(")	2.84	7 RP/kg			
Labor (25 t/d)		125 men	323 10^3 Rp/man.Year			
(50 ")		234 "				
(100 ")		436 "				
(150 ")		627 "				

Table VII-26 Production Costs and CIF Prices

(Rp/kg)

Year \ Capacity	25 t/d			50 t/d			CIF Price
	Caustic Soda Import	Domestic	Produced by own plant	Import	Domestic	Produced by own plant	
1976	528.5	523.6	509.6	495.5	490.6	474.2	310
1977	535	530.1	516.2	502	497.1	480.8	320
1978	536.6	531.7	517.8	503.6	498.7	482.4	324
1979	537.9	533.2	519.2	505.1	500.2	483.8	328
1980	540.7	535.8	523.1	507.7	502.8	486.4	332

Fig VII-13 Production Cost and CIF Price of Rayon SF



As is evident from this table, even in the case of the 50 T/D production where the production cost is lowest, if a profit equivalent to 10% of the invested amount is to be incorporated, the production cost becomes 1.5 times as much as the CIF price. Therefore, it seems unfeasible to industrialize the rayon SF production in Indonesia.

6-2. Comparison with production cost in Japan

Table VII-27 shows the comparison with the production costs in Japan (which have been estimated by the survey team on the basis of the FOB prices in Japan), in order to grasp the above-mentioned problems regarding the production costs in Indonesia. Table VII-28 illustrates the difference between the production costs in Japan and in Indonesia obtained from Table VII-27. (The two sets of costs were compared with each other on an assumption that a plant of 50 T/D scale were constructed in Indonesia in 1972.) The exemptions on the labour cost and the by-products are the advantages for Indonesia, while the costs regarding the plant facilities and the higher pulp prices are the disadvantages for Indonesia.

Table VII-27 Comparisons in Japanese Production Costs

	Indonesia			Japan	
	Consumption (Rp/kg)	Price (Rp/kg)	Cost (Rp/kg)	Price (Rp/kg)	Cost (Rp/kg)
VARIABLE COST					
Pulp	1.06	104.6	110.9	90	95.5
Caustic Soda	0.60	45.6	27.4	30	18
Carbon Disulphide	0.11	96.7	10.6	59	6.5
Sulphuric Acid	1.25	11	13.8	4	5
Sodium Sulphate	1.40	-4.2	-5.9	0.7	-1
Others			9.0		6
Utilities	2.84	7	19.9		13
Total			185.7		143
FIXED COST					
Labor	234	323 10^3 Rp/man.Y	4.1		26
Depreciation	14,128,000 10^3 Rp		59.0		6
Engineering Fee	670,000 "		7.3		0
Start- Up Cost, Interest during Construction			9.2		0
Other Fixed Cost			19.6		19
Total			99.2		51
Production Cost			284.9		194
DISTRIBUTION			8		3
GENERAL ADMINISTRATION			28.5		31
TOTAL PRODUCTION COST			321.4		228
INTEREST					
Interest on Total Fixed Capital			31		0
Interest on Working Capital			6.2		4
TOTAL PRODUCTION COST AFTER TAX			358.6		232

Table VII-28 Difference from the Japanese Production Costs

(1972)

	Difference of Cost 1)	Remarks
Pulp	15.4 (RP/kg)	CIF Indonesia 104.6 RP/kg Price in Japan 90 RP/kg
Caustic Soda	9.4	Produced by Own Plant 45.6 RP/kg Price in Japan 30 RP/kg
Carbon Disulphide	4.1	
Sulphuric Acdd	8.8	Price in Indonesia 11 RP/kg Price in Japan 4 RP/kg
Sudium Sulphate	-4.9	
Others	3	
Utilities	6.9	
Labor	-21.9	
Depreciation	53	Machines and facilities in Japan are already depreciated
Engineering Fee	7.3	
Start-Up Cost Interest during Construction	9.2	
Others2)	0.6	
Distribution	5	
General Administration	-2.5	
Interest on Total Fixed Capital	31	Cost relating to equipment
Interest on Working Capital	2.2	

1) (Cost in Indonesia) - (Cost in Japan)

2) Maintenance, Tax, Insurance, Plant Overhead

The difference between Indonesia and Japan regarding the points disadvantageous for Indonesia are as follows.

Facilities	Approximately	100 Rp/kg
Pulp	Approximately	15 Rp/kg
Chemicals	Approximately	25 Rp/kg

Therefore, it is necessary to take the following three points into serious consideration in order to industrialize the rayon industry in Indonesia.

(1) The facility costs must be made as low as practicable

(2) The decrease in the pulp prices must be undertaken by domestically producing pulp

(3) The cost of the raw material chemicals must be as low as practicable.

7. Scrutinization of Industrial Scale Production

7-1. The Expected Minimum Production Cost

As described above, in order to carry out industrial scale production of rayon SF in Indonesia, it is necessary to reduce the plant costs, the unit cost of pulp as well as the unit cost of chemicals. Here, in the undermentioned conditions, i.e., the present optimum conditions which can be set forth at present, the production cost will be calculated and studies, regarding the deviation from the CIF price levels, shall be conducted as follows.

(1) Concerning the plant costs, -25%, i.e., the minimum level of the plant costs which have been obtained through the present survey shall be employed. (The accuracy of the estimation on the plant costs shall therefore be ±25%.)

(2) Concerning the price of pulp, an assumption is made that the level will be reduced to the present Japanese domestic price level, i.e., 100 Rp/kg., by undertaking the domestic production in Indonesia. (In accordance with the O.T.C.A. surveys conducted in 1968 regarding the pulp and paper industries in Indonesia, data were obtained that the paper pulp produced by the KP method is at a unit cost of 78 Rp/kg, on a 30 T/D basis. Considering the difference between the paper pulp and DP, the 100 Rp/kg. seems to be the minimum production cost attainable in Indonesia.)

(3) Reduction in the costs of caustic soda and carbon disulphide to be produced domestically will be caused by the interest rate decrease described in (4). The sulphuric acid price is estimated at 7 Rp/kg. on the basis that the demand increment will be achieved in the future.

(4) Regarding the rate of interest, an assumption is made that credit obtained from the industrialized countries will be used so that the level will be set at 3.5% and the local interest rate at 10%. On the basis of these assumptions (Ref. Table VII-29), cost calculations were undertaken as shown in Table VII-30 and VII-31. Fig. VII-14 shows the comparison between the thus obtained data and the CIF prices. In this figure, an illustration is made for the cases of import duty imposition upon the CIF prices at the level of 5%, 10% and 20% and also both cases of 10% and 15% ROI at cost are shown in order to clarify the relationship between the cost level and the ROI as well as with the import duty. In accordance with this figure, if the 50 T/D production is undertaken, the CIF price in 1980, with a 10% import duty and production cost at the ROI of 10%, attains approximately the same level.

7-2. Effect of the Main Cost Factors on the Production Cost

The costs and CIF prices are as shown above, however, it must be noted that in the present survey, the accuracy of the estimates is not sufficiently high on the plant cost and the pulp prices, both of which are the most influential cost factors upon the rayon production in Indonesia. Therefore, Fig. VII-15 and VII-16

Table VII-29 Basis for Rayon SF Production Cost Calculation (When plant cost and raw material cost are reduced)

(Capacity, Investment)

Capacity of Rayon Plant	t/y	9,125	18,250
" (per day)[1]	t/d	25	50
Capacity	"	28	56
Investment[2] Machinery & Equipment	10^6 Rp	5,318	9,305
Building	"	735	1,292
Engineering Fee	"	400	670

1) 330 days operation a year.

2) -25%, the minimum, was taken as the plant construction cost.

Raw Materials, Chemicals, Utilities, By-Products, Consumption & Prices

		Consumption (/kg)	Prices	
Pulp (kg)		1.06	100	RP/kg
Caustic Soda (")		0.60	47 43	RP/kg (Rayon25 t/d) RP/kg (Rayon 50 t/d)
Carbon Disulphide (")		0.11	89 81	RP/kg (Rayon 25 t/d) RP/kg (Rayon 50 t/d)
Sulphuric Acid (")		1.25	7	RP/kg
Sodium Sulphate (")		-1.40	4.2	RP/kg
Chemicals		-	9	RP/kg
Packing		-	8	RP/kg
Fuel (")		2.84	7	RP/kg
Labor	(25 t/d)	125 men	323	10^3 RP/man.Y
	(50 ")	234 "		
	(100 ")	436 "		
	(150 ")	627 "		

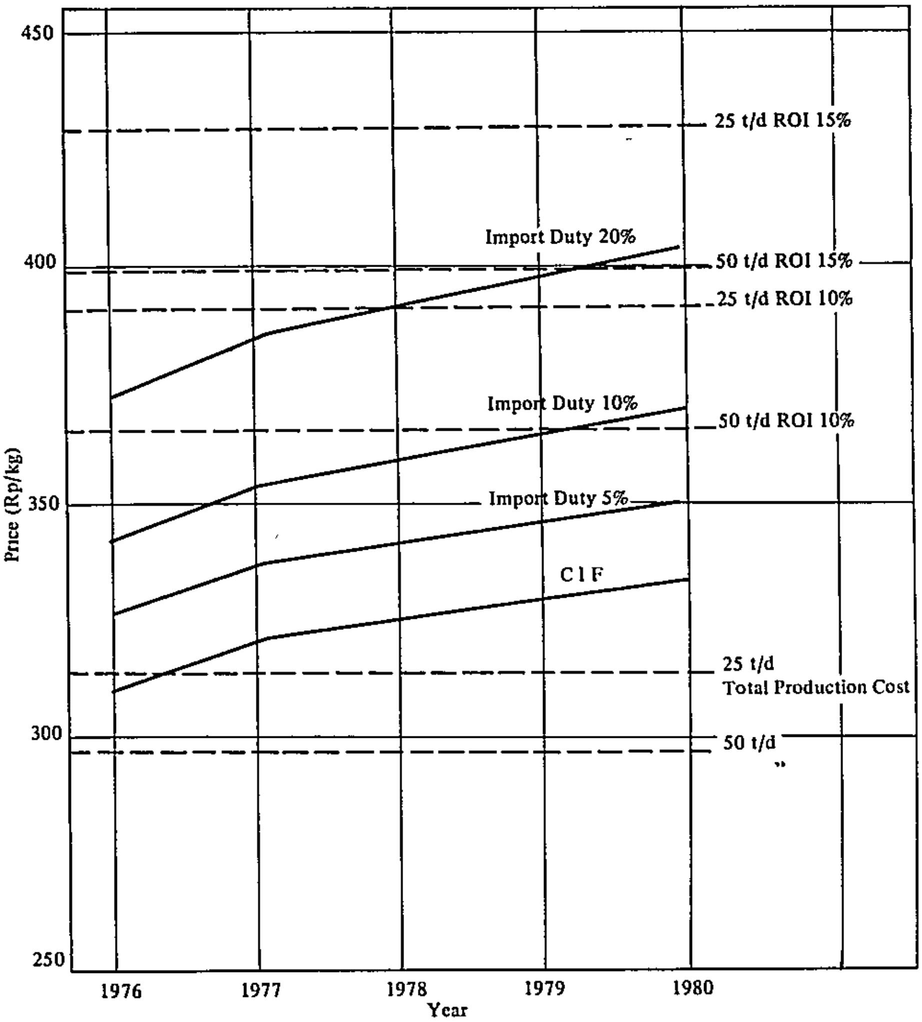
Table VII-30 Production Cost of Rayon SF (25 T/D)

		Consumption (/kg)	Price (Rp/kg)	Cost (Rp/kg)	Remarks
Variable Cost					
Raw Materials					
Pulp	(kg)	1.06	100	106	
Caustic Soda	(")	0.60	47	28.2	Capacity : (T/Y)
Carbon Disulphide	(")	0.11	89	9.8	9,125
Sulphuric Acid	(")	1.25	7	8.8	
Sodium Sulphate	(")	1.40	-4.2	-5.9	Interest on Total
Others			9	9	Fixed Capital :
Total				155.9	0.035
Utilities					Interest on
					Working Capital:
Fuel (kg)		2.84	7	19.9	0.10
Total				19.9	
Variable Cost Total				175.8	
Fixed Cost					
Labor		125 men	$323\ 10^3$ Rp/man.Y	4.4	
Depreciation					
Machinery & Equipment (Main & Aux.)			5,318,000 10^3Rp	50.6	
Building			735,000 "		
Engineering Fee			400,000 "	8.8	
Start-Up Cost. Interest during Construction			208,000 "	4.5	
Total				63.9	
Maintenance				13.3	
Plant Overhead				4.4	
Fixed Cost Total				86.9	
Production Cost				261.8	
Distribution			8	8	
General Administration				26.2	
Total Production Cost				296	
Interest					
Interest on Total Fixed Capital				12.6	
Interest on Working Capital				4.8	
Total				17.4	
Total Production Cost including Interest				313.4	
ROI 10%				390.1	
ROI 15%				428.6	

Table VII-31 Production Cost of Rayon SF (50 T/D)

		Consumption (/kg)	Price (Rp/kg)	Cost (Rp/kg)	Remarks
Variable Cost					
Raw Materials					
Pulp	(kg)	1.06	100	106	
Caustic Soda	(")	0.60	43	25.8	Capacity : (T/Y) 18,250
Carbon Disulphide	(")	0.11	81	8.9	
Sulphuric Acid	(")	1.25	7	8.8	
Sodium Sulphate	(")	1.40	-4.2	-5.9	Interest on Total Fixed Capital : 0.035
Others			9	9	
Total				152.6	
Utilities					
Fuel	(kg)	2.84	7	19.9	Interest on Working Capital 0.10
Total				19.9	
Variable Cost Total				172.5	
Fixed Cost					
Labor		234 men	323 10^3 Rp /man.Y	4.1	
Depreciation					
Machinery & Equipment (Main & Aux.)			9,305,000 10^3Rp	44.3	
Building			1,292,000 "		
Engineering Fee			670,000 "	7.3	
Start-Up Cost, Interest during Construction			378,000 "	4.1	
Total				55.7	
Maintenance				11.6	
Plant Overhead				4.1	
Fixed Cost Total				75.5	
Production Cost				248	
Distribution			8	8	
General Administration				24.8	
Total Production Cost				280.8	
Interest					
Interest on Total Fixed Capital				11	
Interest on Working Capital				4.6	
Total				15.6	
Total Production Cost including Interest				296.4	
ROI 10%				364	
ROI 15%				397.7	

Fig. VII-14 Comparison of Production Cost and CIF Price of Rayon SF



show the results of scrutinizations made concerning the effects of the variation in these factors upon the production costs. Fig. VII-15 shows the case where the production scale was taken at 25 T/D and Fig. VII-16 at 50 T/D. Table VII-30 and VII-31 illustrate these figures by taking the X-axis as O and from these conditions, the extent of variation in the production cost is shown in terms of percentage in accordance with the variation of the plant costs and the pulp unit costs in terms of percentage. From these results, it is evident that if the pulp price varies by 10% from the level of 100 Rp/kg., the production cost will be shifted by 12 Rp/kg. Also, if the plant cost is either increased or decreased by 10%, the production cost will be affected by the extent of 9 Rp/kg.

7-3. Time of Construction and the Production Scale of the Constructed Plants

The above-mentioned Fig. VII-14 and Fig. VII-1 which show the demand forecast figures are combined in order to compile Fig. VII-17. In this connection, the median values and the minimum values are shown as the demand forecast figures. These figures reveal the following.

Fig. VII-15 Effect of Construction Cost and Pulp Unit Price upon Production Cost of Rayon SF

(25 T/D)

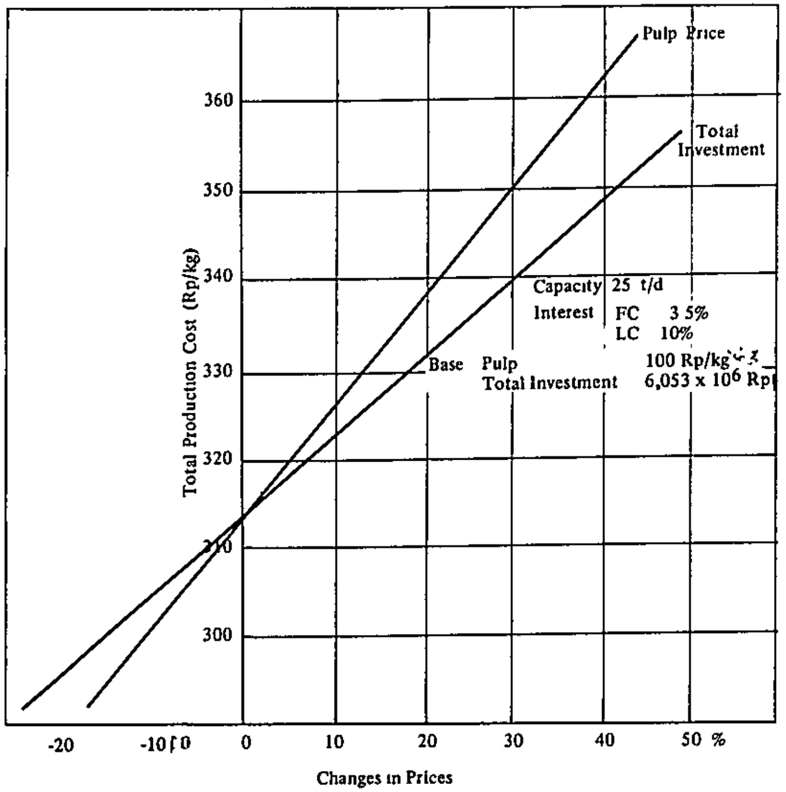


Fig. VII-16 Effect of Construction Cost and Pulp Unit Price upon Production Cost of Rayon SF

(50 T/D)

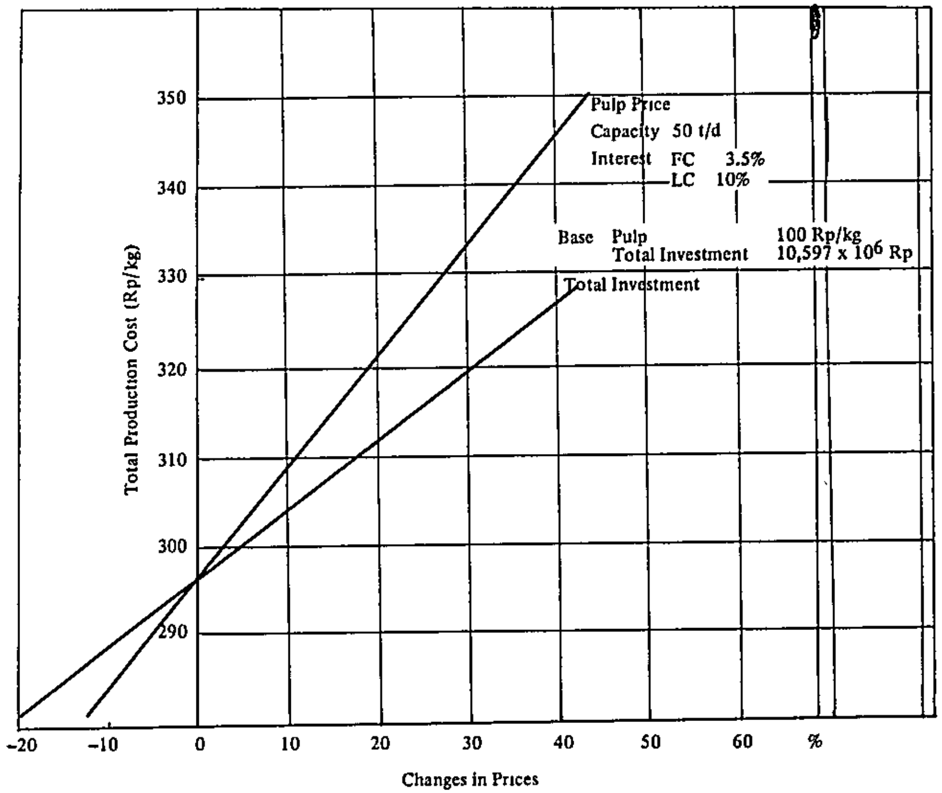
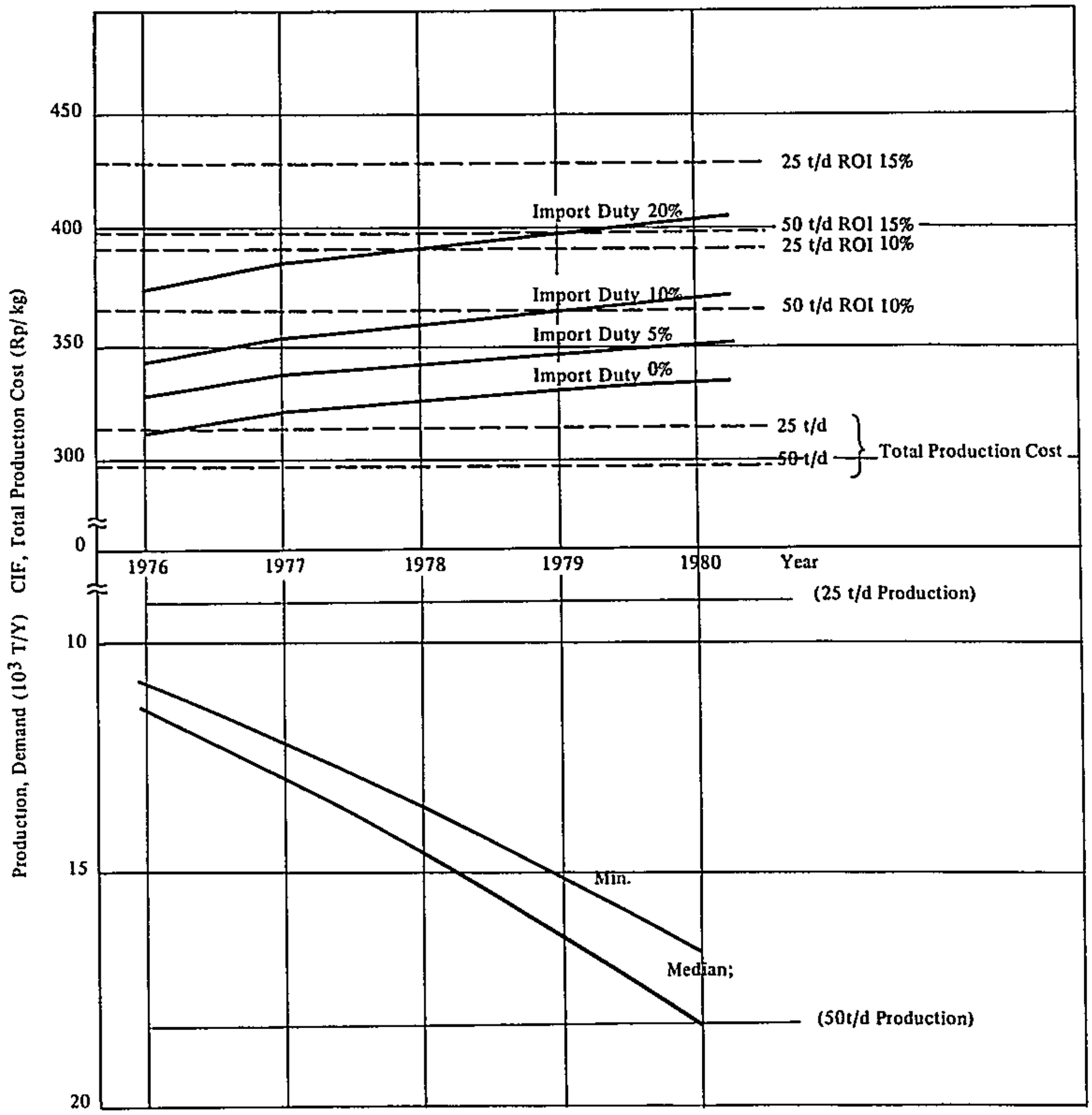


Fig. VII-17 Relationship among Production Cost, CIF Price, Demand Amount and Production Capacity of Rayon SF



(1) If a plant of 25 T/D is constructed, full operation will be carried out from the plant completion time, in 1976 onward, however, the production cost would be extremely high so that in order to obtain over 10% of ROI, it would be necessary to levy more than 20% import duty. Further, it would be possible to reduce the import duty level to 10% in 1980.

(2) A 50 T/D plant will be able to go into full operation in 1980 if the demand increases to the level shown by the median figure. In this case, competition with imported products will be possible if approximately 5% import duty is levied. Here, various cases were hypothetically established concerning the production scale of the plant to be constructed and the time of the construction thereof in order to compare the results of these cases in view of the return rates on the investment.

Analysis was made by means of the Discount Cash Flow method in order to carry out the comparison and assess the most advantageous method.

The rates of return on investment shall hereinafter be referred to as the "DCF rate".

The pre-requisite conditions for the hypotheses are as under.

A. The selling price of rayon was taken at the same level as the CIF price.

B. Although the production cost should change along with the sequence of time, it was taken as being constant for the purpose of this study. The reason for taking this as constant is as follows. The pulp and chemical prices are on a higher level than the international prices. Therefore, it is expected that these prices will be reduced along with the advancement of industrialization in Indonesia, resulting in the production prices becoming constant by the offsetting effect. Also, the labour cost increment in Indonesia is considered to be less acute so that the labour cost influence is considered to have no significant impact for the purpose of these comparative cast studies.

C. The five years after completion of the construction shall be considered as being on the Tax Holidays.

D. The hypothetical cases are as follows.

E. When the demand is lower than the production capacity, the exportations are taken into account. In such cases, the prices were taken at two levels, i.e. the FOB price in Japan and the production cost before depreciation and interest gain.

Cases	Starting Time	Plant Production Scale	Production	Consumption	Excess for Export	Export Price
A	1976	25 T/D	Full	Median Value	No	
B	1976	50 T/D	For domestic consumption only	- do -	No	
C	1976	50 T/D	Full	- do -	Yes	FOB Japan
D	1976	50 T/D	Full	- do -	Yes	Production cost before depreciation and interest
E	1976	50 T/D	Full	Minimum Value	Yes	- do -
F	1980	50 T/D	Full	Median Value	No	

The results of the above calculation revealed the following.

Cases	DCF Rate (%)
F	9.2
C	5.9
D	4.4
E	3.8
A	3.5
B	--

From these comparative studies, the following may be concluded concerning the time of construction, scale of production and the extent of the operation.

(1) The highest profitability can be attained by constructing a 50 T/D plant in 1980.

(2) If a plant is to be constructed in 1976, a 50 T/D plant should be built and operated under full capacity. The portion of the production exceeding the domestic demand can be allocated for exportation. In this case, even if the export price is on the level of production costs excluding depreciation and interest, the profitability would be better than in the case of constructing a 25 T/D plant.

(3) The construction of a 50 T/D plant in 1976 to carry out production merely to cover the domestic demand and leaving the rest of the equipment capacity idle would be the most disadvantageous. This is the method in which the profitability is at its lowest. For this case, i.e. where no exportation is taken into account, as shown in Fig. VII-18, scrutinizations were made as to the most suitable construction method of a 50 T/D plant in order to obtain the higher DCF rate than in the case of building a 25 T/D plant in 1976. In this figure, it is suggested that if a 50 T/D plant is constructed in 1978, a higher profitability can be obtained than in the case of building a 25 T/D plant in 1976, however, the DCF rate in such a case would only be approximately 5%.

7-4. Import Duty, Plant Cost and DCF Rates

Fig. VII-19, shows the relationship between the import duty rates, the fluctuation in the plant costs and the DCF rate variation in the case of building a 25 T/D plant in 1976. As is evident from this figure, if a 10% import duty is levied for ten years after the commencement of the rayon SF production operations, it would be possible to expect approximately 8.5% DCF rate. Further, if the import duty is 20%, the DCF rate would become approximately 13.5%. Also, if the plant cost increases by 10%, the DCF rate would be reduced by approximately 1%.

Fig. VII-18 Time of Construction of a 50T/D Rayon SF Plant and DCF rate

(When export is not taken into consideration)

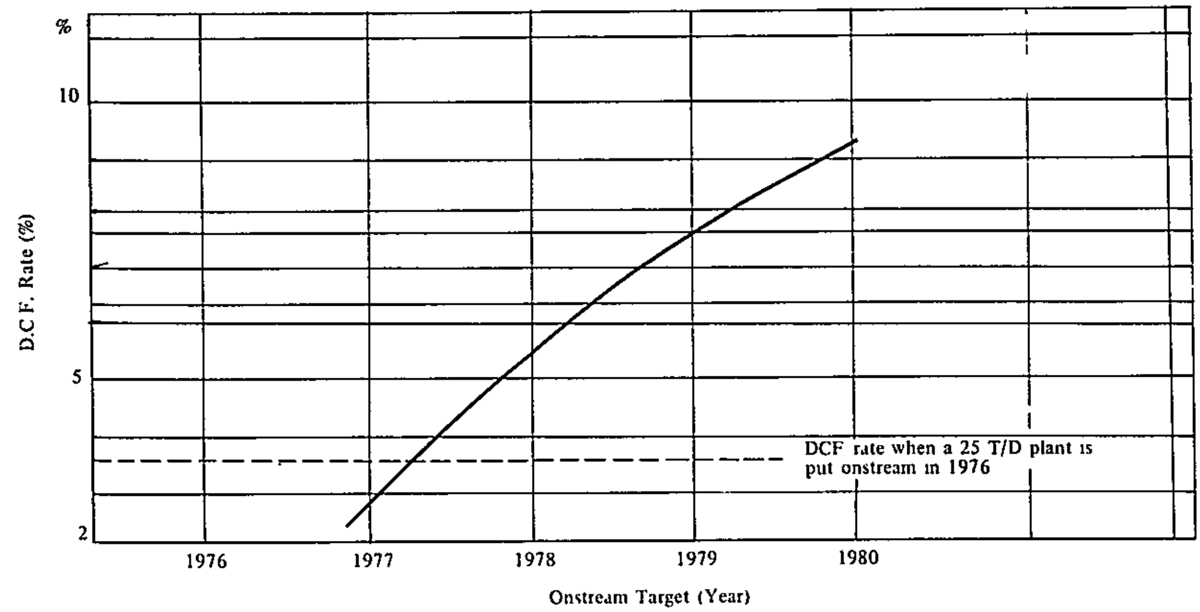
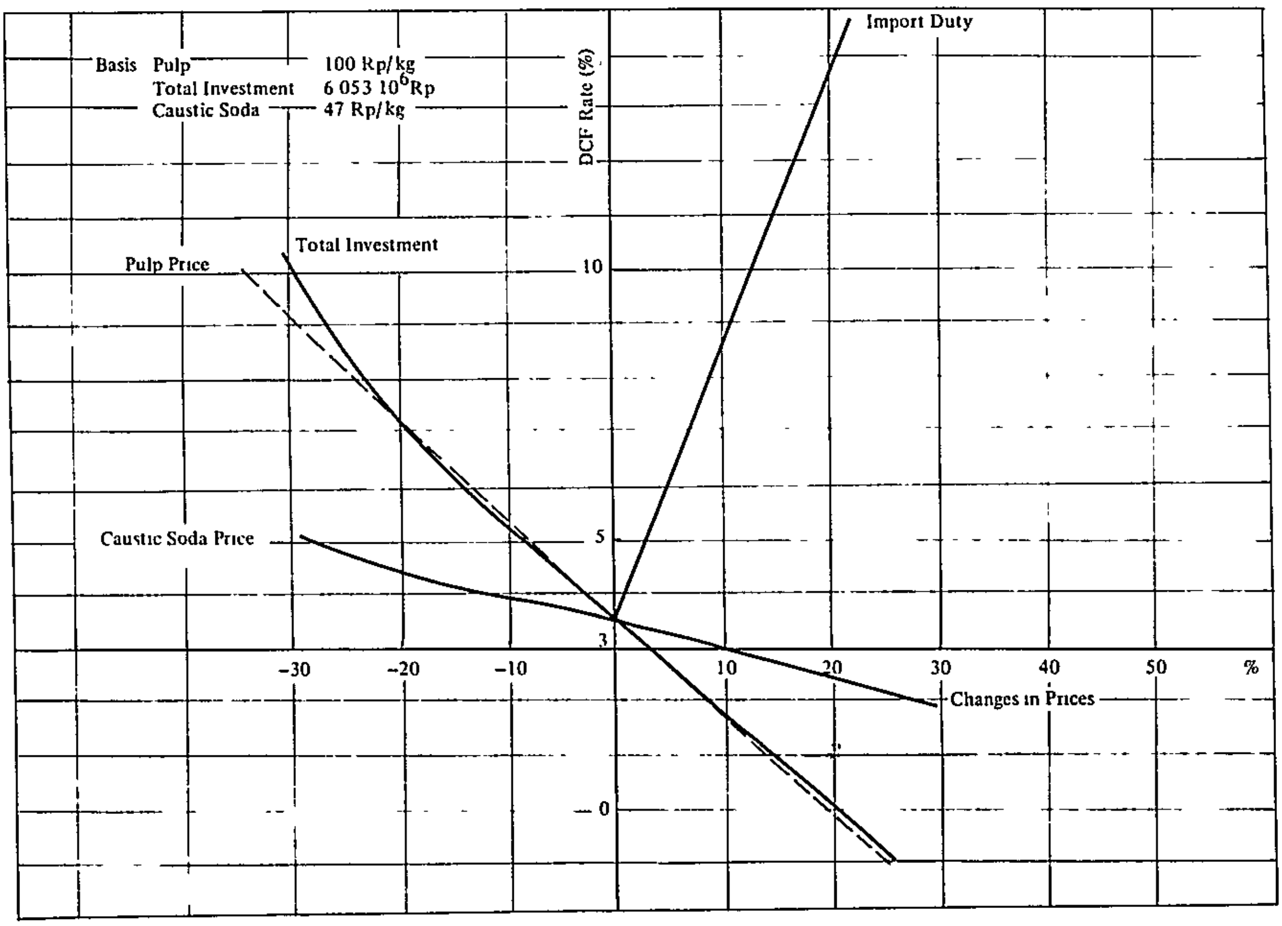


Fig. VII-19 Effect of Import Duty Rate and Plant Cost upon DCF Rate in Rayon SF Production (25T/D)



8. Domestic Production of DP

As has already been mentioned, detailed scrutinization as to the domestic production feasibility of DP is not included within the scope of the present survey, however, in order to carry out surveys on the rayon industry feasibility, visits were paid to the Pertanian Directorates, institutes concerned and paper mills (Padalarang and Banjuwangi). Observations were made on the basis of information obtained through these visits concerning the industrial scale production feasibility of DP in Indonesia. The results of observations are discussed in the following paragraphs concerning the general direction of the considerations.

8-1. Raw cellulosic materials of DP in Indonesia

The following raw materials are the raw cellulosic materials available in Indonesia. They are pinus merkusii, agathis, hardwood (rubberwood, mangrove and other mixed tropical hardwoods), bamboo, bagasse and ricestraw. The generally required conditions for the DP materials are as follows.

1) The materials must be easily processed into DP.

2) The supply of materials should be stable.

3) The cost of the materials must be low.

4) The yield of pulp from the raw materials should be high.

In view of the above-mentioned required conditions, the feasible materials to be used to produce DP are pinus merkusii, agathis, rubberwood and mangrove. The reasons are as follows.

8-1-1. Pinus merkusii and Agathis

1) The fibres of these trees are suitable for rayon SF production as they are long fibres.

2) Imported pulp will be used for the first step of rayon SF production. However, it is easy to change from the imported pulp to domestic pulp as the raw materials of most imported pulp are needle-leaved trees.

3) The species of these trees are not diverse and the DP produced from the pinus is excellent in quality.

4) The pinus at present cannot be used other than as the raw material of rayon and paper pulp.

5) At present, tree plantations for the paper pulp are projected in Indonesia and it is feasible to stably supply these trees as the DP raw materials in the future.

6) The utilization at the LPS (Lembaga Penelition Selulosa) has already been scrutinized, therefore, the knowledge obtained through this scrutiny is available for the DP material studies.

7) Unlike the pinus, the agathis can be used as building material. Also, the applicability as raw materials of DP are inferior to the pinus from the aspect of tree species.

8-1-2. Rubberwood and Mangrove

1) As the species of rubberwood and mangrove used as raw materials for DP are limited, the DP produced from them may be stable in quality.

2) In the industrialized countries, the use of rubberwood and mangrove is already industrialized and are already blended into the DP for the production of normal rayon SF to the extent of approximately 10 to 50%.

3) It seems that rubberwood and mangrove are comparatively stable in supply. The rubberwood especially has the merit of being low in price.

4) Through the LPS studies, the rubberwood has already been fundamentally scrutinized to some degree.

8-1-3. Other tropical hardwoods

The tropical hardwoods are already being used technically in industrialized countries in large quantities. However, the mixed tropical hardwoods other than rubberwood and mangrove are not as yet processed into DP. The reasons for this are as follows.

1) The species of the mixed tropical hardwoods are various and each species has its own specific gravity, chemical composition and morphological characteristics, thereby showing a vast difference in the processability for pulping. Any one of them having a low performance in the cooking adaptability render the filtering characteristics of viscose remarkably inferior, when the various tree species are mixed in cooking. Therefore, the inferiority of the filtering characteristics will be deadly to the DP quality. It is difficult to carry out the selection and assortment of the applicable species considering the state of the mixture of the species in the case of these tropical woods. It is therefore considered that the mixed tropical hardwoods are not applicable as the raw materials of DP.

2) The cellulose contents of these species are low and the lignin and ash contents are high and therefore the yield will be low and, at the same time, the applicability for DP will be poor.

8-1-4. Bamboo

Bamboo is a long fibre material and there are actual records of utilization on an industrial scale in Bangladesh and therefore it would seem applicable for DP. However, bamboo is not plentiful in Indonesia and at present there are difficulties regarding the bamboo supplies at the Gowa and Banjuwangi plants. Therefore, it is considered that bamboo as the main raw material for DP will not be stable in supply.

8-1-5. Bagasse and Ricestraw

Bagasse is potential as agricultural waste compared with the ricestraw, the latter being the main raw material for paper in Indonesia. Therefore, bagasse is suitable for producing paper pulp for middle grade paper or lower quality paper. However, both bagasse and ricestraw are unsuitable as raw materials of DP for the following reasons.

1) The length of the fibre is short, the width narrow and the drainage poor. Consequently, there would be a number of problems in the washing process and the pressing process facilities at the rayon SF production.

2) The ash and pentosan contents are high. Therefore the yield from these raw materials will be low.

3) Bagasse and ricestraw are bulky and therefore the bulk efficiency is low in the cooking process and the costs are thus high.

4) The irregularity in cooking is great and as a result, irregularity in the quality is prone to take place.

5) At present, there are no actual records in the world of the industrialization of the utilization of these materials. Further, there is no case of an industrialization project.

8-1-6. Eucalyptus Globulus

Eucalyptus is available as the raw cellulosic material. The growth of the trees is rapid and therefore the eucalyptus globulus is used at present in the plantations as the raw material of DP. At present only the South African Industrial Cellulose Corp. (an affiliate company of Courtaulds of the U.K.) uses eucalyptus, and the Selbi Corp. of Portugal (an affiliate of Billeruds AB of Sweden) have used the eucalyptus so far.

In Brazil, the plantation of eucalyptus is now projected. The plantation of this species in Indonesia was considered at the outset, however, the tylores of eucalyptus tend to increase in the tropics due to the environmental change. Consequently the eucalyptus is deemed unsuitable as the raw material of DP and the plantation thereof is not practicable.

8-2. Study regarding DP in Indonesia

In Indonesia the project of producing rayon utilizing forest resources began in 1955. The project has been studied for a long time and the history of scrutinization is long. In 1956, the Chemical Research Institute was established in Bogor, and in 1959 the Rayon Laboratory was established in Bandung. In 1964, facilities for studies and tests on paper pulp were established at the Laboratory. Further, in 1968 the Rayon Pilot Plant was established near Bandung with the cooperation of West Germany. The organization of these institutes has since been re-arranged and at present these institutes are integrated under the name of LPS. Up to the present, various types of woods and agricultural waste have been studied chemically and morphologically at the LPS. At the same time, the laboratory scale of paper pulp and DP researches and the pulping, screening and bleaching on the pilot plant scale have also been studied. Particularly, the industrial development upon paper pulp made from rubberwood has been improved from the laboratory scale to the pilot plant scale with successful achievements. Rayon is made from DP which has been produced from rubberwood through the pre-hydrolysis dissolving process and then through a sulphate cooking process and then a 6-stage bleaching process (including the cold alkali purification). Further, the working programme for this year includes such subjects as are shown in Table VII-32 regarding DP and rayon.

The survey team noted with admiration the steady efforts being made in Indonesia regarding the industrialization of rayon production. The following are the opinions of the survey team regarding the present status of such studies in Indonesia.

Table VII-32 Research Subjects of LPS for 1972

A. Long term programme

Direct and develop research work in rayon technology by using Indonesian raw materials towards the realization of a rayon industry in Indonesia.

B. Short term programme for 1972

A seminar in rayon.

C. Research division

a) Raw material Laboratory.
Studies in wood storage.
Survey on wood species for dissolving pulp.

b) Rayon Laboratory
Rayon making of rubberwood and bagasse pulp.

D. Development division

a) Pulp Unit
Process development of rubberwood for rayon dissolving pulp.
Process development of pine and other woods for rayon dessolving pulp.

b) Rayon Unit
Test plant studies on rayon making from rubberw-od pulp, pine and bagasse pulp.
Process development of the rayon laboratory experiments.
Rehabilitation of the rayon pilot plant unit.
Pilot scale development of rayon making from rubberwood pulp, pine pulp and others.

1) The raw materials which are the subjects of the studies as the raw materials for the DP are pinus, rubberwood, agathis and mangrove. It is recommended that pinus and rubberwood in particular be studied, while the study of bagasse and other broad-leaved trees be suspended.

2) It is recommended that the efforts thus saved be allocated to the supports of the studies regarding industrialization by utilizing the Rayon Pilot Plant.

3) It is desirable that the Pilot Plant be utilized for the establishment of a production technique and training of engineers in order to industrialize the DP production. It is therefore recommended that the following counter-measures be undertaken.

(1) The capacity of each piece of equipment should be balanced with the rest of the equipment in order to conduct a quasi-productive operation.

(2) The capacity of the chests should be studied so as to operate the continued process under continuous operation. The automatic control of the temperature and other variables should be devised.

(3) The recovery facilities for chemicals and water should be thoroughly furnished so that the raw material and utility consumption and the quality almost equivalent to the plant scale should be obtained.

The characteristics of the facilities will be rehabilitated by devising the above-mentioned countermeasures. It is also recommended that efficient use be made of the small-scale test plant in order to curtail expenses of the tests.

4) The present on-site surveys revealed that during the rainy season, the collection of raw materials for pulp decreased by 20 to 40% in supply, compared with the dry season, which was partly due to the fact that the infra-structures were not completely equipped. This problem of supply during the rainy season will be improved gradually by mechanizing the wood harvesting and the substantiation of an infra-structure in the future. However, it would be necessary to continue the studies of this problem even during the course of improvement. The rubberwoods in particular are prone to be affected by the discolouring bacteria. The rubberwood whose colour changed to dark green or black in the core part, is difficult to bleach in the pulping process. It has an adverse effect upon the pulp yield, the consumption of chemicals and on the filtering. It is therefore necessary to conduct serious studies in order to solve this problem.

8-3. Possibility of DP production in Indonesia

Concerning the possibility of DP production in Indonesia, while the judgement from an economical standpoint should be left to future investigations, it is believed that as a result of the present surveys there are sufficient grounds for DP production in Indonesia. The reasons for this view are as follows.

1) Studies of DKP and rayon have already progressed to a remarkable extent.

2) With regard to the forestry resources such as pinus merkusil and rubberwood which are available as the main raw materials for DP, the amounts of these materials available in Sumatra and Java alone are as much as illustrated in Table VII-33. (However, it is obvious that the substantiation of roads and plantations should be positively promoted.)

3) As it is expected that the pulp demand will increase in view of the fact that approximately 10% p.a. increase of paper consumption is being achieved, there is a feasibility for constructing a large scale pulp plant.

Table VII-33 Potential of Raw Materials of DP

Region	Rubberwood		Pinus Merkusii		Agathis		Remarks
	Area (Ha)	Supply per year (m^3)	Area (Ha)	Supply per year (m^3)	Area (Ha)	Supply per year (m^3)	
West Java	52,588	420,800	13,865	371,119	2,322	294,854	1) Volume based on
Central Java	26,934	215,200	31,053	2,553,666	7,755	1,946,177	diameter from 16 cm
East Java	20,318	162,400	14,191	512,115	4,158	762,814	and up to 35 cm
South Sumatra	16,598	132,800	-	-	-	-	and up
North Sumatra	113,806	910 400	2,953	787,433	-	-	
Atjeh	11,984	96,000	181,500	18,150,000	-	-	
Total	242,228	1,937 600					

Regarding Central Java alone, calculations were made on the potential of DP production.

With regard to the consumption of pulpwood, the figure for rubberwood is 5 m^3/ton and those of pine and agathis are 6 m^3/ton. It is said that the average annual increase rates of pine and agathis per Ha are 22 m^3/y Ha and 28 m^3/y Ha respectively. On the basis of these figures and in view of the opinion that wood harvesting becomes feasible 15 years after planting (D.G. of Planning and Inventorization of Forestry) and taking the growth amount into consideration, the following are the results of calculations of the potential in a case where up to 1/7.5 of the present wood amount is to be harvested per year.

		I*1	II*2 (T/Y)
Rubberwood	43,000		
Pinus merkusii		114,000	57,000
Agathis		36,200	43,300

*1 The results of calculations by means of the average annual increase amount per Ha.

*2 The results of calculations when harvesting 1/7.5 of the present wood amount per year.

Regarding DP alone, the potential is sufficient for the time being, however, including paper pulp, it is not entirely sufficient, when contemplating the production scale close to the international level. Thus, it is recommended that plantation be promoted systematically from the long-term view towards the future.

4) As for rayon itself, as it is expected that demands equivalent to 25 T/D to 50 T/D will emerge, the rayon growth will be able to contribute to the expansion of the total demand amount of pulp. Further, apart from these domestic situations in Indonesia, it is an important fact to note that pulp prices have shown a universal uptrend. It is also recommended that the following points be taken into consideration when constructing a DP plant.

(1) Concerning the scale of DP plants, the 40,000 T/Y plant in Taiwan is the smallest in the world. The scale of a DP plant is usually approximately 150,000 T/Y. Recently there has been an obvious tendency to enlarge upon the scales, and the size of newly constructed plants are usually 250,000 T/Y. Therefore, if the construction of a pulp plant equal to the scale of rayon production in this project is undertaken, the level of economic production scale would not be attained. Because of this fact, it is feasible to expect an increase in consumption. Considering the simultaneous production of paper pulp and DP, there is a feasibility for constructing an economic scale plant as the main raw material costs and labour costs in Indonesia are lower than those of other countries.

(2) From the viewpoint of simultaneous production of paper pulp and DP, it is desirable to use the K.P. process in the pulp plant due to the following reasons. (For reference, the differences between the S.P. process and the K. P. process are indicated in Table VII-34.)

a) In the KP process, it is possible to use tropical pulp wood so that this process can also be used when utilizing woods other than pinus in the future.

b) It is possible to produce paper pulp with the same process.

c) It is possible to use as the sub raw materials sodium sulphate by-produced in rayon plants.

d) The tensile strength of yarn is high when rayon is made from this pulp.

e) Pollution problems will not be conspicuous as the quality of waste water in this process is better than that in the SP process.

Table VII-34 Comparison of the SP Process and the KP Process

	SP	KP
Cooking	o Cannot cook high resin content woods or special substance containing woods (red-pine, core portion thereof) o Must eliminate bark which is uncoockable and therefore produces residue otherwise. o Penetration of cooking liquid not effective, thereby requiring longer cooking time than the KP method.	o Coocking effect satisfactory for a most of wood types. (Some tropical hard-wood may present cooking problems) o Shorter cooking hours enhance productivity per unit capacity.
Bleaching	Highly effective bleaching	Bleaching effect not very high. Multiple bleaching steps are required, thereby consuming large amount of chemicals
Unbleached pulp	Whiteness is high	Whiteness is low
Pollution problems	High B.O.D. in waste water	Lower B.O.D. of waster water than SP process Waste water highly odrous and requires deodration process
Pulp	High reactibility and easy to process. Generally low cost pulp of 90% alpha for use in making staple fibres Tensile strength lower than KP processed pulp when made into rayon	Pulp slightly hard to process High class pulp (of over 94% alpha) will be produced and therefore the cost is high. Possible to produce rayon of high tensile strength
Cost (in the case of Japan)	Proportional variable cost	(for N, LDP and NDP) SP < KP (for LDP) SP > KP
	Plant cost	(Present) SP < KP (if cooking liquor recovery is necessary for pollution control) SP = KP

As is evident from Table VII-34, there are shortcomings in the KP process when compared with the SP process, however, judging from the above mentioned advantages, it is recommended that the K. P. process be adopted. Further, concerning the industrialization of DP production in Indonesia, if practicable, it is recommended that another on-site investigation and feasibility study be conducted on the basis of the present surveys.

(3) The switch-over from imported pulp to domestic pulp.

As has been mentioned in the charpter pertaining to rayon, when starting the rayon industry with the raw materials of imported pulp for the time being, most of the imported pulp will be NDSP and some LDSP will be added. (As the DKP amount is expected to be small, it is desirable to adopt the following steps.)

First step : The utilization of NDSP (imported).

Second step: The production of domestic NDKP made of pinus.
The utilization of NDKP (domestic) together with NDSP (imported).

Third step : The production of LDKP made of rubberwood.
The utilization of NDKP (domestic) together with LDKP (domestic).
However, in this case it is necessary to establish in advance the technique of changing these into DKP and the producing technique of rayon by utilizing such pulp.