VII The Master Plan for the Industrialization Project

1. Prerequisite conditions of the selection of feasible industries

In the master plan, various industries are taken into consideration on the basis of the utilization of the resources which are produced in the Mahaweli Project area and in the vicinity thereof. The following points are to be taken as the prerequisite conditions as the basis for the selection of the suitable industries to be developed.

(1) The industries must be the ones which are capable of effectively utilizing the resources, (including human resources).

(2) The problems inherent in the exsiting industries, i.e., the problems of raw material shortage, should be partially solved by means of the development of the industries.

(3) The development of the selected industries should be in line with the objectives of the national economy of Sri Lanka, i.e., the solution of the foreign exchange shortage and the expansion of the employment opportunities, both of which are the basic policies of the government.

As the countermeasure for the foreign exchange shortage problems, the so-called import substitution and the export-oriented activities can be considered on the side of the production industries, however, as is evident from the stipulations made in VI-2 "Resources", the available resources by means of which the export oriented production activities can be undertaken are merely the timber and lumber industies so that it is expected that the central activities will have to be the development of those industries by the production activities of which the present importation will be substituted. Further, as to the types of the industries, the following criteria should apply.

(1) The industries must be of the labour intensive type.
(2) The industries should have secure basis for demand.
(3) The industries to be developed should avoid direct competition with the already existing industries and, if necessary, they should assume the position as raw-materials-supplier industries to the existing industries.

By taking into consideration the above points, the practical types of industries to be developed will have to be based upon (2) and (3) of the following types.

(1) Public corporations
(2) Cooperative organizations

(3) Private enterprises

(4) Cottage industries

Of the above, the cottage industries (4) should be considered as a separate item as long as the demand structure for the products of such industries is of the secondary nature, such as, for instance, the so-called handcraft goods or other products of craftsmanship. This category should be treated as work of the governmental organization, i.e., the IDB.

2. Selection of the Feasible Industries

2-1 Agro-based industry

It is no exaggeration to state that in Sri Lanka, little production has been made quantitatively or qualitatively in the Dry Zone which can be considered as the basis for the agro-based industry. However, along with the advancement of the development projects in the Dry Zone centering around the Mahaweli Projects, a great deal of potential resources for agro-based industry became expectable for further development. It can be stated that various industries of medium to small scales, such as those which operate on the basis of the industrial utilization of rice by-products as a result of the intensification of the production increase of the rice, the food industries utilizing food crops other than rice, and the cultivation of industrial crop, etc. have

become possible only with the development of the new projects.

However, the important point in the selection of the feasible industries is the proper selection of such industries in which the economic effect is significant or, to properly select such industries by the development of which the influential effects upon other sectors of industries will be significant.

From this point of view, those industries which fall under the above categories should be firstly selected on the preliminary basis and the specific fostering of such industries should be undertaken. This should be the way to effectively utilize the limited capital and technique.

During the initial stage of development, it would be inevitable, although it should be avoided as much as possible, that the limited types of industries will take a lead over the rest of the industrial fields, however, the important point here is that such leading industries will favourably influence the rest of the industrial fields, thereby pulling the rest along with the development. During the initial stage of industrial development in Japan, the sericulture which started as the side-jobs for farmers, eventually developed into the silk fibre textile industry and then gave rise to the development of the light machinery industry centering around spinning and weaving machinery. This Japanese example is one of the illustrative

cases to explain the above-mentioned point. From this point of view, the selection of feasible agro-based industries shall therefore be made. The cattle raising, chicken farming, fish cultivation, etc. should not be included within the category of agro-based industry as they are, but should be classified as belonging to "agriculture", however, these animal cultivation activities have close bearings upon the feed industries, food industries, etc. so that for the purpose of this paper, these activities will be included within the scope of agro-based industry.

2-1-1 Rice Milling

As has already been mentioned in VI-2-1-3, by the time of the completion of the development of the H and the IH areas, the yield of paddy of 252,000 to 324,000 tons and naturally the rice milling facilities to cope with this amount will be called for.

The MDB naturally took this factor into consideration when scrutinizing the projects concerned, however, the rice milling industry falls under the jurisdiction of the Paddy Marketing Board so that all the project planning, budgeting and implementation are being undertaken by this Board.

As has already been mentioned in V-2-2, the drying, storing, parboili

and milling of the yielded rice should be undertaken in an integral plant. The authorities are naturally advancing the projects along with this direction of establishing an integrated rice milling complex. According to the preliminary calculations made by the MDB, along with the proceedings of a project involving an integrated rice milling complex, having approximately 5t/h capacity of rice milling facilities, it would be necessary to construct approximately 5 to 8 units of integrated rice milling complexes, thereby calling for the necessary funds amounting to US$2,300,000 and Rs.3,100,000. If these projects are completed, the rice milling of 320 t/day will be possible so that together with the existing facilities, it would be possible to process the amount of paddy approximately equivalent to the above-mentioned paddy yield amount.

At the improved rice milling facilities, it is naturally possible to undertake the separation and collection of rice bran and, as will be explained later, such rice bran will be valuable as one of the oil producing resources. At the time of constructing the above-mentioned integrated rice milling complex the consideration concerning the processing and handling of rice bran and the utilization thereof should also be taken into consideration.

2-1-2 Oil Production

Of the agricultural products which are the objectives of Mahaweli

Project, there are several oil producing crops such as seed cotton, (from which cotton seeds are produced), soya beans, groundnuts, etc. Also, from paddy, which is one of the most important crops of the above-mentioned project, it is possible to extract rice bran oil. The last item is considered to be a high potential oil producing source. Although small in amount, sesame production is also projected from which oil production is expected. Therefore, along with the progress of the Project I, a good variety of oil producing raw materials will be lined up.

The demand for the oil products will increase along with the increment in the income of people. According to FAO data, the demand per capita for edible oil in Sri Lanka is as shown in Table VII-1. From this table, the demand amount for edible vegetable oil until 1985 is drawn as shown in Table VII-2.

If a supposition is made here that, on the basis of the pre-requisite conditions as described in V-2-3, the domestic demand increment portion can fulfilled by the supply of cotton seed oil, soya bean oil, groundnut oil etc., the demand for these oil products will be approximately 10,000 tons in 1975 and 22,000 tons by 1980 and, by 1985, the demand will increase to 39,000 tons.

In the Mahaweli Project, plans are laid out for the cultivation of such oil producing crops as seed cotton, soya beans, groundnuts,

etc. and eventually, it will become possible to extract oil from rice bran. Therefore, the oil production industry will be one of the items of feasible industries, the implementation possibility of which is the highest among the agro-based industry ..

Explanations concerning each item of the vegetable oil products are as follows.

1) Cotton Seed Oil

Cotton seeds are the remaining part of seed cotton after removing cotton lint. In the past, the cotton seeds were used directly as feed for domestic animals, however, nowadays, oil can be separated from them and it is generally practised that the residue after oil extraction is utilized as fodder. Generally, cotton seed consists of approximately 15% of crude cotton seed oil, approximately 40% of cotton seed residue and approximately another 40% of the rest of the components.

In Stage II of Project I of the Mahaweli Project, a production of 9,000 tons of seed cotton is scheduled. As cotton seeds constitute approximately 2/3 of seed cotton, the cotton seed amount will therefore be approximately 6,000 tons. If the oil is expelled by means of expellers (assuming that the remaining extent of oil in residue is 5%) approximately 720 tons of cotton

seed oil will be obtained.
Also in the case of employing the oil extraction method (assuming that the remaining oil in the residue being 1%), the oil yield will be approximately 840 tons.

For the extraction of the cotton seed oil, the pre-treatment facilities such as for the removal of calyces, etc., will be necessary so that the plant cost will be higher than in the case of soya beans or groundnuts. The operation will also be more involving than in the case of the other crops.

2) Soya Bean Oil

The projected yield of soya beans in Stage II of Project I of the Mahaweli Project is 5,200 tons.
The government is planning to utilize the yield in the following directions.

a) To be supplied as food directly or after processing
b) To produce soya bean milk and popularize it amongst people as a substitute for cow's milk.
c) To press the soya beans and separate it into oil and residue. The oil thus obtained is to be used as edible oil as a substitute for coconut oil and the residue will be used as high protein content feed in order to replace imported fish meal.

Normally soya beans contain 17% to 20% of oil, however, by means of the oil expelling method by employing expellers, approximately 5% of oil will remain unextracted inside residue so that efficiency is not quite high. In order to completely extract the oil, it is necessary to employ the solvent method. However, whichever method is taken, the soya bean residue will contain a high extent of protein and therefore it is valuable feed of high nutrition.

There is a report in which it is stated that the secretion of milk from cow will be higher when soya bean residue containing a certain amount of oil is fed as compared with other types of feed For chicken, the soya bean residue is especially recommendable as a substitute of fish meal or other animal feed .

If it is assumed that 2,000 tons out of 5,200 tons of planned yield is to be utilized as the oil production raw material, approximately 300 tons and approximately 350 tons of oil can be produced by means of the expelling method and solvent method respectively.

3) Groundnut Oil

The planned yield amount of groundnuts on Stage II of Project I of the Mahaweli project is 6,800 tons (4,000 tons in beans). At present in Sri Lanka, a small amount of groundnuts are being cultivated in family farms, etc., however, no systematic cultivation of groundnuts as the supply source of oil producing

material is yet undertaken.
Normally, groundnuts contain 45% to 52% of oil so that there are cases where groundnuts are cultivated as crops for extracting oil therefrom, however, due to the fact that groundnuts have an agreeable taste, they are directly used as food or often processed into groundnut butter which is also used as food.

As the oil content in groundnuts is high, considerably high efficiency can be realized in extracting oil even if the expelling method by means of expellers is employed. If 3,000 tons out of the planned yield is utilized as oil extracting raw material, approximately 1,200 tons and approximately 1,350 tons of oil will be obtainable by means of the expeller method and the solvent method respectively. Groundnut oil possesses a unique aroma and has an agreeable taste when used as edible oil. The residue produced after the oil extraction has almost the same extent of value as the soya bean residue when used as feed for cows and pigs, however, it is reported that when used as feed for chicken, the groundnut residue is somewhat inferior to the soya bean residue in performance.

4) Rice Bran Oil

Rice bran is the largest potential resource of edible oil amongst the items taken up by the Mahaweli Project.
The planned yield of paddy at the completion of Stage II

of Project I of the Mahaweli Project attains as much as 324,000 tons. The amount of rice bran which can be obtained when completely milling this yield can be obtained as follows:

Rice bran amount=324,000 tons x a x b=20,000 tons

Where, a=0.7 --- yield of unpolished rice from paddy

b=0.09 --- yield of rice bran from unpolished rice

It is difficult to utilize the total amount of the rice bran thus obtained for oil production. Even in Japan where the production of rice bran oil is highly popularized, approximately one-half of the total rice bran yield is being used for the extraction of oil. Therefore, at the time of the completion of Stage II, the total amount of rice bran which can be utilized as the resource for the production of oil in this area will be merely 10,000 tons.

Generally, rice bran contains approximately 15 to 19% of oil. If extraction of oil is undertaken, approximately 1,700 tons of oil will be obtained. However, actually in Sri Lanka at present, the conditions for the immediate extraction of rice bran oil is not yet substantiated. The reasons for this conclusion are as follows.

a) As has been already stated in the "Rice Milling" (V-2-2), almost no bran will be by-produced if the presently undertaken

rice milling method is adopted.

b) Highly versatile rice milling methods are being employed and small scale rice milling enterprises are scattered over wide areas so that it is difficult to collect rice bran in standardized quality. The purpose of collecting rice bran is to obtain high quality edible oil so that it would be economically meaningless to conduct oil extraction operation by using raw material bran which has considerably been affected by oxidation.

c) Due to the nature of rice bran, it is not possible to obtain oil by means of expelling so that the solvent method must be employed. However, in order to conduct an economical solvent method operation, large scale plant facilities will be called for. In Japan, it is an accepted fact that, in order to produce rice bran oil on an economically payable basis, a minimum bran processing amount of 20 tons per day on a continuous operation is absolutely necessary.

5) Castor Oil

Castor oil is an important vegetable oil product for medical use. It is also used for cosmetic industry raw materials. The industrial application scope of castor oil is also wide. At present in Sri Lanka, the total supply of required castor oil is entirely dependant upon import. The amount of such importation

is as already explained. According to a forecast compiled by the Department of Ayurveda, the future demand for castor oil will attain 200 tons. The Ministry of Industries and Scientific Affairs is now planning a project for the construction of three plants, each having 75 ton/year of extraction capacity in order to realize self-sufficiency in the supply of castor oil. The wild castors are growing all over the Dry Zone of Sri Lanka. The Department of Agriculture recommends the "Hazeera" type castor for cultivation. The features of this type are that it contains a high extent of oil and also that the seeds do not pop during growth. According to the cultivation tests conducted in Dry Zone concerning this type, it has been shown as a result that they grows sufficiently even in poor soil as a rainfed crop.

The districts which the government selected as being the most suitable for the cultivation of castors for the future are Puttalam, Anuradhapura, Hambantota, Kurnegara, etc. and the Mahaweli Project areas are not included within the selection. If there are any suitable lands for the cultivation of castors inside the Mahaweli Project areas, it is considered that the oil extraction from castor beans is suitable as one of the small-scale industries to be fostered within the areas.

As castor seeds contains 45% to 50% of oil, approximately 0.45 ton of castor oil can be industrially produced from 1 ton of

seeds. Therefore, if a supposition is made that one-third of the total demand for castor oil in Sri Lanka is to be self-sufficiently supplied, the necessary seed amount will be approximately 150 tons. If it is estimated that the cultivation area required for yielding 1 ton of seed is 0.8 ha., the necessary seed amount will be obtained by undertaking cultivation covering approximately 120 ha. If the self-supply project succeeds, contribution for the savings of foreign exchange will be possible.

Internationally, the castor oil demand is exceeding the supply so that if the cultivation of castors within the Dry Zone succeeds economically, this project can also be fully expected to become one of the export-oriented crop production.

As has been discussed in the foregoing paragraphs , it can be expected, at the time of completion of Stage II of Project I, at least approximately 2,200 tons of liquid vegetable oil production can be expected, consisting of more than 720 tons of cotton seed oil, more than 300 tons of soya bean oil and more than 1,200 tons of groundnut oil. Therefore, it signifies that by 1980, approximately 10% of the oil demand of 22,000 tons, which must be fulfilled by oil products other than coconut oil, will be satisfied.

Further, if the production of rice bran oil becomes possible

thereafter, the vegetable oil production may very well exceed the level of demand. As to the oil extraction facilities, it is expected that, for the time being, the expelling method by means of expellers will be adopted. The reason for assuming this is that, by means of this method, the fixed investment will be kept comparatively low and, at the same time, that the adoption of this method will well meet the economical environment of the area during the period.

2-1-3 Feed Production

There are a number of items amongst the agricultural products within the scope of the Mahaweli Project which can be utilized as feed. Such crops as maize, soya beans, groundnuts, and others as manioc, rice bran, etc. are extremely important as feed materials. Also, the residue produced after extraction of oil from soya beans, groundnuts, cotton seeds, and rice bran will also be valuable as feed.

The molasses which is by-produced from sugar production will be suitable as fodder for domestic animals in general and for cows in particular. The dry chrysalis which are the by-products of sericulture is highly suitable as feed for fish cultivation. It is expected to be extremely feasible and potential as the cottage industry for farmers to catch miscellaneous fish growing inside the tanks or waterways within the Mahaweli Project Area and to produce dried fishmeal to utilize as an effective feed for

chicken raising or fish cultivation as a substitute for the imported fishmeal.

(1) Amounts of Imports and Exports

According to the Ceylon Customs Returns, the trend of the import amount of feed is as shown in Table VII-3. The total amount as of 1969 was 5,000 tons including both animal and vegetable feed. Up to 1964, the importation was made for the vegetable feed alone, however the animal feed began to be imported since 1965 onward. The importation of animal feed has since exceeded the importation of vegetable feed (In 1969, 59% was comprised by animal feed while 41% by vegetable feed).

On the other hand, the export trend has been as shown in Table VII-4 in which it is evident that the exportation amount was on a considerably high level from 1961 up to 1965, however, from 1966 onward, the amount is reduced to an extremely low level of approximately 200 tons.

(2) Production amount

The trend of the production amount of feed is as shown in Table VII-5. The amount is approximately 90,000 tons since 1968.

(3) Price

The average import price levels were calculated on the basis of the Ceylon Customs Returns for 1969 regarding the animal feed and vegetable feed and the results were Rs.794/ton, Rs.647 Rs/ton, respectively.

(4) The feasibility of industrialization

At present, Sri Lanka is not able to fulfill the demand for feed by importation due to the foreign exchange situation so that the instances of animal raising and chicken farming are being forced to reduce. In order to control the reduction and to carry out satisfactory production of milk, meat and eggs, all of which are valuable sources of nuturition for the people, it is extremely important to secure stable supply source of feed. It should be possible to contribute to the saving of the foreign exchange through import substitution as well as to the significant advancement of cattle raising, chicken farming and fish cultivation industries in Sri Lanka, if integrated feed production plans are laid out and implemented by also covering such feed materials as residue produced from the coconut oil production undertaken outside the Mahaweli Project area, in addition to the above-mentioned feed materials which are to be produced inside the project area.

As the form of the feed production operations, classifications can be made into two categories, i.e., comparatively large-scale blended-feed producing organization such as the Oils and Fats

Corporation, and the small-scale enterprizes handling single item such as rice bran, or producing fishmeal, etc.

2-1-4 Farming and Cultivation

If the supply system of feed is substantiated as mentioned in the foregoing, the following farming and cultivation industries will be possible.

a) Cows, pigs and goats

b) Chicken and ducks

c) Fish cultivation

At present, Sri Lanka is importing a large amount of milk products, processed meat products, eggs, salted or dried fish, etc. Therefore, import substitution by means of the above-mentioned farming and cultivation will greatly contribute to the saving of foreign exchange. Also, as most of these production activities can be undertaken by farmers and their cooperatives, the side-job income of the farmers will be increased, thereby helping the farmers' economy. Further, the present status of nuturition of the people of Sri Lanka is not fully satisfactory. It therefore seems necessary that a much higher amount of proteinic nutrition, especially animal protein, is required. Due to the religious backgrounds, people are not accustomed to consume meat products made from cows, pigs and goats. The raising of cows for food production is mainly undertaken for the purpose of milking. As far as the cow raising is concerned, the Mahaweli Project

area is not favourable in view of the land conditions as compared with the other higher-elevation areas where the cow raising could be much better undertaken. Therefore, in the Mahaweli Project areas, not too high an expectation should be made regarding the raising of milk cows. The government is planning to encourage the cultivation of soya bean for the production of soya bean milk in order to substitute the cow milk, however, in view of the traditions and customs in the eating habits of the people, it is not expected that the soya bean milk will be readily accepted.

According to a report submitted by the Living Standard Improvement Survey Team regarding the Dewahuwa area (FAO, 1972), the order of preference given by the farmers residing in the said area to the protein source foods was as follows:

Chicken eggs, unprocessed fish, chicken meat, soya bean, milk, beef, duck meat, duck eggs, goat meat and goat milk.

As is evident from the above survey results, chicken eggs, the unprocessed fish takes up the first, the second place in the order of preference. This particular item is well accepted by the farmers as the animal protein source food without having religious complications. In the Living Standard Improvement Survey conducted by FAO in 1969 concerning the Walgampara Village, 40% of the total village population was said to have been consuming animal protein every

day. For the most part, the animal protein foods consisted of fish. 30% said that they eat fish every two to three days or once a week and another 30% said they do once a month or once in a great while.

Also, there was no farmer who reported that they eat meat or eggs every day. Approximately 30% replied that they eat meat and/or eggs every two to three days or once a week. More than 70% of the whole village population said that they eat meat and/or eggs once a month or once in a great while.

As far as the consumption situation of animal protein is concerned in this report, not only the consumption is low in frequency, but the absolute amount of the consumption was also extremely small. As is evident from the above survey results, the farming and cultivation to be conducted inside the Mahaweli Project areas for the increment in the supply of protein type foods should be carried out with a special emphasis upon at least for the time being, chicken farming and fish cultivation.

Regarding the fish cultivation in particular, it must be noted that, of the Mahaweli Project H and IH areas, 2,230 ha. in Stage I areas and 4,000 ha. in Stage II areas will be occupied by tanks and waterways connecting the tanks, so that the

conditions for the cultivation of fresh water fish are readily and highly favourably available.

2-1-5 Production of starch and derivatives thereof.

The major direction of use of starch and the derivatives thereof are as follows:

a) Starch and millet jelly as the raw materials for food industry
b) Sizing materials for weaving or finishing in the textile industry
c) Sizing materials in paper manufacturing industry
d) Starch for laundry
e) As adhesives in the form of dextrin
f) As raw materials for glucose and alcohol

It is expected that in the future in Sri Lanka, the development of paper and textile industries will be undertaken and that stage, the demand for starch will keenly increase. The self-sufficient supply of starch and the derivatives thereof will not only contribute greatly to the saving of foreign exchange but also will display an extremely conspicuous influence to the other sectors of industries. Therefore, it is recommended that substantiation of this industry be undertaken as soon as possible.

The presently operating plants as well as the plants now under contemplation are all extremely small in size so that the productivity is low and therefore not capable of coping with the demands in which high level of quality is required.
Apart from these samall-scale plants, it is desirable that a middle scale modern plant of approximately 10-ton-per-day capacity be constructed to play the leading role in this industry. In such an event, it is desirable that the plant not only undertake the production of starch but also the processing of the derivatives of starch.
The major resources for producing starch are manioc and maize. The utilization of maize as the raw materials for the production of starch has been undertaken mainly in the U.S.A., however, the production process in this case is highly complex and therefore, it is more advantageous for manioc producing countries to use this material as the starch raw materials.

2-1-6 Sugar Production

According to FAO, a long-term forecast of sugar demand in Sri Lanka is 24.9 kg/capita/year in 1975, 26.8 kg/capita/year in 1980. Further, regarding 1985, the Survey Team calculated the forecast figure as being 28.7 kg/capita/year. The total demand amount will be 345,000 tons in 1975, 412,000 tons in 1980 and 490,000 tons in 1985.

According to the Five Year Plan, it is projected that the production capacity, which was 8,000 tons in 1970 should be increased in 50,000 tons by 1976, however, even if the production of sugar is carried out in accordance with this Plan, the gap between the demand and production will further widen. From this viewpoint, an immediate improvement in the production technique and the enhancement of the production capacity are necessary.
In the project area (D area), it has been duly planned that the sugar cane cultivation area will amount to approximately 6,000 ha. at the time of completion of Stage III. Thus, if it is possible that the cultivation technique of sugar canes and the production technique of cane sugar are improved to such an extent that the sugar production of 6.25 ton/ha. is possible, the production amount in this area would be 37,500 tons. In such an event, either the expansion of the facilities at the presently existing Kantalai Factory or the construction of a new factory would be required, however, the target for the time being (up to around 1980) should be the improvement of the production technique so that Kantalai Factory can be fully operated.

2-1-7 Straw Utilizing Industry

Approximately 2.5 to 3 tons of straw will be by-produced from every 1 ha. of rice yield so that the total amount of straw produced nationwide will be enormous. The effective utilization

of straw has been the common task for all the rice producing countries of the world.
Following are the presently undertaken straw utilization directions.

1) Straw board

Straw can used as one of the raw materials for producing boards. The IDB is now planning to establish and foster middle and small scale enterprises for the production of boards for the substitution of the presently imported boards.
The content of the plan does not seem to turn out sufficient quality board, however, if the products thus made actually replace the importation of the board and fill up the demands for the time being, it can be deemed that the straw in this direction will be effectively utilized.

2) Straw ropes, straw mats, and straw bags

In Japan, straw ropes, straw mats and straw bags and sacks are widely utilized. Recently, the production of these items has become a significant activity as one of the cottage industries for farmers.
In Sri Lanka, wide utilization of coir is undertaken for manufacturing ropes and mats, however, coir is not suitable for making bags. At present, the storage and transportation of grains and other industrial products are being undertaken by

using jute bags which are entirely imported. Along with the development inside Sri Lanka of the agricultural and industrial production in the future, the demands for such bags will continue to increase.

Therefore, the realization of self-sufficiency in the supply of these bags is extremely important in view also of the necessity for the saving of foreign exchange. It is desirable that the straw bag, which could be made as one of the side-jobs for the farmers as now being undertaken in Japan, could be utilized for this purpose.

However, in order to obtain good quality straw bags, straw having long stem and high flexibility will be called for so that it is a subject of further studies as to whether or not the quality of straw produced in Sri Lanka can meet such quality requirements. Further in Sri Lanka, it is planned that the cultivation of kenaf is to be developed as one of the crops for Dry Zone. As kenaf possesses a better character than straw as a substitute for jute bags, if the cultivation and processing of this material can be undertaken economically, the significance in introducing straw bags would have to be reduced.

3) Straw Paper

Utilization of straw as a raw material for the production of paper has long been undertaken in many countries, however, straw is not a suitable raw material for paper. So far, therefore,

only low grade paper has been produced by using straw as the raw material. As straw materials are of short fibres, it is necessary to blend more than 30% of long fibre materials in order to turn out good quality paper. It must be noted with appreciation here, however, that in Sri Lanka, paper manufacturing industry is now operating by using straw as the main material for making paper products, thereby playing the role of import substitution. However, as short fibre woods and pulp resources are available in Sri Lanka, the further utilization of these resources should rather be developed.

Internationally, the extent of utilization of straw as a raw material for paper production has been decreasing, however, the pulp resources themselves are presenting shortage problems increasingly in the recent years. Therefore, the evaluation of straw as the raw material for low grade paper is now being made. In Japan, straw as the paper raw material consists not only of the virgin straw but also includes the re-utilization straw which has already been used once as bags.

2-1-8 Processing of vegetables and fruit

Along with the development of Dry Zone, the vegetables and fruit produced in this area can be utilized and it will be possible to establish cottage industry or small scale enterprises

for processing of such materials. Some examples in this direction are as follows:

(1) Paste

By making the manioc starch as the main component, flour paste can be made by blending sugar, oil, milk products, eggs, etc. together and by treating it through heating and mixing. It is also possible to establish a cottage industry for the production of peanut butter by grinding groundnuts and by adding sugar, seasonings and suitable oil fats.

(2) Worcestershire sauce

Production of Worcestershire sauce by blending onion, tomato and other vegetables, fruit, various spices and seasonings is also an attractive field of cottage industry.

(3) Jam, marmalade, etc.

Production of jam and marmalade by using pectine-rich fruit is for the production of the so-called new foods, the demand for which should gradually expand in the future. Therefore, the production of these items can be considered as one of the items of cottage industries.

(4) Canned fruit

There is a project for producing canned pineapples, mangos,

passionfruit, etc. which are produced in Dry Zone for export. Although the basic idea of this project is acceptable, the production amount of fruit is actually too low for such a project. If a small amount of fruit is to be canned, it will come in direct competition with the consumption demand for fresh fruit so that no stable canned fruit production will be possible. Therefore, industrialization of canned food is possible only when the production of fruit exceeds the consumption.

2-1-9 Cotton

It may be stated with assurance that cotton will be playing the central role even in the future textile industry. Due to the climate and soil conditions, the production in Sri Lanka is inevitably limited to the middle grade cotton. The production of this item for Sri Lanka is not only display an effect of foreign exchange saving by the import substitution, but also will exert a strong effect in the expansion of employment opportunity.

(1) Export and Import Amounts

It would be highly time consuming to try to derive an accurate trend from the Ceylon Customs Returns on the raw-material-wise textile importation. Therefore, on the basis of the per capita raw-material-wise textile consumption amount compiled by FAO, the estimated consumption amounts were obtained by utilizing

the population statistics for each year, thereby compiling the Attached Table VII-1. These estimated import amounts were obtained by converting all the raw materials, intermediate products and final products into the raw material basis. The textile consumption can be expressed in terms of "textile production amount" plus "textile importation amount" minus "textile exportation amount", however, in the case of Sri Lanka, the textile production is chiefly comprised by coir and kapok fibres and also the textile exportation is also mainly constituted by the raw materials or the products from these items. Therefore, the textile consumption amount was directly interpreted as the textile importation amount. Fig. VII-1 shows the trend of the estimated importation amounts in accordance with the raw materials employed.

In the case of cotton, a slight downtrend is noted from 1965 onward. (There is an obvious uptrend for synthetic fibres and regenerated fibres.) Further, Table VII-6 shows the consumption amount of cotton as the spinning raw materials in which it is shown that the approximate yearly consumption is 2,200 tons. To make sure, the cotton yarn production amount was also added to this table. It should be noted here that there is a good correlation between the cotton consumption trend and cotton yarn production trend.

(2) Production amount

The cotton cultivation on the basis of rain water is being undertaken in Hambantota district, however, the production amount from the operation is comparatively small as shown in the attached table VII-2. The production amount merely fulfills 0.3% or less than 0.3% of the total cotton consumption amount. Incidentally, the ginning of this seed cotton is being undertaken by Wellawatte Spinning and Weaving Mills in Colombo.

(3) Future consumption amount

Generally speaking, there are three available methods for compiling demand forecast, i.e., the time series method, the correlation method and the cross section method. In the case of Sri Lanka the statistic data is considerably substantiated, however, due to the problem pertaining to the foreign exchange balance, there are frequent cases of irregularity in the past regarding the textile consumption amount and the import and export amount. Therefore, the time series method or the correlation method which take the basis upon these data will involve a number of problems in compiling the demand forecast. Therefore, in this report, the cross section method was employed. In this method, the forecast is made on the basis of the present situation in Sri Lanka and also on the actual examples of achievements in other countries. Further, the consumption amount of cotton was obtained by subtracting the consumption amounts of synthetic fibre and rayon fibre from the total textile consumption amount.

a) Total textile consumption amount

Fig. VII-2 shows the plotting of the relationship between GDP per capita and the textile consumption amount per capita on the basis of FAO data regarding 68 developing countries whose GDP per capita for the year 1970 was less than US$500.

Of the 68 countries, the regression formula was obtained as follows after excluding 10 countries which are considerably deviated from the over-all distribution:

$$\log y = -1.663 + 0.901 \log x \quad (r=0.80)$$

Where, y= per capita textile consumption amount (kg/capita/year), x= GDP per capita (US$ per capita per year)

The per capita textile consumption amount in Sri Lanka shows, as is clear from Fig. VII-2, a good correlation with the regression line. If the textile consumption amount in Sri Lanka is obtained by means of the regression formula for the years 1975, 1980, and 1985, the amount is 2.30 kg, 2.61 kg, and 3.02 kg., respectively. The consumption amount in 1985 is 1.5 times that of 1970 and this figure can be deemed as a possible figure whatever the actual contents of the consumption may be.

b) Synthetic fibre consumption amount

Synthetic fibre is the material which particularly

hows a specific increment in the so-called developing countries as far as the raw material-wise breakdown of the total textile consumption is concerned. Here, in order to forecast the growth extent of the synthetic fibre rate, (the weight percent of the synthetic fibre consumption amount comprised in the total textile consumption amount) and the maximum attainable synthetic fibre rate in Sri Lanka in the future, the trend of the synthetic fibre rates in the past in other countries where the present synthetic fibre rate has comparatively been advanced are shown in Fig. VII-3.

In the case of Thailand, the Philippines and Taiwan, the synthetic fibre rate was approximately 10% in 1964, however, 6 years later, in 1970, they all displayed a level of 30%-35% where the growth of the rate is almost saturated. In Japan, the synthetic fibre rate jumped from 10% to 30% acutely during the 7-year period from 1959 to 1966.

This implies that it takes 6-7 years at the quickest for synthetic fibre to completely penetrate the market from the time of introduction until the recognition of the merits of synthetic fibre are recognized by the market in which natural and regenerated fibre have thus far been employed. The synthetic fibre rate of Sri Lanka at present is 10 - 15% and, amongst the consumers, the merits and advantages of synthetic fibre products are being recognized and acknowledged to a certain extent.

However, due partly to the foreign reserve situation, it is not expected that the consumption of synthetic fibre will suddenly increase. Therefore, an assumption is made that the synthetic fibre rate will be maintained on the level of 10% until 1975, and that in 1980 the rate will be on the 20% level, and 35% by 1985. In other words, the synthetic fibre consumption amount per head for these years is forecasted to be 0.23 kg, 0.52 kg. and 1.06 kg respectively.

c) Rayon consumption amount

The consumption amount of rayon displays a considerable extent of difference among countries, and, there is no significant correlation between the rayon consumption amount and the GDP per capita, unlike the case of synthetic fibre. The world-wide trend of the consumption amount per capita of rayon is shown in Fig. VII-4. The trend implies the consumption amount per capita is almost on a plateau. The price is now showing an uptrend, and this tendency is considered to persist in view of the increment in the raw material wood cost and labor cost as well as the increase in the production cost caused by the pollution countermeasure.

Technically speaking, if rayon is considered as being a fibrous raw material for producing clothing, the advantages would not be very high if 100% utilization of rayon is undertaken. From this viewpoint, the blending with polyester staple is one of the

sectors where rayon will absolutely be required. The required amount of rayon in such a case will be approximately as low as 3% of the total textile consumption amount, even when at the point where the synthetic fibre rate attained a level of 35%. Therefore, comparatively small amount of rayon will be sufficient even when the necessity for rayon is felt in a country where no rayon has ever been consumed, however, the rayon became necessary along with the advancement of the synthetic fibre rate. Thus, it is assumed that in the contries where the utilization of rayon is undertaken, a certain extent of rayon consumption level will be maintained without conspicuous fluctuation because of the fact that for these countries, the utilization of rayon is the practice to which they are accustomed. By taking the above points as the prerequisite conditions, and, by assuming that the rayon consumption amount will be on the same level as it was in 1970, the figure 0.3 kg per capita per year was adopted.

d) Cotton consumption amount

The consumption amount of cotton is forecasted as shown in Table VII-7 where the per capita consumption in 1975 and 1980 are 1.77 kg and 1.79 kg respectively and in the year 1985 the figure is reduced to 1.66 kg. The reason for the reduction is that it is assumed, as above mentioned, that the synthetic fibre rate will have been advanced by then.

(4) Price of Cotton

Fig. VII-5 shows the cotton import price (CIF Colombo) trend obtained from the Ceylon Customs Returns. The price in 1969 was Rs.8.4/kg, however, it must be noted here that for the most part the importation consisted of the high priced Egyptian cotton. The survey at the time of the visiting mills revealed that the Sudan cotton was Rs.5.8/kg and Egyptian cotton was Rs.8.6/kg. Further, the domestically produced cotton turned out in Hambantota district was revealed to be at Rs.5.0/kg.

(5) Government policy

As is clearly shown in the Five Year Plan, the government is placing particular emphasis on the production of cotton. It is aspired in the Plan that a yield of 18,000 tons of seed cotton should be achieved in 1976 when the Plan has been completed. It is planned that the cotton production is to be undertaken in the Uda Walawe area by irrigation.
The Plan was scheduled to begin in 1972, however, at present the work is one year behind schedule. This cotton production is intended to substitute imports and it is planned that approximately 28% of the domestic demand will be covered by 1976. In addition, the cotton cultivation programme is also laid out for the Mahaweli Project areas, the subject of the present survey.

(6) Industrialization Feasibility

Fig. VII-6 indicates the cotton consumption per capita data which have been calculated on the basis of the total cotton production amount and the population figures of the world. As is evident from the figure, the per capita consumption is clearly diminishing. However, cotton will without a doubt continue to play a major role in the textile industry in the future. The cultivation of cotton is difficult unless the climatic and soil conditions are suitable and unless labour is abundant and comparatively low in cost. At present, the cotton production in the U.S.A. is decreasing while in Central and South America and in Africa, the production is showing an increment. If the irrigation is completed for the Mahaweli Project area, the lands are suitable for cotton production, and in view of the present production situation of the world, the government's cotton policy is deemed appropriate. The future cotton consumption amount in Sri Lanka, production schedule in the Uda Walawe areas. (As the plan is one year behind schedule, the commencement is in 1973. The seed cotton production in 1977 will be 18,000 tons, and in 1975 it is presumed to be on the level of 9,000 tons. The schedule thereafter has not been disclosed so that the production amounts for 1980 and 1985 are assumed to be on the same level as the figures scheduled for 1977) . and the production schedule set for the Maharveli Project area are shown in the Fig. VII-7.

The plan for the Mahaweli area is to start in 1976 and the production will be 9,000 tons of seed cotton in 1980. By 1985 the seed cotton production is assumed to become 11,400 tons since by that year the cotton importation amount should be suppressed to the level of 1980.
The yield of cotton from seed cotton is taken as 1/3. Also, the cost for constructing a cotton ginning mill is, according to the feasibility studies conducted by the MDB, US$0.3 million (Rs 1.79 million, however, seed cotton production is assumed to be at the level of 12,000 tons). If the expansion of the cotton ginning mill is made along with the increment in the production amount, the investment will be comparatively low so that the construction of the ginning mill and production of cotton should be considered to be the projects to be studied within the scope of the Mahaweli Industrialization Project.

2-1-10 Silk yarn

Regarding sericulture, the Sericulture Research Center was established in Pallakelle in 1971 and at present, studies and researches are being undertaken regarding mulberry cultivation technique and species of the silkworm. The main objective of this organization is the acquirement of foreign reserve by means of exportation of raw silk.

(1) Exportation and Importation Amount

As mentioned earlier, the importation amount of silk items in 1969 was obtained in terms of raw material on the basis of the Ceylon Customs Returns. The result is 29 tons which occupies 0.1% of the total imports. However, the present import amount is estimated to be extremely small. The exportation on the other hand consists of an extremely small amount of Batik alone.

(2) Production Amount

No production is being undertaken at present, however, the cocoons recently produced at the Sericulture Research Center were made into dried cocoons in the amount of 0.9 tons and were sent to Japan. The reeling characteristics and yarn quality level are being evaluated.

(3) Supply/Demand Equilibrium in the world

The trend of raw silk production amount and the per capita raw silk consumption amounts since 1960 are shown in the Attached Fig VII-1. The per capita consumption amount trend has attained a plateau on the level of 10 to 11 grammes. The Attached Table VII-3 stipulates the cocoon production amount, raw silk production amount and the reeling yield from cocoon of several countries of the world. The raw silk production achieved in Japan comprises 50% of the world total and People's Republic of China takes up slightly over 1/4 of the total world production.

Although the details are not to be covered in this report,

the raw silk production in China, Republic of Korea, India, Korea (North) and Brazil are showing uptrend and Italy is showing a vast decrease. Japan also is showing a downtrend in the production of raw silk. The raw silk production is growing in those countries where labour forces are abundant and labour cost is comparatively low. The consumption of raw silk by Japan, on the other hand, takes up almost 60% of the world total thereby forming the world's centre of the raw silk consumption (raw silk consumption of Europe and America together and China is 14% respectively, while the USSR 7% and India 4%). The production of raw silk has been suppressed by the sudden increase in the production of synthetic fibres. However, along with the advancement in the income level in the recent years, the consumer's interest is being returned to silk material as a high class commodity. Further, even with the highly developed techniques of the recent synthetic fibre production, there still are several points of the unique silk characters which synthetic fibres simply cannot attain. These points will be extremely difficult to attain even in the future. Therefore, although no vast increment in the demand is expected of raw silk, in view of the stagnation in the growth of production amount, it is forecasted that the supply/demand balance of this material will continue to be tight.

(4) Price

As Japan is the world's centre of raw silk consumption and also in view of the fact that Sri Lanka is aiming at the exportation of this item, the trend of raw silk prices was obtained regarding the spot goods at the Yokohama Silk Exchange. The results are shown in Fig. VII-8. Concerning the dried cocoons the quotations at the Maebashi Exchange are also stipulated. All the prices are the average from January to July, regarding the year 1972. Due to the fact that the raw silk is a high class commodity, it is highly vulnerable to the fluctuation of the general market conditions. Due to the fact that this commodity is traded on the market, the riggers are prone to come into the market trend, thereby making the amplitude of fluctuation wide.

(5) Government Policy

According to the Five-Year Plan, it is scheduled that 48 tons of raw silk production will be attained by 1976 and investment of Rs 40 million is planned for the period of 1972 to 1976. As mentioned earlier, the government established the Sericulture Research Center where serious research and pilot tests are being undertaken.

(6) Industrialization Feasibility

The level of technique covering the whole process from mulberry cultivation through sericulture up to reeling will clearly manifest itself in terms of the degree of silk yarn

yield rate from cocoons. This rate is affected by four major factors, i.e., the quality or species of mulberry, species of silkworm, silkworm rearing method and the reeling method. As shown in the attached Table VII-3, the yield rates in the advanced silk industry countries such as Italy and Japan, are extremely high, however, in the cases of China, the USSR and India, the rate is less than 10%. The world average rate is 11.6%.

As a result of a visit made to the Sericulture Research Center, it was reported that the yield rate achieved at the institution was 12.5% and, it was also revealed that the silk waste rate was 6.3%. Although this yield rate exceeds the world average, it must be noted that this rate will be considerably decreased in the case of actual commercial production in view of the fact that the present high rate was obtained on the basis of a hand-made model reeling machine at low reeling speed.

In other words, the evaluation of reelability of the material by mass production machines is not as yet finalized. Therefore, no technical feasibility forecast in this respect has been established. Also, as mentioned above, the climate in this area is not suitable for sericulture. Therefore, at the present stage, it seems too early to incorporate sericulture into the industrialization plans for the H area of the Mahaweli project. However, in view of the fact that the supply and demand relationship for raw silk is expected to remain tight in the future, as has been mentioned earlier, and that sericulture is one of the typically labour-intensive industries and will require a low extent of foreign reserve, this operation is considered to be suitable for the economic situations of Sri Lanka. Therefore, it is desired that this subject be reinvestigated when the technical feasibility is confirmed. Further, a large amount of investment will be required for the installation of reeling facilities. It is therefore advisable to export dried cocoons during the early stage of sericulture industrialization.

2-1-11 Bag Manufacturing Industry

(1) Kenaf bags

Kenaf is one of the traditional farm products in the Dry Zone. Sunhemp is also one of the crops which can be cultivated in the Dry Zone. Although used in many different ways, they are

mostly consumed as raw materials for making bags. Especially kenaf is widely known as a substitute for jute. At present Sri Lanka imports jute bags for use as containers of rice, seed cotton, etc. Therefore, the possibility of substitution of jute by kenaf will be investigated. Due to the fact that no sufficient prospect for the future production of sunhemp is available at present and also that the government is presently planning to cultivate this item merely on an experimental basis, kenaf alone will be taken as the subject of discussion here.

a) Exportation and Importation Amounts

According to the Ceylon Customs Returns, the importation quantity value of jute bags has been showing a trend as shown in Fig. VII-9.

The importation of the jute bags, as shown in the figure, showed a drastic increase since 1968 so that in 1969, the amount attained 134 million bags, totalling Rs.2.4 million Incidentally no exportation of this items has ever been undertaken.

b) Production amount

At present no jute bag is being produced in Sri Lanka and the entire amount is imported.

c) Future Demand Amount

Jute bags are suitable for containing paddy, milled rice, seed cotton, cotton lint, cotton seeds, etc. and this material is also used widely in other countries. As has been mentioned above, the government of Sri Lanka is now placing particular emphasis upon the production increment of rice and cotton so that in the H and IH areas of Mahaweli project alone, the plant production is as shown in Table VII-8. Taking these production figures as the pre-requisite condition, the required amount of jute (in terms of woven fabric weight) will be roughly calculated as shown in Table VII-9, where an assumption is made that milled rice will be contained in 40 kg. package, seed cotton and cotton seeds will be in 50 kg. package and cotton will be in a 220 kg.package.

d) Price

The Ceylon Customs Returns were taken as the basis for calculating the unit price of jute bags. The result of calculation indicates a fair extent of fluctuation depending on the years, however, in 1969, the unit price was approximately Rs.1.7.

e) Government Policy

The cultivation of kenaf has been taken up as one of the subjects of the Five Year Plan and the target is set to effect

by 1976 the substitution of the imported jute bags by 50 to 60% along with the substitution of the long fibre importation. (approximately 5,500 ha. of lands are scheduled for the cultivation of kenaf)

f) Possibility of industrialization

In order to manufacture kenaf bags, it is necessary to firstly spin kenaf yarns and then to weave the yarns into fabric. In order to carry out the spinning of kenaf the spinning machine which is uniquely designed for jute spinning will also be required. For the weaving operation, the circular looms or shuttleless looms (Rapier type) are widely employed. At present in Sri Lanka, the available machines are all for the cotton spinning, cotton weaving and for synthetic filament weaving. Therefore, if spinning and weaving machines for treating kenaf materials are to be installed newly in order to cope with the total demand expected to be generated for instance in 1980, approximately Rs.22 million of investment will be required merely for the machine cost, even if the conventionally employed jute spinning and weaving machines are also utilized altogether. Also, if 6,000 spl. which is considered to be the economic unit in the case of hard and fast fibre spinning, are to be installed and then corresponding extent of weaving facilities are equipped, the machine cost alone will call for approximately Rs.14 million. Even so, merely approximately 65% of the total demand will be covered.

Further, a rough calculation of the production cost of the kenaf bags to be produced by the facilities reveals that the price of such kenaf bags will become more expensive than presently imported jute bags. Thus, in order to newly install kenaf spinning and weaving facilities, an extremely large amount of investment is required. Further, there is little advantage in view of the price aspect of such an operation.

This being the circumstances, it seems that, in view of foreign exchange situation of Sri Lanka, the industrialization of kenaf bag manufacturing is difficult. It is rather recommended that rice straw which will be by-produced in great quantity from the cultivation of paddy be effectively utilized to produce bags to contain paddy and milled rice. It is therefore considered more advantageous to limit the utilization of imported jute bags for containing seed cotton and cotton.

(2) Straw Bags

As mentioned above, the production of kenaf bags to substitute the presently imported jute bags for containing paddy and milledi rice would not be advantageous in view of the necessity for a large extent of investment and comparatively high production cost for spinning and weaving. Therefore, consideration will be given here to the possibility of manufacturing bags from rice straw materials.

a) Future Demand Amount

As has shown in Table VII-8 regarding kenaf : the production amount of paddy and milled rice in Mahaweli project H and IH ; areas will be 252,000 tons and 176,000 tons, respectively, in the year 1980.

If both paddy and milled rice are to be contained in 40 kg. bags respectively, the quantity of straw bags required and the quantity of straw material to produce the straw bags will be as shown in Table VII-10. However, the assumption is made here that the quantity of straw required for making one straw bag will be 3.3 kgs. in the case of paddy bags and, 3.0 kgs. in the case of milled rice bags by taking into consideration the waste during production.

b) Possibility of industrialization

Generally speaking, in the cultivation of rice, 70 parts of milled rice and 80 parts of straw will be produced against 100 parts of paddy. Therefore, the rate of the straw required for bag making as against the straw obtainable as the by-product will be as follows:

Amount of by-produced straw: 80 parts

Amount of straw required for paddy containing bags: 100 x 3.3/40 8.3 parts

Amount of straw required for milled rice containing bags 70 x 3/40 5.3 parts

Therefore, 13.6/80 x 100% = 17%

At present, the straws are usually returned to the rice field in the form of fertilizer. Even if 17% of such abandoned rice straw is used for producing bags, no adverse effect will be exerted upon the condition of paddy.

In Japan, bags and sacks made of straw were used extensively for the transportation and storage of rice and each farmer used to own a simple device to produce such straw bags.

It is considered feasible also in Sri Lanka to produce straw bags sufficiently as a type of home industry.

The agricultural population in the year 1980 will be approximately 220,000 in the H and IH areas. If an assumption is made that average number of persons per household is 6, the number of household will be calculated as being 36,700. On the basis of the production amount of paddy, the average required amount of straw bags per farmer household will be 172 bags for containing paddy and 120 bags for containing milled rice, so that, the operation of producing straw bags seem to be suitable as domestic operation for one year supply of bags for a farmer's family.

In consideration of the above discussion, the production of straw bags as a partial substitution of the imported jute bags will have sufficient significance. Further, the device for producing straw bags can be simply made even by the farmers themselves. Even if such devices are industrially produced, the cost will be approximately Rs.10. Further, as has been

already mentioned, the matters pertaining to the production of straw bags should be undertaken under the guidance of the IDB, therefore, no further discussion concerning this point will be made in this report.

2-2 Forest Industry

Regarding the utilization of forest resources which will be obtained during Phase I of the Mahaweli Project which was the subject of the present survey, broad qualitative categorizations can be made as mentioned earlier (VI-2-2). It seems necessary to consider the present quantitative aspect and the status thereof in order to scrutinize the projects in view of the site conditions of this particular area, the supply and demand trend domestically and internationally concerning the products, as well as in view of the economy of the whole operation.

2-2-1 Lumbering Industry (Sawing industry)

As far as the raw material logs for lumbering are concerned, the shapes are a more important factor than the species of the wood. The wood materials of more than 30cm diameter will qualify themselves as the raw materials for the lumbering operation. Therefore, the total quantity of (A) and (B) and a part of (C) which were classified in VI-2-2-3 will be the subject of processing as the raw materials for lumbering. However, regarding (A), the species of these materials are

the so-called valuable woods which are internationally well known so that a portion of this category should be destined for the domestic consumption lumbering logs or as the raw materials for producing plywood , while allocating other portions of such valuable materials for export.

In view of the site conditions for lumbering industry, this area possesses well developed transportation routes and communication systems. Further, the sypply of electrical power is also planned as one of the main objectives of the Mahaweli project.

Therefore, a portion of (A) and (B) should be destined for general market and (C) can be processed at removable mills where the materials will be lumbered into products for use in house construction or as agricultural use raw materials for the local markets.

According to the FAO survey statistics, more than 20% of the total lumbered wood materials so far has been comprized by the species belonging to the (A) category obtained from the Dry Zone. As has been mentioned earlier, the future demand is expected to increase up to 11.9 to 8.5 million ft^3 in the year 1975, however, the felling of the woods to be conducted within the scope of this project is also included as a part of such expected increment, therefore, the above-mentioned generally used lumbering raw materials(B) which will be obtained

by felling carried out during this project (total amount 1.92 million ft^3) should naturally be destined for fulfilling the above-mentioned 1975 demand level. It is also desirable that some contributions be made to the increment of production from the so-called valuable woods which are suitable, as the above-mentioned, for producing plywoods and for lumbering as categorized (A).

However, it must be taken into consideration at this stage that the above-mentioned supply amount of the lumbering raw materials is the total amount for approximately ten years (on an assumption that Project I will continue until 1985). Therefore, a clear understanding should be made as to whether (a) to deem the above project as the project within the said ten-year period or (b) the cutting amount of wood for lumbering after the expiration of such period should also be incorporated.

If an assumption is made as above (a) and if the lumbering materials and valuable wood materials for plywood manufacture are to be divided to three destinations i.e., for lumbering, for plywood making and for export, the following will ensue:

Total amount of lumbering raw material: $1.92 + 5.76 \times 1/3 =$ 3.84 million ft^3

This implies that the annual consumption amount of lumbering raw material will be 3.84/10 which approximately equals to 0.384 million ft^3. The annual estimated lumber accumulation will be 0.384 x 45% = 0.1278 million ft^3

These lumbered products will remarkably contribute to the increment of demand level in Sri Lanka.

2-2-2 Plywood Industry

For the purpose of intensive utilization of valuable wood materials, the valuable wood materials have been used in various countries as veneer boards or as the face material by adhering such materials on the surface of plywood or other base board materials. The materials shown in VI-2-2-3 are high class materials even for use as surface materials for plywood industrial manufacturing so that it seems unfeasible to undertake the plywood industry by employing these valuable materials alone as the raw materials. (If it is desired, for instance, to produce the base boards on the surface of which these valuable materials are to be adhered, it would be necessary to obtain the materials for such base-board production at least three times the amount (17 million ft^3 or more) of the valuable materials (5.76 million ft^3). Therefore, the materials under the category(A) should be destined to the existing plywood industry and also for the lumbering industry as mentioned earlier, and at the same time the portions of

materials(A) should be destined for export for overseas market in the original log form or after being processed into single veneer boards.

However, it must be noted here that these valuable materials are generally employed as the face back decorative materials of plywood that the arrangement of grains will become an important factor. Further, the extent of dryness will affect the commodity value of the finished veneer plywoods quite severely so that it is a normal practice that the veneer plywood manufacturers import these valuable materials in the form of logs in order to carry out the production of these boards by themselves. Therefore, unless there is any specific contract with certain veneer plywood manufacturers overseas regarding the supply conditions, it would be dangerous to carry out the exportation of such valuable materials in the form of single veneer. Therefore, the exportation of valuable materials are recommended to be undertaken in the form of logs. In the case of supplying these valuable wood materials obtained in the Dry Zone to the plywood mills existing in the southern part of the country to which the distance is rather long, the raw wood material cost will be increased by the extent of the transportation cost. However, after such a stage where Sri Lanka can self-sufficiently supply tea chests completely, it would be economically highly advantageous to utilize the Dry Zone valuable wood materials as the face wood for veneer or plywood production.

If there is no significant demand generated domestically, the product can be exported as the plywood veneer materials for furniture and house construction materials, and they should be well accepted in the overseas markets. Also in the existing mills, slicers which are necessary for the production of veneer face wood are installed so that there is little necessity for additional facility investment. Such an operation will therefore be comparatively easily carried out by employing the facilities of already existing mills.

One third of the above-mentioned valuable wood(A), i.e.,1.92 million ft^3 would represent, if it is to be consumed within the approximately ten-year period of Project I, corresponds to approximately 37% of the annual consumption of 5.2 million ft^3. The production capacity increment to cover this much of increase is considered to be easy to attain.

Further, if there is no sufficient consumption capacity in demand, these materials can then be exported in the status of raw material.

2-2-3 Chip Industry for Pulp Manufacture.

The resources (C) described in VI-2-2-3 which mainly consist of Wira are set to be unsuitable qualitatively for use as raw materials for paper manufacture according to the reports maintained by the FAO. The question remains here, however, as to whether or not it is still inappropriate to utilize these as the raw materials for paper manufacture. Since 1968, in Japan, every species of tropical wood materials imported from Malaysia area which have been said to contain silicon and are inferior as fibre materials. These materials have been utilized widely as main materials for producing board paper. However, due to the fact that no experience has been made by utilizing Sri Lanka materials for producing any paper, it goes without saying that detailed and severe tests are required to determine the suitability of such materials for this purpose. If these wood materials prove to be applicable as the paper board raw materials, the following possibilities will arise.

(1) Exportation of the materials in the form of chips:

1) The installation of small chippers in the vicinity of wood producing areas so that the materials in the form of chips will be transported to the port of export.

2) To gather all the raw materials at the port of export and process them into chips by means of large scale chipping facilities.

3) Combination of the above 1) and 2) methods.

However, it is necessary to make the transportation unit as bulky as possible (normally 20,000 tons or more per vessel) in order to reduce the ocean freight in the case of export. This implies that either the number of chippers must be increased or the size of each chipper should be made larger. Further, port facilities should be able to meet these production capacities. The present situation of the port facility conditions in Sri Lanka do not seem to warrant such a mass production industry. Even in the case where the buyers of the chips are to newly substantiate the port facilities, the burden of such operations will be exceedingly high.

(2) Destination of such materials to Paper Mills

In this category of possibility, there seems to be two feasible ideas, i.e., to destine the materials to pulp mill which are already existing, and, to construct new pulp mill and destine material thereto. In view of the quality of the resources, the materials are not suitable for any other production than for board paper under the presently available technique so that it seems appropriate here to discuss and scrutinize the feasibility of this operation concerning the board paper production only.

In the former of the above two ideas, the following may be commented

1) A large amount of investment will be required if the already existing mills are to be converted into board paper mills. Also the most important problem, i.e., the securing of necessary industrial water must be settled, however, the solution seems rather doubtful.

2) The question as to whether or not it is necessary for Sri Lanka to produce board paper for which the country does not have so much of demand, in spite of the fact that a large extent of investment and large amount of industrial water will be absolutely necessitated.

The scope of economic unit of a board paper mill in the case of Japan is over 50,000 tons per year of production. The new installation cost for undertaking such a scale of production will be more than approximately Rs. 240 Million. The raw material consumption will be approximately 6 million ft^3 and the industrial water will be required for an amount of 4 million tons. This being the circumstance, it seems appropriate to re-scrutinize this matter as and when the port facilities in Sri Lanka are substantiated to such an extent that the chip loading can be undertaken satisfactorily.

2-2-4 Wood Based Panel Industry

Generally speaking, the quality of material wood does not cause much problem in this industry, however, the wood materials which are the subject of utilization in this field (Wira, etc.) are usually of large specific gravity so that if they are used for producing chipboards, the final products will be comparatively heavy. This fact may cause some problems in utilizing such materials for furniture, however, along with the utilization expansion of plywood in recent years, the application of chipboard has remarkably expanded so that the weight problem is not expected to present any vital problem. As the effective utilization of wood resources of the world has become more important in the recent years, the production of chipboard in various countries has been showing a continuous uptrend as shown in Attached Fig. VII-3 and Attached Table VII-4. Also in Sri Lanka, a mill for this operation was constructed in Avissawella. This implies the fact that the effective utilization of wood resources of the country is now fully recognized and put into action by the Sri Lanka authorities.

Unlike the pulp industry or fibreboard industry, this particular field of industry does not call for a large amount of industrial water for the operation process and no pollution by exhaust water will be caused. Therefore, no particular condition is required for the site of the mill, for receiving of wood materials and for the shipment of finished products. Due to the fact that the already

existing chipboard mills in Sri Lanka are carrying out production, the products which will be turned out under the present project will have to be destined to overseas markets.

However, if the mill to be newly constructed under the present project is to be equipped with facilities for turning out versatile products (in thickness, and in the layer structure), the exportation promotion of the products will be comparatively easy.

At the present stage, the same raw wood materials are used for producing chipboards and fibre boards, however, the production process of these two types of board products are extremely different from each other. In the case of the latter, the pulping, adhesion, pressurizing and drying process will be called for. Therefore, the fibre board production will require much larger extent of facility investment. Also, the fibre board has a lower extent of products are not highly appreciated in the overseas market in general.

As mentioned above, the utilization of low grade wood materials such as Wira, etc. involves a number of problems including such items as the development of port facilities which are related to works outside the scope of the present project. On the other hand, chipboard industry generally has less extent of impeding factors and therefore it seems to have future development potential.

If the materials destined for production of chips stipulated in VI-2-2-3(C) in the amount of 20.5 million ft^3 is to be consumed during the approximately ten-year period of Project I (assuming

that Project I will be completed by 1985), the annual consumption of approximately 2.05 million ft^3 will have to be undertaken. If only one mill is to be constructed, a mill capacity of approximately 6,830 ft^3 (190 M^3) per day raw material consumption will be required.

2-2-5 Felling of Raw Material Wood (valuable wood)

The so-called valuable wood materials are necessary for the domestic plywood veneer industry and the demand for this material is extremely high also in the overseas market.

Therefore, the domestic demands should be fulfilled firstly and the remaining amount should naturally be allocated for export in order to obtain foreign reserve.

The port of Trincomalee is suited for this type of exportation and the existing port facilities will be sufficient for such an operation. However, in this case, comparative scrutinization should be made as to the advantages and disadvantages of the exportation as against the allocation for domestic consumption.

2-6 Charcoal-making Industry

Charcoal was originally developed as fuel and the production method of this item is highly versatile depending upon locality. Generally speaking, the production of this item has mostly been undertaken on the basis of the home industry. Recently, the industrial application of charcoal has been developed so that the production process has gradually been mechanized. The use of charcoal as a fuel has been showing a decrease all over the world due to its inferiority, economically speaking, to oil when used as fuel. Around 1960, Japan used to produce and consume approximately one third of the world's total charcoal (38 million m^3 converted into raw material wood). Thus, the charcoal production technique in Japan is comparatively advanced. (Following Japan in the production of charcoal is the U.S.S.R. The production around 1960 in the U.S.S.R. was estimated at 2.7 million tons per year.) Around the same time, approximately 300 thousand tons of production was achieved in Europe, however, most of the

products were applied for industrial use, thereby showing a different situation from the case of Asia where charcoal is primarily used as fuel. Along with the development of the economy, the production and consumption of fuel charcoal has been reduced considerably. At present, except for special application for cooking, the production of charcoal is being undertaken mainly to cover industrial application in Japan. The industrial fields where charcoal is applied are the metallurgy and chemical industries. In the case of these fields, the high purity and easy reaction characteristics of charcoal are the points of application. The high adsorption characteristics of charcoal carbon are utilized for application with acetylene gas containers and for water filtering. The polishing performance of charcoal is utilized in the surface finishing field in the form of polishing charcoal or carborandum. The electrical characteristics of charcoal are utilized in the field of electrodes or clip tool earth. Other fields of application for charcoal are for ammunition powder production and for fine art drawing materials.

The industrial use of charcoal is applied in large quantities in the metallurgy and chemical industries. In the chemical industry field, charcoal is used for the generation of carbon disulphide in the form of white coloured charcoal. This type of charcoal has a volatile content of approximately 5%, which is next only to coke (volatile content 1.32%).

In the field of metallurgy, the application is made mainly for

iron production. Charcoal in this field is used in the form of black coloured charcoal which contains a low extent of calcium. The characteristics of charcoal used in Japan are shown in attached Table VII-5. The yield (%) of the product through wood dry distillation process are shown in the attached Table VII-6. The attached Table VII-7 shows the yield of products in accordance with the dry distillation temperature level.

The most popular charcoal producing method was previously earth covering method (the material wood is burned on the ground surface and then covered with earth at a certain time) and the charcoal furnace method were widely employed, however, the employment of more industrialized furnaces for the production has been undertaken in recent years. Especially in the case of producing charcoal in large quantities, mechanically constructed charcoal furnaces are employed. Most of such furnaces use heavy oil as fuel. Such charcoal furnaces are normally expensive and it is reported that a charcoal producing device of 200 t/day capacity will cost approximately US$ 2 to 3 million. The Forestry Experiment Station of the Ministry of Agriculture and Forestry of Japan conducted a series of tests by employing the SIFIC type test furnace made in the U.S.S.R. which is supposed to be the best developed furnace in the world and the yield results obtained were as follows.

Charcoal 20.5%, Wood tar 14.3%, Pyroligneous liquid 31.1%

If Wira or other low grade woods were to be utilized as the raw materials for producing charcoal, the following points will be

the problems to be solved.

1) The produced charcoal will be for export rather than for domestic utilization. In such a case, the question remains as to whether or not the quality of such charcoal will be acceptable in the overseas market. Also, it remains to be seen as to whether or not the production will meet the demand in view both of quality and price.

2) The question as to whether or not such produced charcoal is able to compete favourably with other fuel materials in overseas markets in view of cost, in spite of the fact that a large extent of investment will be required for the production of the charcoal.

3) The question as to whether or not an economic profitability will be obtainable as an export industry.

4) The problems concerning the required quality standard of the products to be sorted out with the consumers until the actual exportation of the products can be undertaken.

As mentioned above, a number of studies must be completed before actual implementation of the project. At the same time, a series of experiments will be called for in the production aspect. In the overseas market, the general tendency is that the demand for charcoal has been reducing considerably due to the supply of petrol and other carbon resources.

2-3 Mineral Resources Utilizing Industry

2-3-1 Correlation between the Mineral Resources and Industry

Concerning the mineral resources which were enumerated in VI-3, the category of mineral resources in utilizing industry and the

available resources will be as follows:

Ceramic Industry	: Dolomite, Clay, Feldspar, Quartz
Cement Industry	: Limestone, Clay
Glass Industry	: Feldspar, Quartz
Fertilizer Industry	: Apatite, Dolomite
Building materials Industry	: Mica
Others	: Graphite, Gem Stones, Iron Ore, Magnetite

The above show the relationship between the feasible industrial fields and the mineral resources which can be utilized therein. The common characteristic of these types of industries is that the raw material will contain a large extent of impurities in addition to the substances which are desired to be extracted in the industrial production. Thus, the excavation and the preparation of these raw materials will form an independent industry. Therefore, the under-mentioned establishment of the Raw Material Supply Centre should be included within the scope of discussions here as one of the industrial fields.

Raw Material Supply Centre: Smelting and preparation of various mineral resources shall be undertaken by this institute and the supply of such raw materials to each field of industry will be undertaken. As the matters pertaining to the establishment of the Raw Material Supply Centre were not possible for discussion as one of the topics of the mining industries, the matters were discussed in a chapter pertaining to the ceramic

industry as one of the practical examples.

2-3-2 Ceramic Industry

(1) General

The history of the ceramic industry in Sri Lanka is comparatively new and of the production activities traditionally undertaken in this field were the chinaware lamp production and pitcher production. However, in recent years, a number of investments have been undertaken in the ceramic industry field in Sri Lanka and the Ceylon Ceramic Corporation has been assuming the leadership in the course of the development of this sector in the country. However, a number of aspects still remain undeveloped in this industry and a portion of ceramic products are still being imported. The actual situation of the Sri Lanka ceramic industry is as follows.

(2) Crockery production plant

The Ceylon Ceramic Corporation owns dishware manufacturing plants in Piliyandala and in Negombo. The production amount with these two plants together is 2,880 tons (in 1972). Further, a joint venture company was established with the Ceylon Ceramic Corporation and a Japanese manufacturer and it is now scheduled that the operation commencement of such a plant will take place by the end of 1973. In such an event, the production amount will be further increased

(3) Tile production plant

The Ceylon Ceramic Corporation's Piliyandal plant now

undertakes the production of approximately 320 tons of wall tiles (in 1972). Other private sector factories do produce tiles, however, the production amount is negligible.

(4) Sanitary ware production plant

The Piliyandala plant of the Ceylon Ceramic Corporation undertakes the production of approximately 590 tons (in 1972) of sanitary chinaware products.

(5) Electrical porcelain production plant

In the Nogombo Plant of the Ceylon Ceramic Corporation, the construction of a new plant is now being undertaken for the production of low voltage electrical insulators. Commencement of production is expected to be undertaken in the near future.

(6) Red brick production plant

So far, the red brick production plants are all organized under the National Small Industry Corporation, however, the corporation was recently merged with the Ceylon Ceramic Corporation so that there are a series of plants which are now being organized under the Ceramic Corporation. The plants are existing in seven areas of the country (Bangadeniya in the Puttalam district, Weuda in the Kurnegala district, Yatiyana in the Matara district, Mullaitivu in the Vavuniya district, Aluthnuwara in the Badulla district, Irrakkamam in the Amparai district and Elayapattuwa in the Anuradhapura district).

Each one of the above plants respectively has approximately 500,000 pcs. per year of production capacity. The present annual output is 3,335,300 pcs. (in 1970)

In addition to the above, a number of red brick manufacturers on a cottage industry scale exist all over the country and it is said that they number approximately 2,000 units, however, it is extremely difficult to grasp the production amount turned out by these small scale manufacturers. However, it is roughly estimated that the annual production altogether will be approximately 500 million pcs. The red bricks produced by these home industry manufacturers hardly satisfy the Ceylon Standards which were enacted in 1968. The reason for such a status is attributable to the inappropriateness in the selection of raw materials and to the insufficiency in carrying out quality control.

(7) Roofing tile production plant

As in the case of the earthen pipe production industry, there is no specialist manufacturer of this item. The present status is that the roofing tiles are being produced in the same factory as the red bricks. The total production amount of corporation and private sector plants in 1970 was 32,745,000 pieces. Further, all roofing tiles produced at present are without glazing.

(8) Earthen pipe production plant

As mentioned above, there are no specialized earthen

pipe producers in Sri Lanka at present. The production of the pipes is being undertaken together with red bricks or roofing tiles. The main portion of the production is now being undertaken by the private sector plants, however, the production amount in 1970 was only 75,000 pieces, approximately.

(9) Refractory manufacturing plant

At present in Sri Lanka, little production of refractories is being undertaken. The demand is entirely filled by imports. Refractories are the basic materials for various fields of industry and, therefore, along with the future development of industries in Sri Lanka, the demand for this item will also increase year by year. If Sri Lanka's Five Year Plan is completed, approximately 8,000 tons of refractories will be called for and the foreign reserve necessary to procure this amount of products will be considerable. As Kaoline and good quality refractory clay are available within Sri Lanka, the industrialization of this field of production is quite potential.

2-3-3 Cement Industry

The present cement industry in Sri Lanka is being undertaken solely by one corporation, namely the Ceylon Cement Corporation. The production statistics of this Corporation are shown in Table VII-11. The table shows that so far the production fulfilled the demand and it is also estimated that the present demand level is approximately 500 to 550 thousand tons per year, how-

ever, the Corporation is now constructing a new production facility of 220 thousand tons per year capacity in Puttalam, which is scheduled to be completed by the end of 1973. Therefore, the production capacity from 1974 onward will be 715,000 tons per year so that the future demand for some time to come will be amply fulfilled. Concerning the raw material aspect on the other hand, the lime and clay can be procured within Sri Lanka, however, gypsum which takes up approximately 5% of the raw material amount, is entirely dependent upon imports from Pakistan.

2-3-4 Glass Industry

The investigation into various statistics pertaining to the glass industry of Sri Lanka revealed that all the glass manufacturing has been undertaken by private sector enterprises, the production figures of which are as shown in Table VII-12, which are the production statistics of the industry. On the other hand, the import statistics of glass ware products revealed the facts shown in Table VII-13, which indicate that the dependability upon imports is quite high. In view of raw materials, the glass industry requires as raw materials, silicon sand (approximately 70 weight % of product), quartz and soda ash (approximately 17 to 18 weight % of the product), as well as a slight amount of lime, dolomite, etc. Concerning the silicon sand which is the main material, the sand produced in Sri Lanka exists within the so-called mineral sand, so that the separation of ilumenite and rutile, etc. is necessary.

Also, the analyses values of the iron content, the key factor for the quality of silicon sand to be used as a raw material for glass production, are not clarified as yet. Concerning the quartz, this material is abundantly produced in Sri Lanka, however, quartz is not suitable for the production of general use glass products such as flat glass, although this material can be used as a raw material for producing special purpose glass products. Therefore, in view of raw materials, the Mineral Sands Corporation should undertake the extraction process of the silicon sand from the mineral sand.

On the other hand, in view of the economic scale of a glass plant, the minimum economic scale is considered to be approximately 15,000 ton/year for flat glass production, the optimum scale being considered as approximately 22,500 ton/year. Therefore the economic scale required will be more than five times the present domestic demand which attains approximately 3,000 ton/year, thereby indicating a difficulty in the construction of a plant unless there is a secure export outlet.

In conclusion, it is recommended as a desirable status that the extraction of the silicon sand should be undertaken in close cooperation with the Mineral Sands Corporation and after confirming the quality of the raw materials and the economical raw material price level, then a joint venture enterprise be established with overseas capital which has a secure foothold in the export oriented flat glass manufacturing industry.

2-3-5 Fertilizer Industry

The fertilizer industry of Sri Lanka is entirely dependant upon imports as far as main elements of fertilizers are concerned, such as nitrogen, phosphate, potassium etc. (Refer to Table VII-14) By importing these chemical fertilizer elements separately, the Ceylon Fertilizer Corporation undertakes monopoly production and distribution in the form of single or mixed fertilizers. On the other hand, dolomite and apatite are available as domestically produced raw materials for the fertilizer industry. The present status of these materials is as follows.

(1) Dolomite

A slight amount of this material is being used as a soil improving agent or as a dolomite fertilizer. According to the statistics for 1970, approximately 2,150 ton/year of dolomite was utilized. The dolomite application is always extremely small in amount so that no significant growth in demand can be expected.

(2) Apatite

As has already been discussed in the chapter pertaining to distribution, it is reported that potential reserves of this material have been discovered. On the other hand, in view of domestic consumption, (for the saving of foreign reserve), the details of these ores and underground reserves are worthy of attention from the viewpoint of the recent world market trend of phosphoric fertilizers.

Under these circumstances, the government of Sri Lanka has established the Phosphate Working Committee, the members being the Geological Survey Department, the Ministry of Agriculture and Lands, the Ministry of Industries Scientific Affairs, the Ministry of Planning and Employment, the Ceylon Fertilizer Corporation and the State Fertilizer Manufacturing Corporation.

It is reported that an independent development project by this Committee was recently commenced.

2-3-6 Other mineral resource utilizing industries

Concerning fields of industries other than the above, explanations will be made in the following paragraphs on the basis of the raw materials (mineral resources) which are employed in the respective categories.

(1) Graphite and mica

Both these materials are placed under the jurisdiction of the State Graphite Corporation. As was mentioned in VI-2-3, the projects are now being formulated for the rationalization of the exploitation of the resources and the processing and development of the utilization of the resources. As far as the Mahaweli project areas are concerned, the following comments can be made.

a) Concerning the reserves of graphite, the Corporation is not showing any interest in increasing new exploitation as the authorities consider that the existing mine will amply fulfill the demand.

b) Concerning mica, the processing and other methods of utilization are being scrutinized. Development plans are being formulated as mentioned above concerning the exploitation. It is also planned that cooperative organizations will be formed. The cooperative organizations are expected to be in a position to supply the materials to the Corporation, according to an interview held with the general manager of the Corporation.

(2) Gemstones

Twenty four per cent (approximately Rs. 4.3 million) of the foreign reserve earned by Sri Lanka's mining industry in 1970 was comprised by the gemstone sector. The gemstone industry in this country is controlled by the State Gemming Corporation* which was recently nationalized. Development efforts are being exerted for an increment of the acquirement of foreign reserve. For the time being, no immediate plans have been disclosed, however, in view of the fact that this Corporation is an integrating organization of the industry, no expansion of the gemming activities into the private sector or to middle-sized enterprises is anticipated.

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*The State Gemming Corporation was established on 1st November 1971 with the objective of undertaking the direct proceedings of the exportation of gemstones produced in Sri Lanka.

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(3) Iron ore, etc.

Due to the fact that no trial excavation has been undertaken and no confirmation has been obtained concerning the quality of the ore, the economy of ore reserve excavation cannot be made at this stage. Thus, it seems too early to formulate the establishment of an industry on the basis of this material.

2-4 Other Industries

In this clause, the so-called home industry or cottage industry will be discussed although this subject is not directly connected with the utilization of resources available in the concerned area. The reason for recommending that the home industries in general and the handcraft article production in particular be placed under the jurisdiction of the IDB in the outset of this chapter are as follows.

As far as the handcraft article production industry is concerned, the following comments seem appropriate.

(1) As far as the articles being turned out at present are concerned they are poor for the most part in view of marketability of the commodities and very few show a high level of commodity value. It seems that technical guidance in the production method is required.

(2) Metal workers such as metal carvers complained about the difficulties in securing raw materials. For the most part, their raw materials come from scrap metal and are not obtained from imports. The selling of the products is also undertaken by the workers themselves or by their family members in many cases. This situation seems to require organizing of the selling aspect of this industry.

The above being the problems in this field of industry, it is considered that the function of the IDB is most suited in view of its position and functions for the solution of these problems. In the IDB itself, there are such problems as the lack of specialists in the handcraft industrial field and also that the authorities are fully involved in the execution of the Five

Year Plan, thereby having no allowance to look after the handcraft sector of the industry. Therefore it must be considered here that such raw material as bamboo, cane and so on is abundantly available in Sri Lanka and also available within the Mahaweli project area and therefore the potential for the production of handcraft items for souvenir or export is by no means low. In the case of the Philippines, a successful handcraft industry has been achieved with technical cooperation from Japan (under the auspices of the O.T.C.A.), utilizing such raw materials as wood, fibres, ceramics, cast iron, bamboo, shells, etc. The exportation of these items from the Philippines was 60 million Pesos in 1969, however, in 1972, the amount increased to 270 million Pesos, thereby assuming sixth place in the total exports and first place as far as the exports of industrial products are concerned. In view of this example, the establishment of the handcraft industry should require the technical assistance from developed countries to the IDB.

Suggestions for the Industrialization of the Mahaweli Project Area

9-1 Mahaweli Development Project and Industrialization Programme

As has been discussed in the foregoing chapter, the feasible types of industries in this respect are as follows.

Agro-Based Industries: Oil production, feed stuff production, fish cultivation, chicken farming, starch production, straw products, ro- vegetable and fruit processing,

		cotton ginning
Forestry resources utilizing industry	:	Lumbering, chipboard manufacturing
Mineral resources utilizing industry	:	Ceramic industry
Others	:	Handcraft industry

3-1-1 Agro-Based Industry

The execution programme for the Mahaweli area development is now being undertaken concerning its Phase I, Project I, Stage I and Stage II which are now actually progressing as described in IV-2. This implies that the actual projects have been laid out for the period 1976 to 1980. Also, the feasibility studies concerning the actual execution of the programme contain the cultivation projects which have been taken up on the basis of judgement in view of the national interest of Sri Lanka (refer to VI-2). According to such cultivation plans, no programme is set forth for the cultivation of manioc which is the starch supply source. It was also discussed in IV-2 that it would be impossible to obtain a sufficient extent of vegetables and fruit which can be supplied as raw materials for processing. However, concerning the supply source of starch in particular, it is considered that the future demand for starch in Sri Lanka is considerably high as was discussed in VII-2 so that this subject will have to be seriously considered in due course. However, in this respect, the industrial application of starch has been positively taken up by the IDB so

that this matter will not be included in the present suggestion. Fig. VII-10 illustrates the possible patterns of the agro-based industries on the basis of the above-mentioned cultivation programmes. From the pattern shown in this figure, the following industries seem to be the fields in which agricultural products can be directly utilized and which also seem to assume a position of priority within the framework of the Mahaweli development project.

a. Cotton ginning

b. Oil and feed stuff production.

On the other hand, regarding the chicken farming and fish cultivation, these are not considered to be particularly unique projects for the Mahaweli development area so that an outline only of these industries will be given in the Appendices.

8-2 The Positioning of each Industry in view of Industrialization Incentives

From the foregoing chapter, the following fields of industries are considered to be feasible industries.

Agro-Based Industries: Oil production, feed stuff production, cotton ginning and straw products

Forestry resources utilizing industry : Lumbering, chipboard manufacturing (wood products industry)

Mineral resource utilizing industry : Ceramic industry

Others : Handcraft industry

Also, the following patterns will be obtained when scrutinizing the prerequisite conditions for the project implementation concerning the Mahaweli project area.

Foreign currency situation	:	Export oriented industries, import substitution industries
Expansion of employment opportunities	:	Promotion of side jobs for farmers' households and home industries.

In addition to the above, consideration should be made concerning the effective utilization of resources and raw materials. From this viewpoint, the above-mentioned industries shall be categorized into the following four patterns.

(1) Export oriented industries	:	Lumbering, chipboard industries including felling and log exportation
(2) Import substitution type industries	:	Oil production, feed stuff production and cotton ginning
(3) Resources and materials effective utilization type industries	:	Ceramic industries
(4) Home industries	:	Handcraft item production, straw products manufacture

3-3 Ranking of the Selected Industrial Fields

Before giving the priority rankings to each industrial field, the priority order will be arranged for the four patterns

described above. In view of the prerequisite conditions in general and from the standpoint of the national economy in particular, it seems appropriate to consider the priority order in the following manner, especially in view of the present economic situation of Sri Lanka.

(1) Export oriented and import substitution type industries

(2) Resources and materials effective utilization industries

(3) Home industries

When expressed in terms of priority amongst the industrial fields, the following will ensue.

(1) Fores industry, oil production, feed stuff production, cotton ginning

(2) Ceramic industry

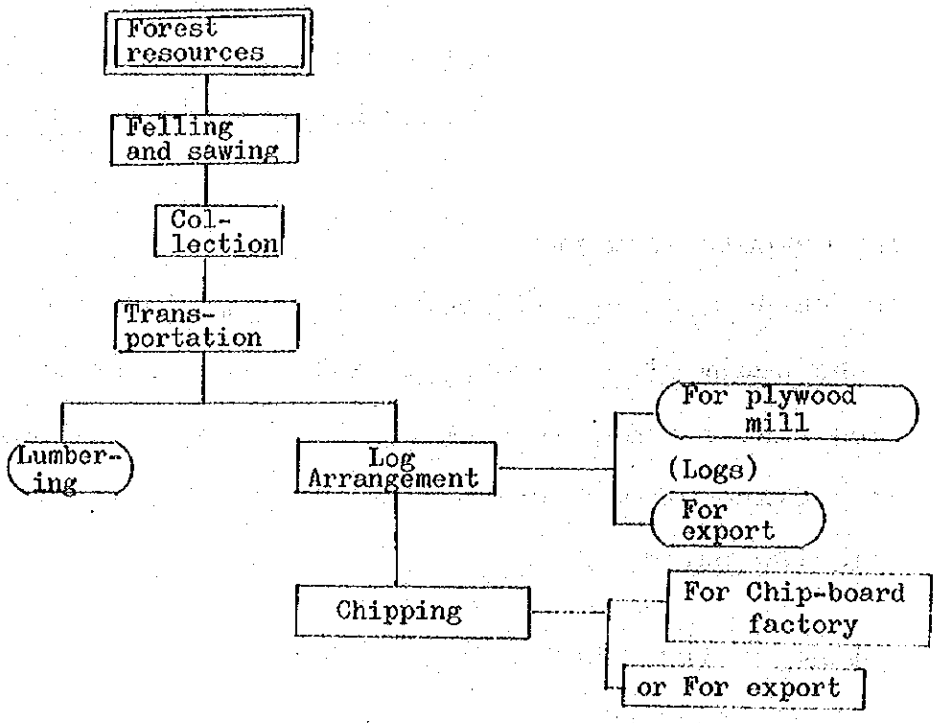
(3) Straw products industry, handcraft industry

On the basis of the above priority order amongst the selected industrial fields, in view of the national economy objectives, the outline of each one of the fields shall be explained in the following paragraphs.

3-4 Outline of the Recommended Industries

3-4-1 Forest Industry

This industry aims at the lumbering and a certain extent of processing depending upon the direction of application after felling various wood materials existing in the areas to be developed along with the progress of the Mahaweli development area. The felling shall be undertaken in accordance with the species of the wood materials. The pattern of this industry is as follows:

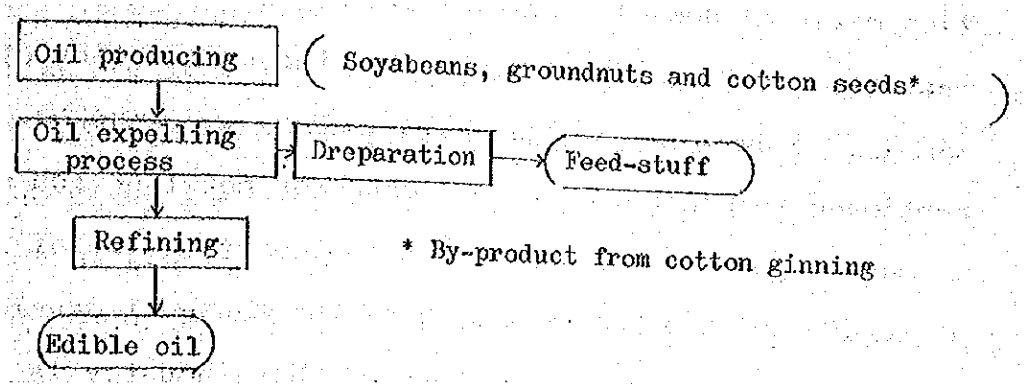

Forest resources
Felling and sawing
Col-lection
Trans-portation
Lumber-ing
Log Arrangement
For plywood mill
(Logs)
For export
Chipping
For Chip-board factory
or For export

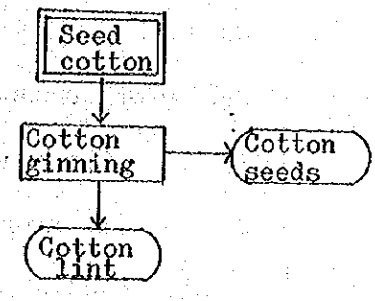
3-4-2 Oil Production and Feed Stuff Production

The oil production industry is to produce edible oil by means of an oil extraction process by utilizing the oil producing crops as raw materials which are included within the scope of the Mahaweli development project. The objective of this industry is to reduce the allocation amount of coconut oil for domestic consumption so that the saved amount of coconut oil can be destined for export. Further, this industry aspires for the substitution of the presently edible oil products. Also, the feed stuff production utilizes the residue produced from the oil production process, thereby substituting the presently imported fodder. The production pattern of these two related industries are as follows.

3-4-3 Cotton Ginning

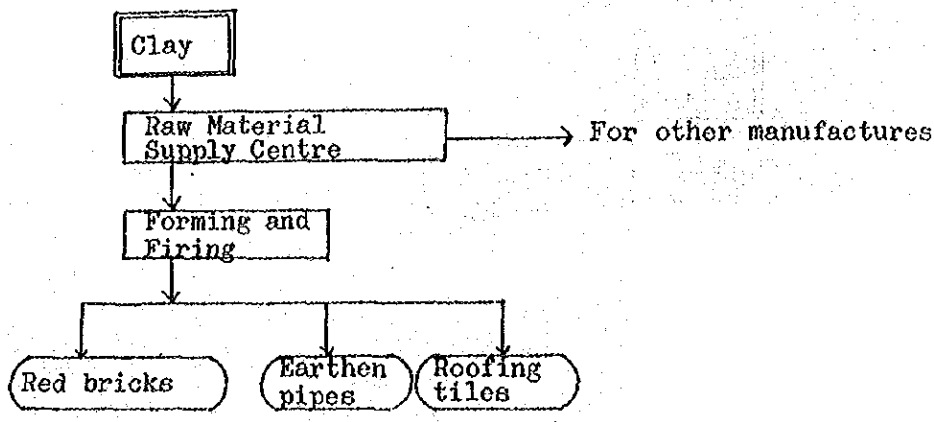
At present in Sri Lanka, various forms of cotton (raw material, spun yarn, etc.) are entirely dependent upon imports so that a certain extent of cotton ginning mill facilities are planned to be established on the basis of middle grade cotton which is scheduled to be produced within the Mahaweli project area. This project therefore aspires for the substitution of the presently undertaken importation and, at the same time, by means of utilizing the by-product, the cotton seed oil and the feed stuff can be produced as mentioned above.


Oil producing
Soyabeans, groundnuts and cotton seeds*
Oil expelling process
Preparation
Feed-stuff
Refining
Edible oil
* By-product from cotton ginning


Seed cotton
Cotton ginning
Cotton seeds
Cotton lint

3-4-4 Ceramic Industry

This project is based upon a forecasted growth in the construction material demand, the rehabilitation of the presently idle factories in Tissawewa and also for the utilization of the clay which will be mined in the development area. The above-mentioned forecast growth in demand for construction materials is based upon the development in the construction of infra-structures within the framework of the Mahaweli development project. The production pattern of this industry is as follows.



5-4-5 Straw Products and Handcraft Products

(1) Straw products

It was already discussed in VII-2 that there are several problems in view of the quality of the straw materials produced in Sri Lanka due mainly to the grade of the paddy and also to the method of harvesting. Of the straw products, particularly the straw bags for the transportation and storage of the products from each industrial sectors and from agriculture are necessary as was already mentioned in VII-2. Therefore, it seems necessary to practically implement the production of such items in some form, however, under the present circumstances, where the prerequisite condition of the raw material quality involves certain problems, it seems too early to embark upon such production immediately in a large scale operation. It seems necessary here that the domestic production of the straw bags manufacturing machines and the organization of the home industry on the basis of the farmers' family operation should be firstly substantiated under close coordination between the IDB and TSA. It seems particularly significant to consider receiving guidance and training from an experienced party such as Japan where the manufacturing of straw bags has long been practised.

(2) Handcraft Industries

As this field involves such problems as explained in VII-2, technical assistance seems to be necessary as in the case of the above straw product industry.

Table VII-1 Future Demand Amount of Edible Oil and Fat Products

(Kg/capita/year)

Year	(1970)	1975	1980	1985
Butter	0.1	0.1	0.1	0.1
Vegetable Oils & Fats	4.0	4.3	4.7	5.2
Animal Oils & Fats	0.4	0.4	0.4	0.4
Total	4.5	4.8	5.2	5.7

Source: FAO Commodity Projection

Table VII-2 Trend of Demand for Edible Vegetable Oil and Fat Production

Year	Population* (1,000 persons)	Per Capita Demand for Vegetable Oils and Fats (Kg)	Demand for Vegetable Oils and Fats (t)	Demand Increment (t)
(1970)	12,505	4.0	50,020	-
1975	13,870	4.3	59,641	9,621
1980	15,390	4.7	72,333	22,313
1985	17,070	5.2	88,764	38,744

* Population increase rate is taken at 2.1%/year

Table VII-3 Trends of Feed Stuff Import

(t)

Year	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Animal Feed Stuff	0	0	0	0	0	1,085	3,841	3,799	1,552	3,068
Vegetable Feed Stuff	1,269	853	1,265	5,806	1,660	305	125	317	840	2,151
Total	1,269	853	1,265	5,806	1,660	1,390	3,966	4,116	2,392	5,219

Source: Calculated on the basis of the Ceylon Customs Returns

Table VII-4 Trend of Feed Stuff Export

(t)

Year	1970	1961	1962	1963	1964	1965	1966	1967	1968	1969
Vegetable Feed Stuff	7	4,001	11,168	3,729	17,539	9,806	292	36	175	283

Source: Calculated on the basis of the Ceylon Customs Returns

Table VII-5 Trend of Feed Stuff Production

(t)

Year	1965	1966	1967	1968	1969	1970
Feed Stuff for Cattle Breeding and Chicken Farming	68,106	74,516	81,213	88,200	92,700	88,200

Source: Statistics of Industrial Production

Table VII-6 Cotton Consumption Amount

(1,000 ton)

	1963	1964	1965	1966	1967	1968	1969	1970
Cotton Consumption Amount for Industrial Use	1.5	2.2	2.2	2.2	2.0	2.2	2.2	2.2
Cotton Yarn Production Amount	1.5	2.2	2.3	2.2	2.2	2.2	2.3	1.8

Source: Statistics Yearbook of UNITED NATIONS

Table VII-7 Forecast of Cotton Consumption Amount

	(1970)	1975	1980	1985
Per Capita Consumption (Kg/person/year)	1.40	1.77	1.79	1.66
Consumption by the Whole Country (1,000 tons/year)	17.5	24.5	27.5	28.3

Table VII-8 Production Amounts of Paddy, Rice Seed Cotton, Cotton Lint and Cotton Seeds

(1,000 tons)

	1975	1980	1985
Paddy	67	252	252
Rice	47	176	176
Seed Cotton	0	9	11.4
Cotton Lint	0	3	3.8
Cotton Seeds	0	6	7.6

Table VII-9 Required Amount of Jute (in Weight of Woven Fabrics)

(t)

Application	1975	1980	1985
Paddy	871	3,276	3,276
Rice	610	2,293	2,293
Seed Cotton	0	144	182
Cotton Lint	0	29	36
Cotton Seeds	0	96	122
Total	1,481	5,838	5,909

Table VII-10 Required Quantity of Straw Bags, Straw Weight (1975)

Application	Quantity of Straw Bags (1,000 pieces)	Straw Weight (t)
Paddy	6,300	20,790
Rice	4,400	13,200

Table VII-11 Cement Industry

Year	Capacity (ton/year)	Production Amount (ton/year)
1967	275,000	206,634
1968	275,000	246,709
1969	275,000	268,639
1970	495,000	350,802
1971	495,000	385,108

Source: Statistics of Industrial Production

Table VII-12 Production of Glass

	1968		1969		1970	
	Number of Plants	Production Amount (1,000)	Number of Plants	Production Amount (1,000)	Number of Plants	Production Amount (1,000)
Bottles and Containers (pcs.)	2	17,180.8	2	19,088.9	3	21,916.2
Mirrors (M^2)	14	56.8	15	50.0	16	66.9
Chimney (pieces)	2	109.3	2	241.2	2	119.4
Others (pcs.)						15,597.0

Source: Statistics of Industrial Production

Table VII-13 Import Statistics of Glass Products

	1968	1969
Flat Glass (t.)	2,624.1	2,882.8
Others (t.)	3,817.9	1,182.2
Total (t.)	6,442.0	4,065.0

Source: Ceylon Customs Returns

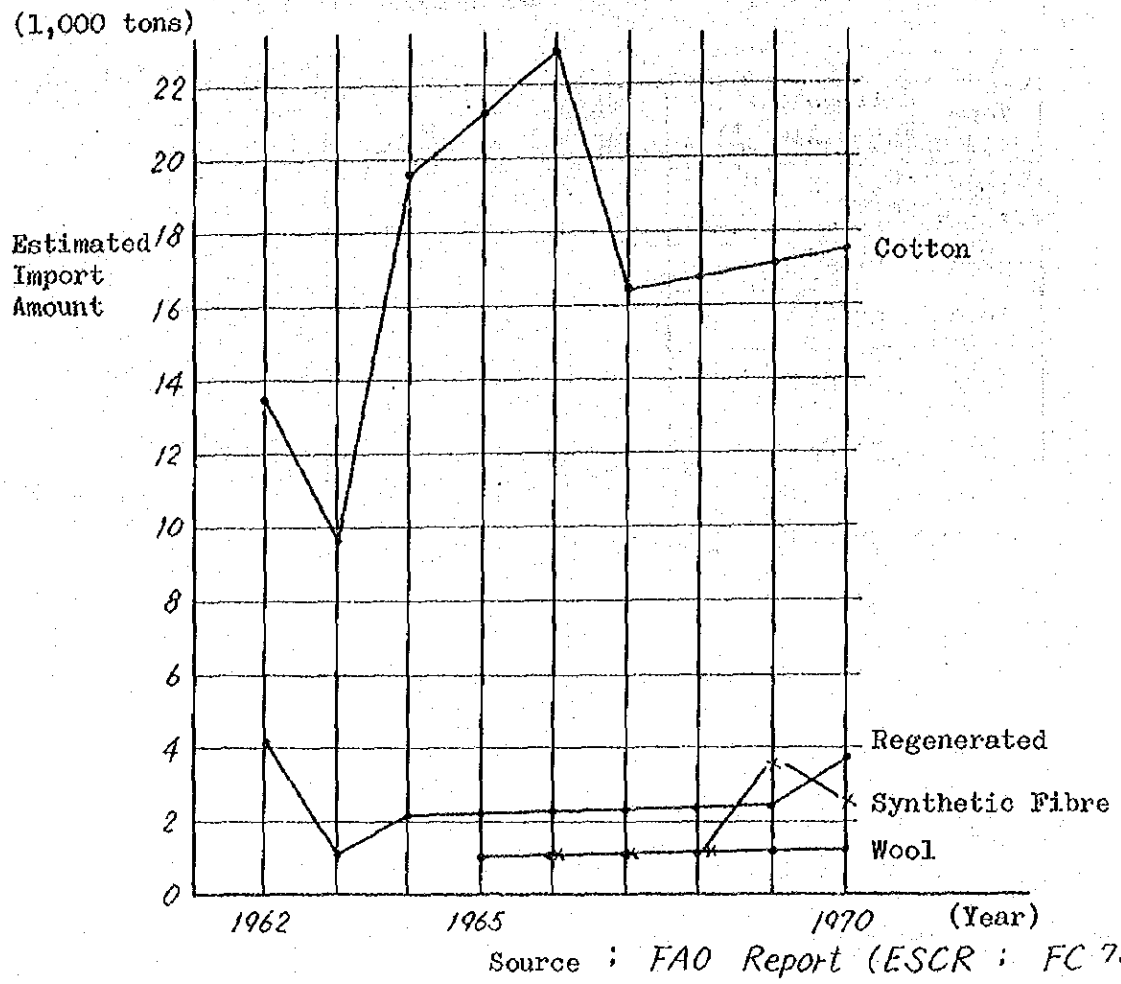
Table VII-14 Fertilizer Import Statistics

(Unit, 1,000 element t)

Year	Nitrogenous Fertilizer (N)	Phosphate Fertilizer (P_2O_5)	Potassium Fertilizer (K_2O)
1968	56.54	25.83	42.70
1969	61.08	36.47	47.70
1970	58.94	29.45	43.20
1971	62.64	28.50	40.35
1972	64.27	24.78	38.85

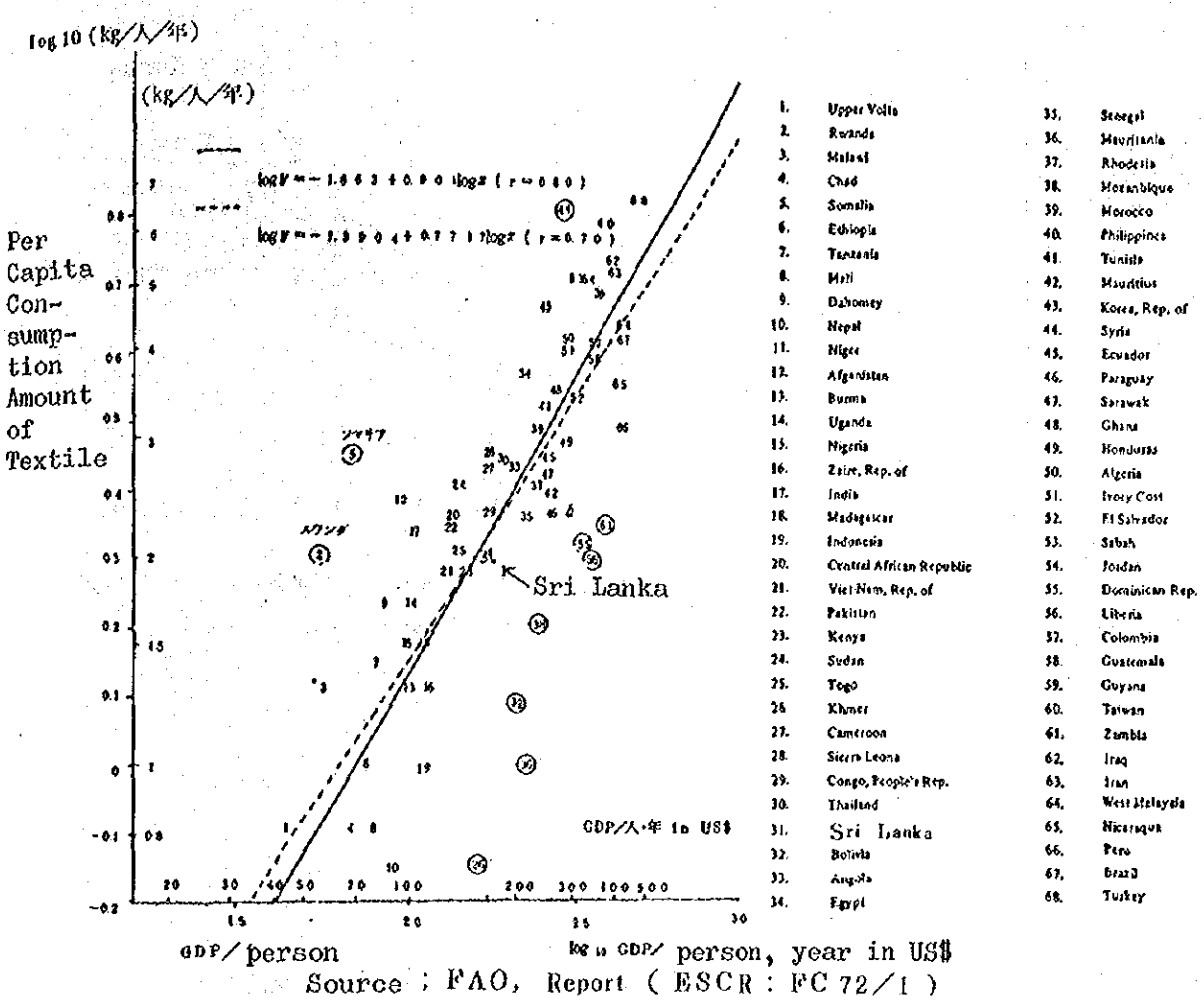
Source: Ministry of Agriculture and Land

Fig. VII-1 Grend of Estimated Import Amount Raw Raw Material-wise



Source : FAO Report (ESCR : FC 72/1)

Fig. VII-2 Relation between per Capita Textile Consumption (kg/person/year) and GDP/person in Developing Countries where GDP per Capita is less than US$ 500 (as of 1970)

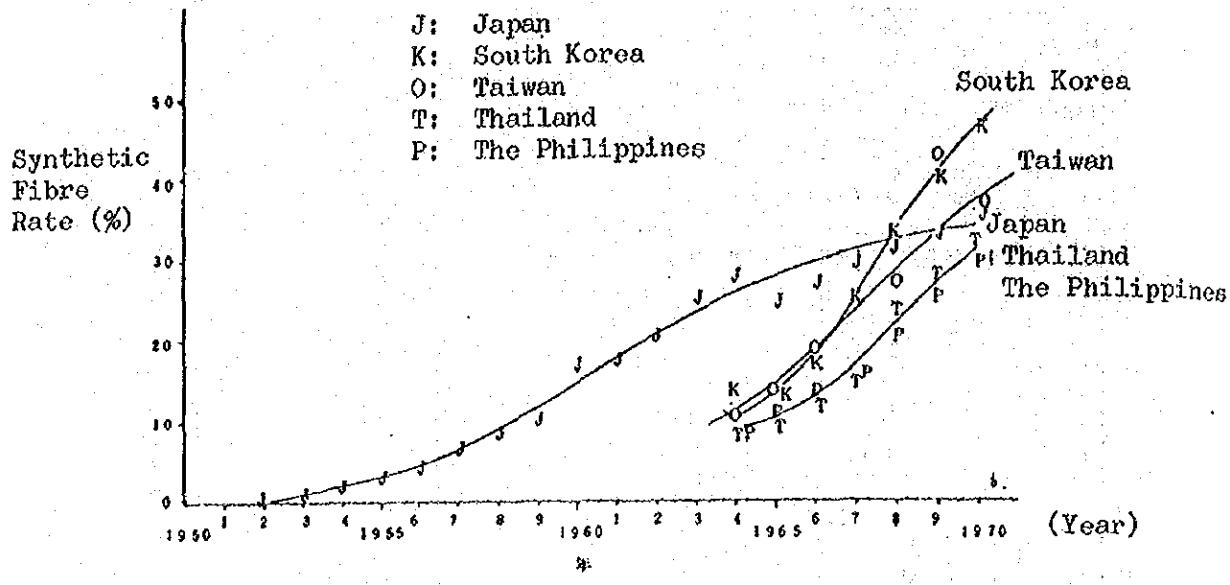


Source : FAO, Report (ESCR : FC 72/1)

——— Regression line excluding 10 countries marked with circle.

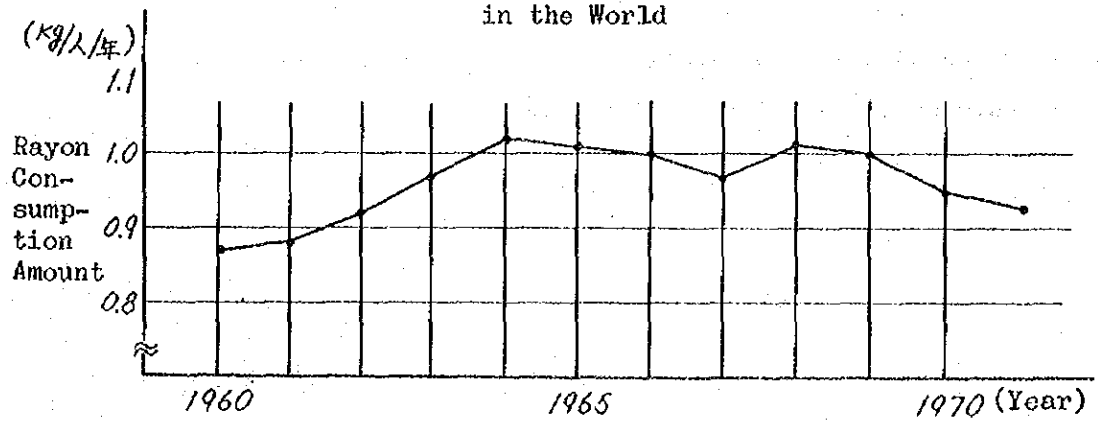
- - - - Regression line for 68 countries.

Fig. VII-3 Trend of Synthetic Fibre Rate



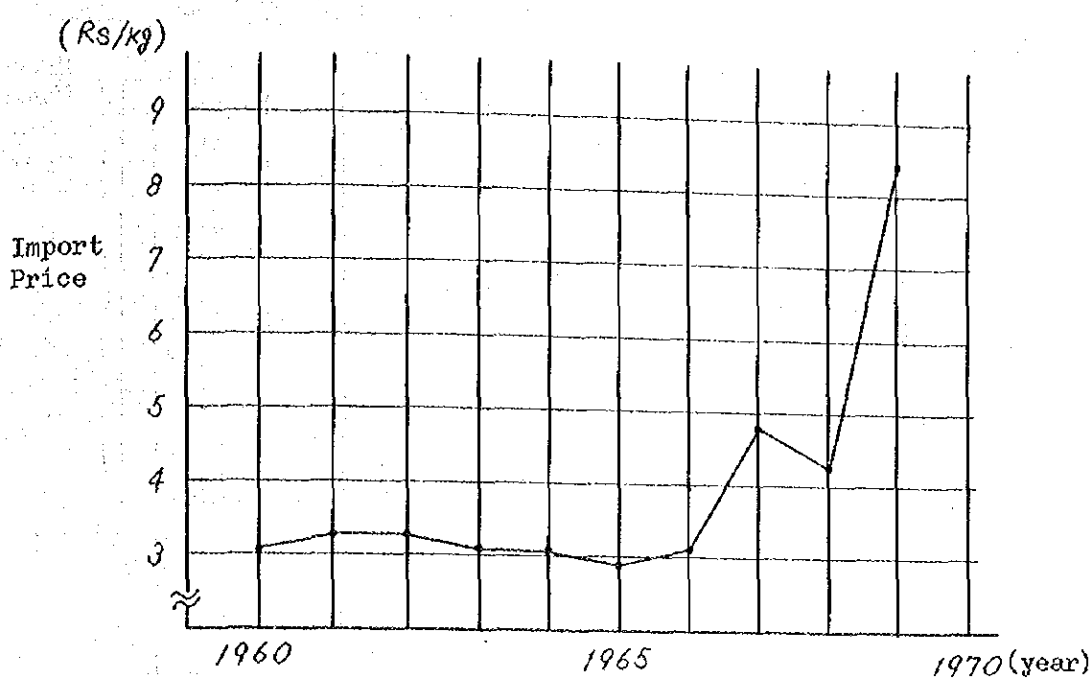
Source ; FAO, Report (ESCR : FC 72/1)
Calculated on the basis of

(kg/person/year) Fig. VII-4 Trend of Rayon Consumption Amount in the World



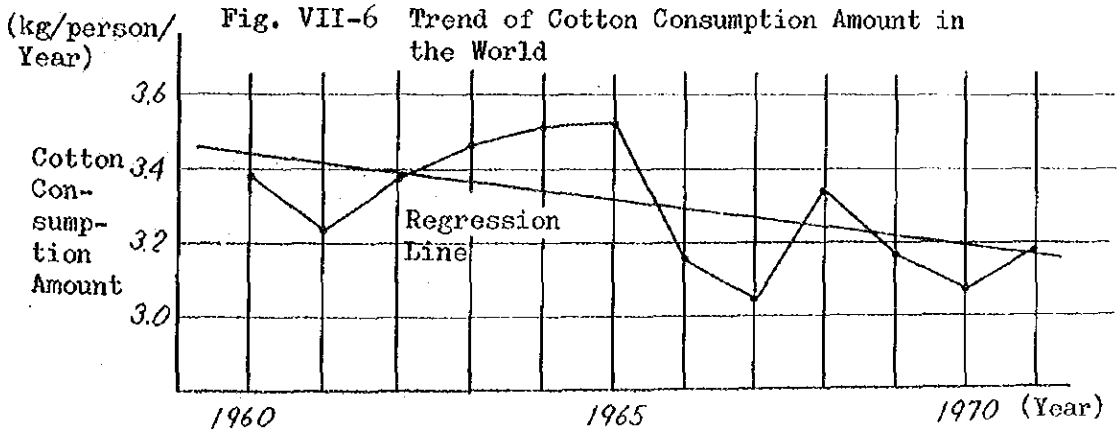
Source: Chemical Fibre Handbook

Fig. VII-5 Trend of Cotton Import Price



Source : Ceylon Customs Returns

Fig. VII-6 Trend of Cotton Consumption Amount in the World



Source: Chemical Fibre Handbook

Fig. VII-7 Trend of the Breakdown of the Cotton Supply Amount

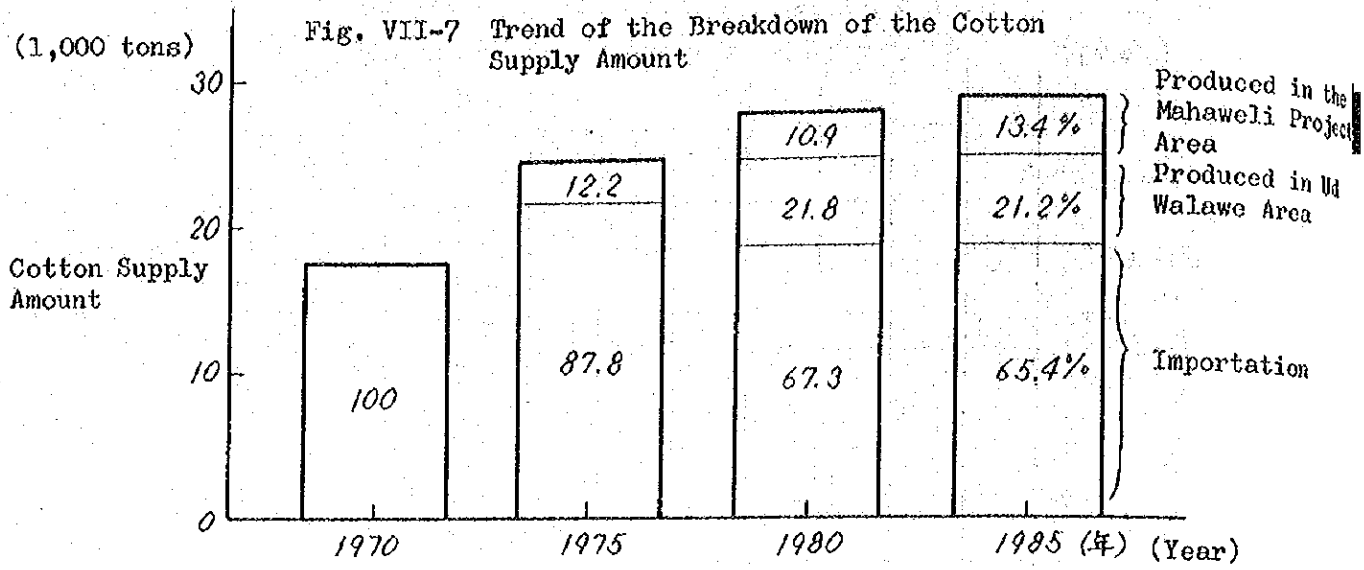
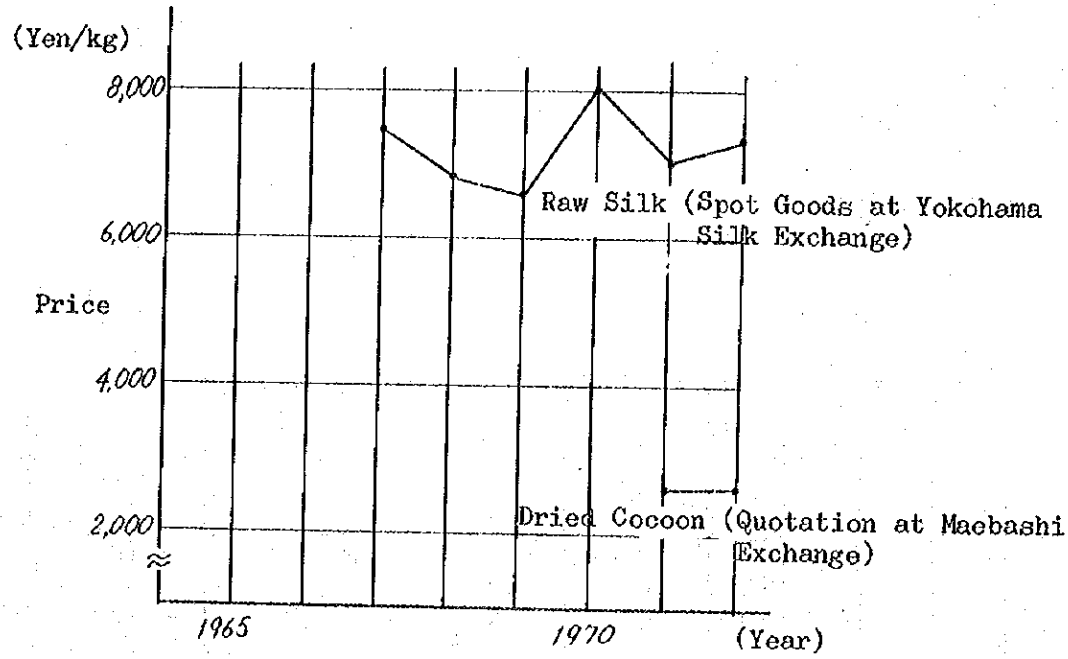
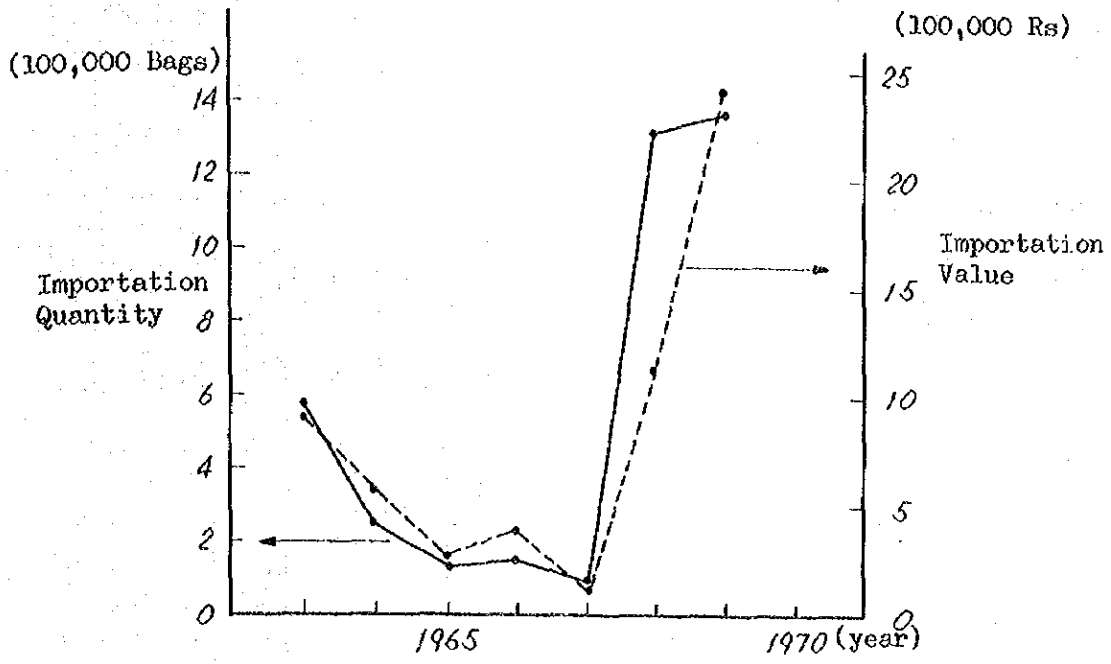


Fig. VII-8 Trends of Raw Silk and Dried Cocoon Prices



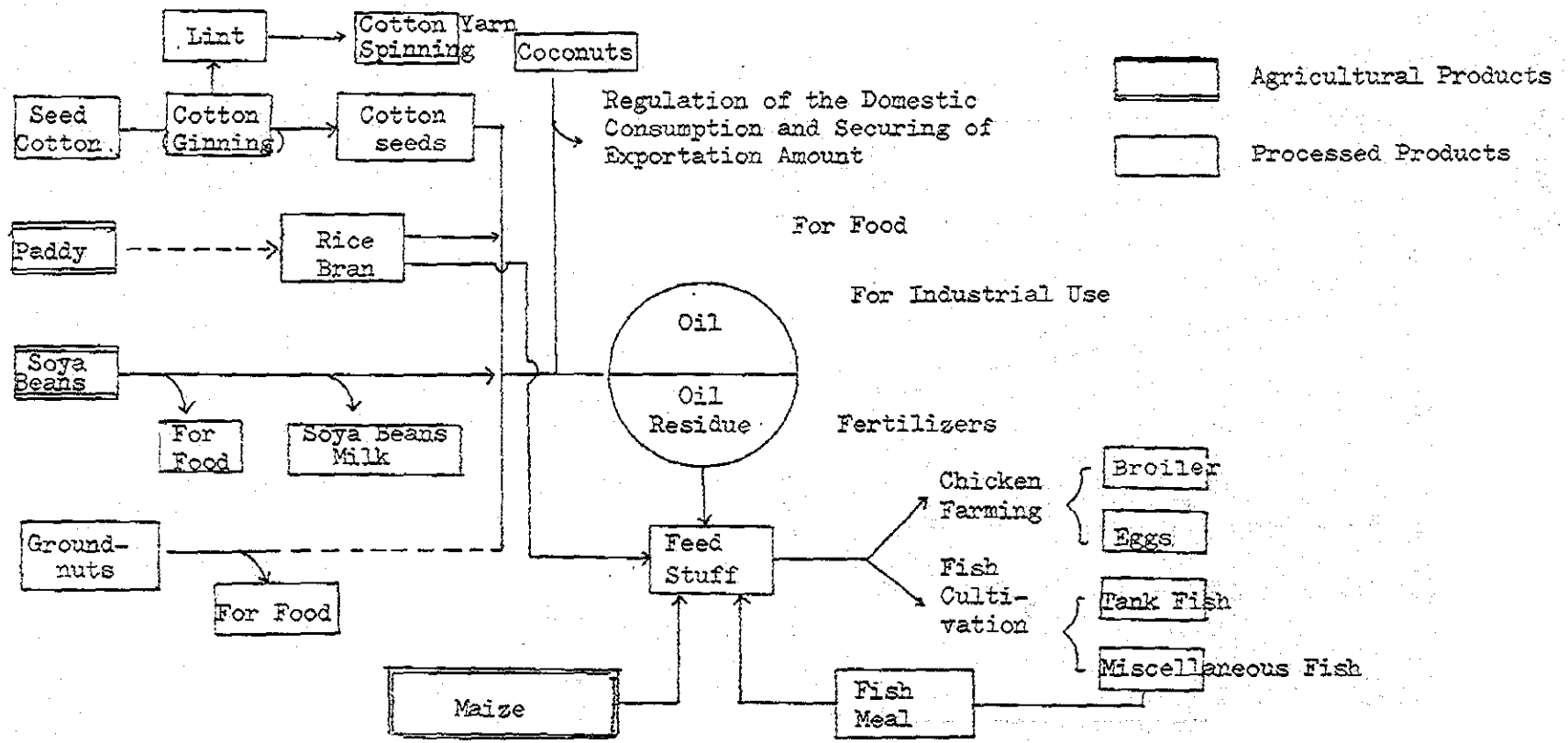
Source: Silk Yarn Year Book

Fig. VII-9 Trends of Importation Quantity and Importation Value of Jute Bags



Source: Ceylon Customs Returns

Fig. VII 10 Pattern of Agriculture-related Industries



VIII Outline of the Presently Feasible Projects

1. General

In this chapter, detailed plans will be compiled concerning each one of the industries stipulated in the "Industrialization project plan" in order to obtain estimates upon the investment amount for each industry. On the basis of such estimates, the economic evaluations in accordance with the respective patterns should be made for each industry to scrutinize the implementation thereof.

Concerning the feasible industries, no mention will be made here of such industries which will call for technical assistance such as described in the Master Plan. The descriptions here shall be made concerning other industries, i.e., wood products, oil production, feed production, cotton ginning and ceramic industries.

2. Agro-based Industry

2-1 Oil Production and Feed Production

2-1-1 Raw Materials for Oil Extraction

It has already been stated earlier that if the Mahaweli Project proceeds successfully, the oil producing crops such as stipulated in Table VIII-1 will be utilized after 1974 as the oil extraction raw materials before 1980.

Table VIII-1 Oil Producing Raw Materials

Item	Q'ty of resources	Q'ty as oil resources	Production method	Product quantity (t) Oil & fat	Product quantity (t) Feed-stuff	Use
Cotton seed	6,000t.	6,000t	Explr.	720	2,880	Oils and fats for consumption as food
Soya beans	5,200t.	2,000t.	Explr.	300	1,500	
Groundnuts	4,000t.	3,000t.	Explr.	1,200	1,500	
Castor beans*	(140t.)	(140t)	Explr.	(75)	(0)	For medical & industrial use
Rice bran**	unconfmd	-	Solv.ex.	-	-	as food

Note: Explr.: Expeller
Solv.ex.: Solvent extraction

*: Figures in ( ) not finalized as yet.

**: To be finalized after 1980.

As shown in the above table, the cotton seed oil, soya bean oil, groundnut oil, etc, will be obtainable as extracted edible vegetable oil and will be used as a substitute for coconut oil.
(At the same time, the residue by-produced from the oil extraction will be utilized as feed in order to supplement the feed shortage of the country.)
Also, is the cultivation of castor beans is to be undertaken, there is a possibility that valuable castor bean oil for medical and industrial use can be produced to replace the importation. In this case, however, the residue produced after the extraction of castor-bean oil cannot be utilized as feed because of its poisonous characteristics.

2-1-2 Plant Projects

All the above-mentioned oil commodities can be produced by means of the extraction by solvent. While the solvent method is capable of reducing the remaining extent of the oily substances in the residue to a level of approximately 1%, the expelling method, by means of expellers, normally leaves 5% to 8% of oil in the residue. Therefore, in view of the extraction efficiency, the solvent method is superior to the expelling method, however, the latter calls for large-scale plant facilities and also requires a certain level of technical skill.
Further, with such a plant there is a danger of fire and explosion.

Also, the small extent of oil remaining inside the residue is necessary as one of the feed components, so that from the view point of utilization of the residue as feed, the oil extraction does not have to be thorough.

This being the circumstance, even in the industrially advanced countries, both the expelling method and the solvent method are employed side by side. Often the expelling is undertaken in the first step and then the still remaining oil substances are further extracted by solvent in the second step.

Since it is desirable in Sri Lanka to construct plants for which the fixed investment capital requirement is minimal and the operation is of a labour intensive nature, it is recommended that, for the time being, the expelling method, by means of comparatively small sized expellers be employed.
However, it must be noted that it is not possible to extract economical oil from rice bran by means of the expeller method. Therefore, in this case only, the solvent must be employed.
The solvent method facilities, now owned by the Oils and Fats Corporation, still seem to have a surplus capacity so that the residue produced after the expeller method undertaken by this plant project can be transported to the solvent method facilities in order to further divide the residue into remaining

oil and feed. The plant project can be studied by dividing it into the following three categories.

(1) Cotton seed processing mill

The expelling of cotton seeds calls for extremely involving pretreatments. As cotton seeds contain 7% linter and 26% shell, these substances must be mechanically removed prior to processing. Otherwise no efficient oil expelling can be undertaken. If not so treated, the by-produced residue will have a much lower value as feed. Also, in the obtained crude oil, such poisonous substances as gossypol, etc. are contained so that the oil will not be edible unless these substances are removed by refining. Therefore, for the processing of cotton seeds, a specialized plant for this purpose must be constructed. This plant is planned to have a processing capacity of 6,000 tons per year (20 tons per day) (Ref. Fig.VIII-1). It is advantageous to construct this plant in the vicinity of the production areas of cotton seeds. The outline of the cost calculation of this plant is as follows.

1) Fixed Investment for Facilities

			Amount in Rs.
a)	Pre-treatment facilities (2t/hr.) x 1		400,000
b)	Expellers (w. kettle, 15HP) x2		160,000
c)	Residue conditioner	x1	40,000
d)	Crude oil refining device (5t/day) x1		1,200,000
e)	Boiler (evaporation,4t/hr.) x1		300,000
f)	Industrial water works	x1	120,000
g)	Buildings (Rs.200/m^2)	2,500 m^2	500,000
h)	Land (Rs.40/m^2)	10,000 m^2	400,000
i)	Construction cost		400,000
		Sub total:	3,520,000

2) Labour Cost (monthly)

	Rs.		Rs.
Plant manager	1 x 600		600
Skilled workers	12 x 300	(2-shift)	3,600
Unskilled workers	12 x 250		3,000
Warehouse attendants	5 x 250		1,250
Clerical workers	2 x 250		500
Electricians,boilermen	3 x 300		900
Engineer	1 x 400		400
		Sub total:	10,250

3) Balance of Payment (monthly)

Item	Remarks	Exp.(Rs.)	Income(Rs.)
Edible oil	60(t)x1,845 Rs./t		110,700
Residue (feed)	240(t)x452 Rs./t		108,480
Linter	35(t)x800 Rs./t		28,000
Cotton seeds	500(t)x417 Rs./t	208,500	
Labour cost	36 workers	101,250	
Depreciation cost	Buildings:10yrs. Mach.eqpt.:7yrs.	35,000	
Repair cost			
Utility cost		25,000	
Sub-materials cost			
General administration			
Sub Total:		278,750	247,180
Balance: (Gross profit)			-31,570

(2) Processing plant for Groundnuts, Soya beans and Castor beans

As groundnuts, soya beans and castor-beans do not call for such involving pretreatments as was called for in the case of cotton seeds, it is possible to carry out oil expelling by constructing one plant for processing these three items. Although the groundnut shells must be removed prior to feeding into the pretreatment process, the soya beans and castor-beans can be fed into the rough-crushing process directly. The castor bean oil expelling process is different from that for the other two materials in that the second step and the third step expelling should be carried out in order to minimize the remaining amount of the oil in the residue because of the fact that castor bean oil residue has no value as feed. The details of the castor oil expelling process are described in the "IDB Project Report 27". Fig. VIII-2 shows the oil expelling process for soya beans and groundnuts. The yield rate of the product as against the raw material is as follows (in the case of the expeller method).

Soya beans:

Raw material oil content:	19%	
Expelling yield rate:	15%	(Acid value 1 - 2)
Residue:	75%	

Groundnuts:

Raw material oil content:	46%	
Expelling yield rate:	40%	(Acid value 1 - 10)
Residue:	50%	

Although these products are the so-called crude oil which has merely been filtered after coming out of the expellers, southern countries consume these crude oils without carrying out any particular refining. Groundnuts and soya beans will be considered as the main materials for the process. In order to process a total production of these two materials of 5,000 tons per year, it is necessary to build two sets of plants each having a per-day p ocessing capacity of 15 tons. These plants should be installed at suitable sites within the Project area after confirming that the raw material procution will be securely undertaken.

The cost calculation of such a plant can be outlined as follows:

1) Fixed Investment for Facilities

		Amount in Rs.
a)	Pretreatment facilities 1.5t/hr. x1	120,000
b)	Expellers 15HP x2	160,000
3)	Crude oil filter 500kg/hr., w. pump x1	6,000
d)	Residue conditioner x1	40,000
e)	Small boiler Evaporation 1t/hr. x1	20,000
f)	Industrial water works x1	20,000
g)	Buildings (Rs.200/m^2) 300m^2	60,000
h)	Land (Rs.40/m^2) 1,000m^2	40,000
i)	Construction cost	100,000
	Sub total:	566,000

2) Labour Cost (monthly)

		Amount in Rs.
Chief personnel	1 x Rs.400	400
Skilled workers	4 x Rs.300 (2-shift)	1,200
Unskilled workers	8 x Rs.250 (2-shift)	2,000
	Sub total:	3,600

3) Balance of Payment (monthly)

(In the case of processing 400 tons of soya beans)

Item	Remarks	Exp.(Rs.)	In. (Rs.)
Edible oil	60(t)x1,850 Rs./t		111,000
Residue (feed)	300(t)x 637Rs./t		191,100
Soya beans	400(t)x 743 Rs./t	297,200	
Labour cost	13 personnel	3,600	
Depreciation cost	Buildings:10yrs. Mach.eqpt.:7yrs.	6,000	
Repair cost			
Utility cost			
Sub-material cost		15,000	
General administration cost			
Sub total		321,800	302,100
Balance: (Gross profit)			-19,700

In the case of groundmut oil, the profit will be less than the above figure.

(3) Rice Bran Processing Plant

The extraction of oil from rice bran is not feasible in Sri Lanka until 1980. Therefore, the outline only of this project will be described here for the purpose of reference to serve for the future project in this respect. In the light of the example of India, the oil content of rice bran of Sri Lanka is expected to be on a comparatively low level of approximately 15%. (In the case of Japan, the content is 18% to 20%). Therefore, the crude oil amount obtainable through the extraction process will be 13% and the de-oiled rice bran amount is estimated therefore to be approximately 80%. As the acid value of the collected rice bran is high, the acid value of the extracted crude oil will be approximately 40. This implies that the extent of the edible oil obtainable for the crude oil will be, at the most, 45% as against the amount of the crude oil. The remaining approximately 45% may not be utilized for any other directions than for low grade industrial oil. At the same time, approximately 3% of wax substance will be by-produced at the extraction process.

At present in Burma, the production of edible oil by means of rice bran extraction is being carried out under technical

cooperation with Japan. In India, there are a number of rice oil extraction plants,however, there are few cases in which the production of edible oil from rice bran oil is being carried out with success.

Fig. VIII-3 shows the oil extraction process from rice bran. As the minimum economical scale for such a plant, the monthly rice bran processing amount should be 500 tons, i.e., 20 tons per day on the basis of 25 days/month, 12 hours/day operation. On the basis of assuming this scale of a plant, the outline of the required investment and the profit-loss estimation are estimated as follows.

1) Fixed Capital Investment : Rs.3,500,000

Required personnel:	Plant manager	1
	Supervisor	1
	Skilled operators	4
	General workers	14
	Total:	20 persons

2) Balance of Payment

(When processing 500 tons of rice bran)

Item	Remarks	Exp.(Rs.)	In.(Rs.)
Edible oil	30(t) x 2,380 Rs./t		71,400
Industrial oil	30(t) x 1,319 Rs./t		39,570
De-oiled bran	400(t) x 204 Rs./t		81,600
Rice bran		85,000	
Processing cost	Such cost items as labour, fuel, solvent, electricity,etc.	30,000	
	Oil production: Rs.60x500t	30,000	
	Refining: Rs.100x60t	6,000	
Facilities depreciation		40,000	
Miscellaneous cost		6,000	
Sub total:		167,000	192,570
Balance (Gross profit):			+25,570

2-2 Cotton Ginning

2-2-1 Prerequisite Conditions

(1) Administration of a Cotton Ginning Mill

The cotton produced in the H area of the Mahaweli Project Area is of the middle-grade cotton and it is expected that the Thulhiriya Mill (the location of which is the closest to the H area) is the plant where this type of cotton will be consumed in a large amount. Therefore, it is desirable that the administration of such a cotton ginning mill be undertaken by the National Textile Corporation.

The reason for this suggestion is that the problems pertaining to the spinning operation of cotton can then be promptly fed back to the cotton ginning mill for appropriate action.

(2) The Plant Site

It is a usual practice to undertake cotton ginning operation in a location as close as possible to the cotton cultivation area in order to divide the seed cotton into cotton lint and cotton seeds. This is due to the fact that the seed cotton is bulky, thereby calling for a higher extent of transportation cost.

Following four major points should be particularly noted in constructing a cotton ginning mill.

a) The mill site should be close as possible to the cotton cultivation area

b) Electrical power should be easily available

c) The transportation facilities for cotton should be easily available (Generally, railway transportation is more advantageous than by trucks)

d) Labour force can be amply secured

Of the available sites within the H area of the Mahaweli Project area, Kekirawa seems to satisfy all the above prerequisite conditions.

Further, the area is located in the centre of the cotton cultivation and the electricity power source is also available (a high voltage transmission line of 30,000 is already existing). Also, this site is in a close vicinity of railways and highways.

(3) Types of Ginning

There are following types of gins presently available .

Roller Gin (Macarthy gin, Knife roller gin,)

Saw Gin

Of the above two, the saw gin has a higher extent of productivity. This is the method which is employed for the production of the U.S. Cotton. The saw gin is considered to be suitable for application to the Mahaweli Project areas as the cultivation of HC101, middle grade cotton, is scheduled there.

(4) Storing of Seed Cotton

Generally speaking, the harvesting of HC101, is undertaken during the February/March period. It is presumed that all the yield shall be packed in 50kg hessian cloth sacks and shall be transported from the farmers houses to the warehouse of the cotton ginning mill. As the trucks necessary for the transportation of the yield will be called for only during the harvest season so that the vehicles should be procured by chartering contracts.

(5) Products obtained from Seed Cotton

From the seed cotton, cotton and cotton seeds will be produced at the ginning mill. Generally, cotton lint yield is 1/3 of the seed cotton and the remainder is cotton seeds. The cotton shall be destined to the spinning mill and the cotton seeds shall be used as the oil extraction raw materials.

(6) Construction Method of Cotton Ginning Mill

As shown in Table VIII-2, the seed cotton production amount in 1976 was 1,800 tons. This production amount seems to satisfy the level on which a cotton ginning mill can be operated. Therefore, a mill for cotton ginning is suggested to be constructed firstly and the production capacity should be expanded in pace with the increment in the production amount of seed cotton. This being the case, scrutinizations here shall be made solely upon the case for the year 1976.

The harvesting of cotton is carried out during a limited season, however, the cotton ginning mill should be assumed to be operated throughout the year.

(7) Transportation of cotton

Transportation of cotton shall be undertaken by means of trucks from the cotton ginning mill to the Thulhiriya Mill (Normally, railway transportation calls for lower transportation cost, however, in the case of Sri Lanka no surplus is available from freighter train transportation capacity. Also, as it is not expected that improvement in this respect will be made for the foreseeable future, the truck transportation method is adopted here.)

2-2-2 Investment Amount

		(in Mil. Rs.)
Machinery	(Gin, etc. incl. installation)	0.385
Mill ($500m^2$)		0.087
Warehouse ($2,500m^2$)		0.393
Lift	1 unit	0.029
		0.894

However, the unit cost for mill building shall be Rs.173/m^2, warehouse Rs.157/m^2.

2-2-3 Production Costs

(1) Prerequisite conditions

Seed cotton shall be purchased from farmers at the price of Rs.95/50.9kg (Rs.95/cwt).

The total amount of seed cotton shall be purchased from the farmers during the harvesting season and the purchased crops

shall be stored in the warehouse of the cotton ginning mill. The interest on the purchasing funds shall be 7% p.a. and the average storing period is 6 months. The fixed installment method shall be employed for depreciation and the depreciation period of 10 years shall be taken for the machines, the mill, and the warehouse, 5 years for the lift.

Electricity cost: Rs.0.11/KWH
Packaging cost Rs.45/ton for cotton, Rs.35/ton for seed cotton and cotton seeds.

The personnel shall consist of 30 persons including the mill manager under 3-shift and the average wage shall be Rs.3,870 per year.

The operation funds shall be equivalent to two months worth of packing material cost and wages. The interest to be imposed thereupon shall be 7% p.a.

The transportation shall be undertaken as follows:
(Distance)
Seed cotton: From farmers houses to the cotton ginning mill: Average 16 km
Cotton: From the cotton ginning mill to Thulhiriya mill: 122 km
Cotton seeds: From the cotton ginning mill to the oil extraction plant: 1.6km

(Transportation costs)
The transportation cost is estimated to be Rs.0.62/km/ton in all the above cases.

The number of operating days shall be 290 days/year. The by-produced cotton seeds price shall be estimated at Rs.417/ton (This figure was the average figure of the cotton seed export FOB prices of various Asian countries stipulated in the "Trade Yearbook" of FAO.)

(2) Cost calculation

	(in million Rs.)
Raw materials (Seed cotton, 1,800 tons)	3,360
Labour cost	0.116
Charges: Electricity	0.015
Packing materials	0.132
Maintenance servicing, repair	0.009
Clerical costs at the mill	0.009
Depreciations:	
Machinery:	0.039
Mill and warehouse:	0.084
Lift:	0.006
Production cost	3.734
Interests :	
Raw materials	0.118
Operation funds	0.004
Transportation costs	0.065
	3.921
Revenue from by-products:	
Cotton seeds (1,200 tons)	0.500
Production cost (cotton 600 tons)	3.421

Unit production cost of cotton: Rs.5.70/kg.

In other words, cotton can be procured at Rs.5.70 per kilogramme. At present, the ex-factory price of the Sudan cotton is approximately Rs.5.8/kg. so that the profit margin for the cotton ginning mill may be small, however, it must be noted that this operation will be sufficiently significant as the import substitution.

3. Forest Industry

Descriptions will be made in the following paragraphs regarding the saw mill project, plywood materials project, the wood felling for export project, and chipboard plant project.

3-1 Log Felling Project

The distribution of the wood resources in relation to the above-mentioned project is as shown in Table VIII-3.

3-2 Details of each project

3-2-1 Saw mill

As far as the lumbering operation is concerned, an already operating mill is already present at Minneriya. It is desirable, therefore, that this activity be undertaken within the framework of the State Timber Corporation.

(1) Material logs

The processing of the large diameter woods (diameter 30cm or more) amounting to 1.92 million ft^3 except for the valuable wood resources and 1.92 million ft^3 of the large diameter valuable wood resources within the project area, totalling 3.84 million ft^3 shall be undertaken for a period of ten years.

(2) Mills

The mill is located in Minneriya.

The processing capacity (yield rate 45%): 173,000 ft^3/year.

Constant operators:19. Required logs:384,000 ft^3.

(3) Material log production

The felling amount within the project area:384,000 ft^3/year.

Constant operators:16

(4) Production process

The production process is shown in Table VIII-4.

(5) Production organization

Refer to Table VIII-5

(6) Production facilities and production costs

The production facilities and production costs are respectively shown in Table VIII-6 and Table VIII-7.

From the tables, the total of the lumbering cost will be calculated as follows:

A + B + C + D + E + F + (E + F) X 0.024* = Rs.411,120

*Interest on the operation fund (for 3 months)

The felling cost is as follows:

a + b + c + d + e + f +(e + f) x 0.024* = Rs.185,870

*Interest on the operation fund (for 3 months)

1) Production costs

a) Lumbering production cost per ft^3

Rs.411,120 ÷ 173,000 ft^3 = Rs.2.38 .....(i)

b) Material log production cost

Rs.185,870 ÷ 173,000 ft^3 = Rs.1.07

Converted into logs (yield rate 45%)

1.07 ÷ 0.45 = Rs. 2.39/ft^3 .....(ii)

c) Sawn lumber production cost

(i) + (ii) = Rs. 4.77/ft^3

2) Profit and loss calculation

a) Sawn lumber price

The number of species of the wood which belongs to Class 2 is high so that the average of the Class 2, i.e. $\frac{Rs.9.50 + 12.50}{2}$ = Rs.11.00 and average of Class III, i.e., $\frac{Rs.8.0 + 11.0}{2}$ = Rs.9.50 are both calculated at first.

The price is deemed to stay somewhere between these two figures and, therefore, estimated at Rs.10.00/ft^3.

b) Annual sales revenue

(Rs.10,00 - Rs.4.77) x 173,000 ft^3 = Rs.904,790

3) Annual employment

33 persons:	Wage:	Saw mill	Rs.70,000
		Felling	57,800
		Total	Rs.127,800

3-2-2 Material log production for plywood plant

Supply will be made for ten years, with annual supply amount of 0.192 million ft^3, to the existing plant in the southern part by collecting one third of the 5.76 million ft^3 of valuable woods in the project are (of more than 30cm in diameter), i.e., 1.92 million ft^3.

The total of this production amount and the export-destined log material production amount (which will be discussed later) is equivalent to the amount of the above-mentioned log materials for lumbering. The production capacity and the operation and administration costs for this operation corresponds to 1/2 of the felling section which is stipulated in Table VIII-7. Concerning the production cost, the transportation cost from the Minneriya area will be added to the above-mentioned figure of Rs.1.07/ft^3. If the transportation cost is assumed here as being Rs.0.15 per ft^3, the following will ensue:

Production cost at the plywood plant: Rs. 1.07 + Rs.0.15 = Rs. 1.22 per ft^3. These log materials are to be utilized to contribute to the production increment of the Plywood Corporation so that it is difficult to estimate the selling price therof, however, if the production cost is excessively high, this is considered possible to destine the products to export. Also, an assumption is made that the plywood plant will receive the material at the minimum log material price of Rs.4.50 per ft^3 of Class II, the

yearly sales revenue can be calculated as follows:

Sales revenue: (Rs.4.50 - Rs. 1.22) x 192,000 ft^3 = Rs. 629,760

The investment amount required for this project: Rs.292,000 ÷ 2

= Rs.146,000

Employment: 14 persons ÷ 2 = 7 persons

Wages: Rs.57,800 ÷ 2 = Rs.28,900

3-2-3 Log material production for export

The same amount of the valuable woods similar to ones destined to domestic plywood factory (1.92 million ft^3) shall be exported during a period of ten years at a rate of 0.192 million ft^3 per year. The port of export shall be Trincomalee. Concerning the production facilities, the operation and administration costs, three factors correspond to the felling section stipulated in Table VIII-7.

In the case of the production cost of these export materials, transportation charges from the Minneriya area shall be added to the material log production cost (Rs. 1.07 per ft^3). If this transportation cost is estimated as being Rs.0.10 per ft^3 , the production cost of the material at the wharf of the port of export will be as follows:

Rs. 1.07 + Rs. 0.10 = Rs. 1.17 per ft^3.

Whereas, export of such species as Satinwood, Kaluwara, Milla, Halmilla, Timbiri, Palau, Panaka, etc. will have demands as

the face veneer materials which have a high demand in overseas markets. Although the prices for these different species of woods are not necessarily on the same level, it is forecasted that Rs.7.00 per ft^3 ex-ship will be the price level. Therefore, the estimated annual sales revenue is as follows:

Revenue: (Rs.7.00 - Rs. 1.17) x 192,000 ft^3 = Rs. 1,119,360.
Investment amount required: Rs.29,200 ÷ 2 = Rs.146,000
Annual employment: 14 persons ÷ 2 = 7 persons
Wages: Rs.57,800 ÷ 2 = Rs.28,900

3-2-4 Chipboard Industry

(1) Raw materials

As mentioned earlier, the 20.5 million ft^3 shall constitute the main supply to be obtained from the scheduled tree stock inside the project area, however, if any shortage should be present, the wasted woods produced in the saw mills existing inside the area will also be used and also the low grade woods obtained from the Phase II area will be consumed. The supply to the plant shall be undertaken in ten-year installments.

(2) Plant

Production capacity: 36,000 tons/year. Log consumption:2.05 million ft^3/ year. Constantly employed operators:58 persons. Location:Trincomalee

(3) Log production

Felling amount from all over the project area: 2,050,000 ft^3/year.
Constant employees: 54 persons

(4) Product

As the plant facility is also used for the production of multi-layer boards, the products to be turned out from this plant will be versatile.

(5) Production process

The production process is shown in Table VIII-8

(6) Production Organization

Production organization is shown in Table VIII-9

(7) Production facilities and production costs

The production facilities and production costs are respectively shown in Tables VIII-10 and VIII-11.

Total of annual production costs: A + B + C + D + E + F + (E + F) x 0.24* = Rs.843,650. * Interest on operation funds for three months

Log production unit cost:

Rs.843,650 ÷ 2,050,000 ft^3 = Rs.0.41 per ft^3

Raw material cost: Rs. 0.41 per ft^3 x 2,050,000 ft^3 = Rs 840,500 (G)

1) Production cost

a) Annual production cost total

(A) + (B) + (C) + (D) + (E) + (F) + (G) + ((F) + (G)) x 0.024*

≒ Rs.12,681,700 *Interest on operation funds for three months

b) Unit production cost (ex-factory price)

Rs.12,681,700 ÷ 36 000 ≒ Rs.352 per ton . . . . US$59.2 per ton

c) Sales price (ex-factory)

(Japanese market price: US$120/ton. Transportation up to Japan and sales charges US$25/ton)

Therefore, US$95/ton

2) Sales profit and loss

Annual sales revenue: (US$95. - US$59.2) x 36,000 t = US$1,288,800

..... Rs.7,667,300

3) Annual employment: 58 persons. Wages: Rs.228,500

3-3 Outline

3-3-1 Outline of the enterprise

Table VIII-12 shows the outline of the enterprise

3-3-2 The required amounts of local currency and foreign currency

Table VIII-13 shows the outline of the necessary local currency and foreign currency. The details of this table are further shown in Table VIII-14.

4. Ceramic Industry

4-1 Selection of the ceramic products

4-1-1 General

Number of conditions are present whenever a project for planning of industrial establishment is to be scrutinized, however, the following paragraphs describe the main items of the conditions from which the ceramic industry is not an exception.

(1) Raw materials

As has been mentioned to a certain extent in the earlier part of this report, one of the important factors in the ceramic industry is the grade of raw materials. Approximately 15% of crystal water is contained in the clay which is the main material for ceramic products. When the products are made by using this raw material, the weight of reduction will take place due to the evaporation of this water. Also, further quantity reduction during the production process is present. A long distance transportation of raw material would be disadvantageous cost-wise, except for special types of raw materials.

(2) Market

One of the important factors here is the location of the market

as well as the extent of demand. If the location of the market is far away from the production site, the transportation charges will increase, thereby making the operation disadvantageous. When the transportation charges are taken into consideration, there would be no problem if the excavation areas of the raw materials and the market location were identical. However, if these two locations are away from each other, the question as to establish the plant, i.e., whether close to the raw material excavation areas or to the market, is a problem which should be assessed by taking various other factors into consideration.

(3) The availability of labour force and sub-materials

As already mentioned regarding the site conditions of Mahaweli project area, when the Mahaweli project areas are considered, it seems that the availability of low class labour force is sufficient. Regarding the high class skilled labour force, it does not seem necessary to limit the scope of consideration within the frame-work of the project area.

Therefore, the skilled labour force supply can also be deemed to be abundant and sufficient. In this respect, the industry de-centralization policy of the government will be helpful in scheming the skilled labour force requirement. Concerning the sub-materials and utilities, the necessary items would be electricity, heavy oil, etc. Concerning electricity, no problems seem to be present as has been mentioned earlier. Regarding

heavy oil, the Ceylon Petroleum Corporation is undertaking the selling and distribution of heavy oil by utilising its own lorries. Also, efforts are being exerted by the Corporation in order to minimize local differences in the price of heavy oil. Therefore, it can be assumed that no practical problem will be present in this respect. In other words, in view of the availability of labour force and the sub-materials, Mahaweli project area cannot be considered as being unsuitable for the project.

4-1-2 Selection of the products

(1) Regarding the raw materials and the demand for the products, the scrutinization concerning various ceramic industry plants, which were the subjects of the present survey, revealed that the raw materials partially available for making refractories, dishware, tiles, and sanitary ware. However, the fact that the main raw materials for these items are not available inside Mahaweli project area, there are several problems in the industrialized production of these items.

On the other hand, concerning the above-mentioned products, exception of the refractories, the production activities are being undertaken in the other areas. Therefore, several projects are being under contemplation elsewhere not for filling the domestic demands, but as export projects. Therefore, the types of ceramic industry which are worthy of scrutinization here are as follows:

a) Earthen pipe project

b) Red brick project

c) Roofing tile project

(2) Market

In Sri Lanka, the production of earthen pipe, red bricks and roofing tiles are already undertaken, however, the demand amount for these items is not yet high. Especially in the Mahaweli project area, two factories are already existing adjacent to each other in which the production of red bricks and roofing tiles can be undertaken. However, those are now in the state of idling so that, actually, the supply of these materials in the area is close to none. The detailed explanation will be made concerning these products in the following paragraphs, however, if the development and the urban constructions are to be undertaken in the Mahaweli project area, the demand for red bricks, roofing tiles and earthen pipes will concentratedly emerge due to such activities as civil engineering and construction, sewerage system construction, irrigation works, water works, etc. If these items are purchased and transported into the project area from other areas, it would not only invite highly increased cost, but will also make the realization of the urban development project itself impossible under the present circumstances because of the fact that the supply capacity covering such a large demand is not available from any other areas.

Naturally, it is possible to substitute the above-mentioned construction materials with cement products, however, when comparing with concrete tubes, earthen pipes (glazed pipes) possess the following advantages;

1) Due to the sintering conducted at the optimum temperature, yield strength is better.
2) As the surface is glazed, permanent resistance performance is displayed against acid and alkali.
3) The bent pipes, branched pipes, joints and other shaped tubes can be prepared in high versatility in accordance with the application requirements.
4) Due to the fact that the surface of earthen pipes is smooth, the precipitation from sewage can be easily removed and at the same time the maintenance and administration will be facilitated.

As it is expected that the above-mentioned construction materials can be produced by using only the domestically available raw materials and also the expansion of the employment opportunity in relation to such production activities is possible, it is considered that the industrialization of this enterprise is exactly suitable for the basic policy of the Five Year Plan.

4-1-3 Ceramic plants which exist in the Mahaweli project area

As was mentioned earlier, there exist the ceramic industry

as the brick factory on the domestic industry scale and the brick and tile factory on the big scale in the suburbs of Anuradhapura, Tissawewa.

These factories are closed down at present. Therefore it would be advantageous for the ceramic industry of this area to resume production activities in this factory after undertaking, rehabilitation to the this plant facilities.

4-2 Capacity set up

4-2-1 General

Concerning the establishment of capacity, the following two points must be taken into consideration as the basis for scrutinization.

(1) Demand capacity

(2) Production capacity on the economic operation unit

In other words, if the demand amount is low and, at the same time, if the production amount cannot exceed the economical operation unit, no enterprise is feasible as an industry. Therefore, in order to establish a target for the production capacity, these two points must be scrutinized in the outset.

4-2-2 Demand forecast

The product-wise demand forecast is as follows.

(1) Demand forecast for red brick

(1) The present market situation in Sri Lanka

a) According to the "Ceramic & Non-metallic Mineral Products in 1970" (Ministry of Industries and Scientific Affairs), the extent of demand is 3,335,300 pieces/year from the public corporations and 904,400 pieces/year in private industries, totalling approximately 4,240,000 pieces/year.

b) In accordance with a report dated 20th February 1973, complied by the Building Materials Corporation, the demand extent is indicated as being 245,000,000 pieces/year.

c) According to "A Report on the Cottage Brick Industry as it Exists in Ceylon Today" (E. I. Munasinka, Building Department), the total production amount is approximately 500,000,000 pieces/year. As mentioned above, it is lightly difficult to grasp the extent of demands in terms of figures. It is said that there are approximately 2,000 brick factories in Sri Lanka, the majority of which are operating on the cottage scale production. Therefore the actual production figures achieved by these factories are extremely difficult to assess. For the sake of clarity, the actual quantity for the total production is assumed in this report as 500,000,000 pieces

containing approximately four million pieces of the standardised items.

2) The market forecast

According to the "Financing of Housing and Urban Development in Sri Lanka", published by the Department of National Housing, the construction schedule for resident housing is set forth for 70,000 houses a year. If all the "Sand Crete Bricks" to be used for the model house were substituted in total by the standard red bricks, approximately 1,400 bricks per house will be required. By assuming that the yearly demand amount increased by this degree, the following will ensue:

1,400 pieces per house x 70,000 houses = 98,000,000 pieces (approximately 100,000,000) will be the annual incremented demand.

The above figures were obtained on the basis of general resident housing. If high class housing, hotels, factory constructions are to be also taken into consideration, the demand scale will further expanded. When implementing the Mahaweli development projects which have recently being projected, there would be certain concentrated demands of red bricks for the construction of urban areas.

Therefore, the demand increment in this respect must also be taken into consideration.

3) Establishment of demand capacity

If an excessively high demand capacity is established, it would be difficult to expect a stable operation Certain allowance in this respect must be incorporated into the above quoted figures. The establishment of the demand scope by so doing will be as follows:

a) If it is assumed that yearly demand increment by 100,000,000 pieces centering around the housing demand should arise, the demand increment for five years after 1974 would be 500,000,000 pieces.

b) In order to cope with this increment, it would be necessary to take action in order to quickly resume stable operation of the presently idling plants.

(2) Demand for earthen pipes

Earthen pipes and cement pipes are being utilized as the pipes for sewage facilities. However, due to the lack of the production capacity of earthen pipes, cement pipes are mostly utilized at present. Here, the demand forecast is made on the assumption that earthen pipes will be utilized

for the sewage systems except in the case of extremely large sized or special specifications.

1) The supply/demand situation in Sri Lanka at present

The production amounts are as follows according to the "Ceramic and Non-metallic Mineral Products in 1970,"

Earthen Pipes: yearly production 75,000 pieces

Concrete pipes: yearly production 75,000 pieces

Above totals approximately 150,000 pieces. This figure can be considered as being the present scope of demand.

2) The demand capacity along with the development of the Mahaweli project areas.

The calculation results shown in Table VIII-15 have been obtained on the basis of the "Requirements of reinforced Concrete Spun Pipes" complied by the MDB. If conversion calculations are made on the basis of the standard dimensions of earthen pipes in Japan, the results shown in Table VIII-16 will be obtained. For reference, the standard dimensions of earthen pipes in Japan are as follows:

diameter	length	weight
229 mm	660 mm	35 kg
305 mm	660 mm	50 kg
381 mm	660 mm	75 kg
457 mm	660 mm	105 kg
609 mm	660 mm	175 kg

As shown above, the earthen pipes to be utilized during Stage II of the Mahaweli project will be approximately 25,000 pieces weighing 3,900 tons, so that if the construction is to be executed within the five years, the yearly figure will then be 5,000 pieces, weighing 780 tons.

3) Demand forecast for earthen pipes in Sri Lanka

The Sri Lanka demand amount for earthen pipes is 150,000 pieces including those cement pipes to be substituted by earthen pipes. If the average weight figures of these earthen pipes are identical to the above mentioned items, the weight will be approximately 23,000 tons. It is natural that the further development in the demand will be materialized in Sri Lanka as a whole and yearly increment of demand by 5% to 10% is expected. Therefore, the yearly demand increment will be 1,150 tons to 2,300 tons.

4) Establishment of demand capacity

In accordance with the forecast made in the foregoing, the following demand extent establishment is now possible.

Demand in accordance with the development of the Mahaweli project area: 5,000 pieces/year

Other general demand (10% increment): 15,000 pieces/year

Total: (Approximately 3,200 tons/year)

(3) Demand for roofing tiles

1) The present demand for roofing tiles in Sri Lanka:

a) According to the "Ceramic and Non-metallic Mineral Products in 1970," the annual production amount is said to be 32,745,000 pieces.

b) According to the "Geological Survey of Ceylon Exhibition (1970)", relative figures are shown as follows:

Private industries:	35,000,000 pieces
Public Corporations:	15,000,000 pieces
Public Corporations: (under contemplation)	3,000,000 pieces

The above totals 53,000,000. However, these figures

include production amount which is presently under contemplation and also includes the production amount which is expected from the presently idling production facilities. Therefore, the actual production amount should be less than the above figure.

c) In accordance with the materials dated 20th February 1973 complied by the Building Materials Corporation, the annual demand amount is 24,000,000 pieces.

2) Forecast on the demand increment

According to the "Financing of Housing and Urban Development in Sri Lanka", published by the Department of National Housing, the scheduled construction of the residental houses are 70,000 houses per year.

The roofing tiles to be employed for the model house amounts to 1,590 pieces (approx. 1,600 pieces) of the standard types and 40 pieces of ridge tiles so that the annual demand can be estimated as follows:

Standard types:	1,600 pieces/house X 70,000 houses	
	= 112,000,000 pieces	
Ridge tiles:	40 pieces/house X 70,000 houses	
	= 2,800,000 pieces	
Total:	114,800,000 pieces	

If it is supposed that half of the above figures is taken up by utilization of asbestos roofing tile, the demand increase for the sintered roofing tiles can be expected as being approximately 60,000,000 pieces per year.

3) Establishment of demand capacity

The present production capacity of roofing tiles is 53,000,000 pieces per year, however, the actual demand amount is 24,000,000 pieces for residential houses. In addition to this, the buildings other than residential houses take up approximately 33,000,000 pieces of roofing tiles. (According to the "Ceramic and Non-metallic Mineral Products in 1970").

This implies that even if the rehabilitation and repair were given to the presently idling factories and full capacity operations were undertaken, the production capacity will still be short of the demand. Incidentally, if the average weight is taken at 2.5 Kgs, the annual demand becomes 150,000 tons.

4-2-3 The Economic scale of production unit

In the case of considering the economic scale of production unit the solution to the problem will be different depending upon the selection of the production process and the type of production facilities. The point which particularly becomes a problem will

be the sintering kiln. Concerning the selection of the kiln, the discussion will be made in the latter part of this report, however, it is assumed here for the sake of clarity that in this project a tunnel kiln is to be adopted at all the newly installed plants. If in the case of adopting a tunnel kiln, the kiln itself may have a capacity limitation depending upon the types of the products to be sintered, however, the performance efficiency is generally higher when the size of the kiln is larger. The kiln scrutinization in accordance with the subject products is as follows:

(1) Red Brick

In considering the maintenance of operation the economic scale of the unit will be within the range of 10,000,000 pieces to 12,000,000 pieces per year. If a new plant is to be constructed in order to cope with the demand increase for the forthcoming five years, plant construction of four to five units per year will become necessary.

(2) Earthen pipes

The economic unit is approximately 6,000 tons per year. If one plant is constructed, it would be possible to cope with the demand for approximately two years to come.

(3) Roofing tiles

The economic unit in this case is 3,000,000 pieces-per-year production and in order to the increased demand in the future, a plant construction of approximately 10 to 20 units will be necessary.

4-3 Realization of ceramic industry projects

4-3-1 General

It seems advantageous to construct a ceramic industrial plant along with the advancement of the development of the Mahaweli area. The following three items are recommended as the ceramic industry products, i.e., red bricks, earthen pipes, and roofing tiles. On the other hand, scrutinization of the following points in necessary as the requisite conditions at the time of deciding the plant sites for the ceramic industry.

a) Raw materials must be easily obtainable
b) Delivery of the products can be conveniently conducted
c) The intensification of labour forces must be possible
d) The sub-materials (fuels, electricity, industrial water), must be obtainable on a low cost
e) The ground bearing should be more than ten tons per square meter
f) Red bricks, earthen pipes and roofing tiles must be produceable within the same area and at the same time, sufficient space allowance must be provided in order to enable future expansion of the plant facilities.

4-3-2 The rehabilitation of the existing plants

At present a roofing tile plant and a red brick plant are idling in Tissawewa. As has been mentioned earlier, the production of red bricks and roofing tiles in Sri Lanka is tending to present shortage and therefore, in view of the expected increment in demand in the future, the most effective means which can be taken at present is to rehabilitate these idling plants and bring them up to carry out stable operation. In view of the plant site conditions, these two idling plants seem to satisfy the conditions stipulated in the foregoing 4-3-1.

(1) Facilities of the existing plants

The capacity of the facilities of the existing plants and the number of the devices are shown in Table VIII-17.

(2) Rehabilitation of the plants

1) Causes for idling

In order to scrutinize the ways and means for the rehabilitation of the idling plants, it is necessary to confirm the causes which necessitated the idling of the plants.

The causes can be classified into the following categories:

a) Managerial problems

b) Technical problems

2) Managerial problems

a) Concerning sales aspect:

It is suspected that one of the causes for preventing the

plant operation from taking positive activities is the fact that no active demand was so far been generated within this area. This problem will be automatically solved along with the implementation of the Mahaweli area development projects in the future.

b) The production cost aspect

Apart from the technical problems, the first point to be noted here is the excess in the depreciation cost. The main production facilities have been entirely dependant upon importation. In such a case, the imported machinery and equipment will not only lead to indirect foreign currency reserve expenditure but also cause the additional imposition of a high amount of FEECS, taxation, etc. Therefore, in the case of employing imported machinery and equipment, the actually paid amount attains a level of approximately 1.8 times the actually paid foreign reserve amount. Also, regarding the locally available equipment and materials, the iron and steel materials also attain approximately 1.8 times the international price levels. This being the case, the facilities become apparently expensive so that the depreciation cost will inevitably be augmented.

Also, if the construction cost is not deemed to be covered by the own fund but is financed by loan from the governmental funds, the interest thereupon will also become high due

to the fact that the facility cost is already very high. The end products are generally low in the sales price so that it is easy to imagine that the rate comprised by the above-mentioned depreciation cost and interest in the production cost will be considerably high.

3) Technical problems

a) Concerning raw materials

Products of satisfactory quality cannot be produced if the raw material plasticity is too high or too low. If the plasticity extent is either extremely high or low, the production itself may become impossible. The particles clay produced in the Mahaweli project area are of such quality as can be used as raw materials and if the cause for the idling of the plant were attributable to the quality of the clay, it is necessary to adjust plasticity of the raw materials. Practically, the following points should be considered:

(a) It is necessary to so provide that a large amount of raw material clay can be utilized uniformly in its quality.

(b) Adjustment of the plasticity of the raw materials should be carried out by adding rocky material, if the plasticity of the clay is too high. The adjustment must be undertaken by

blending clay of high plasticity , if the low plasticity clay is used.

(c) Aging should be carried out.

b) Concerning kiln

The kiln presently installed is a ring kiln. A ring kiln is effective for carrying out sintering operation of low grade clay products because of low extent of construction cost and the comparatively low level of fuel requirement However, this type of kiln has a larger kiln cross section and the fuel used is wooden materials. In addition, loading and unloading of the semi-finished products (green body) are undertaken manually so that it is impossible to carry out a high temperature uniform sintering. The case of breakage is also high. As a result, it has been difficult to obtain high quality products and the yield rate has been kept low.

From the foregoing situations it is recommendable that the presently existing ring kiln should be primarily em loyed for producing earthen pipes which call for com aratively low level of heat load and, at the same time, red brick sintering should also be undertaken in order to enhance the sintering efficiency. Due to the fact that the sintering is undertaken manually in the case of ring kiln, training should be given to sintering operators and also it seems necessary to firmly establish the standard method for the sintering operation

c) Regarding operation after the completion of plant rehabilitation

Production status and the existing facility status after the completion of the plant rehabilitation will be as follows:

The material preparation, forming and drying facilities presently existing (Items No. 1-12)

Roofing tile 2,800,000 pieces/year

Existing ring kiln

Earthen pipes 20,000 pieces/year (3,200 tons/year)

4-3-3 Expansion of the machinery and equipment

As has been mentioned in the foregoing, if the rehabilitation of the existing plants is completed, it would be possible to carry out the forming and drying of roofing tiles and the sintering of earthen pipes. Therefore, if the following facilities are additionally installed, the production of roofing tiles and earthen pipes within the famework of the existing plants will become possible.

(1) Sintering facilities for roofing tiles (on the basis of the production amount of 2,800,000 pieces/year)

If flat and also uniform quality roofing tiles are desired to be turned out, it is necessary to install a facility by means of which uniform sintering can be undertaken without piling the tiles too much. A tunnel kiln is suitable for such an operation as to

carry out sintering of this type under mass production scale.
As the capacity of 2,800,000 pieces per year is the amount equivalent to an economical unit, it is recommended that installation of one unit of tunnel kiln be undertaken.

(2) Production facility for earthen pipes (On the basis of production amount of 20,000 pieces/year)
As it is possible to carry out sintering of earthen pipes by employing the existing ring kiln, the entire earthen pipe production will become possible if the raw-material preparation, forming and drying facilities are additionally installed.

4-3-4 Establishment of a new plant

By carrying out the rehabilitation and expansion of the facilities at the existing Tissawewa roofing tile and brick plant, the production of earthen pipes and roofing tiles to cope with the forecasted damand will become possible. The subsequent problem is the industrialization of the red brick producing industry.
As has been mentioned earlier, the demand for red bricks in Sri Lanka as a whole will involve demand increment of 500,000,000 pieces per year. When expressed in terms of economical unit, this amount corresponds to 4 to 5 units.
As the above-mentioned increment in demand is not intended to cover the Mahaweli project area alone, it is recommended that roject should be laid out for a construction of one unit capacity plant (12,000,000 pieces/year) for the time being inside the Mah weli project area.

4-3-5 Supply of Raw Materials

When projecting a production plant, the matters pertaining to the supply of raw materials are the most important factors. In the foregoing paragraphs some mention was made of these matters, however, in order to proceed with this project, the following points must especially be taken into consideration.

(1) Selection of the project site

Firstly, it is necessary to select the raw material from which the projected product in the projected quality can be achieved. In this respect, it is assumed that all the necessary raw materials can be obtained inside Sri Lanka by taken the clay produced in Kekirawa of the Mahaweli Project area. However, this Kekirawa area is still under-developed and no confirmation as to the extent of the reserve of the clay and the uniformity in the quality thereof has been obtained. Therefore, a thorough survey concerning these points must be undertaken prior to the industrialization of this product. Then, scrutinization must be made concerning the methods of clay excavation and transportation in order to finally decide the site from where the raw materials are to be obtained.

(2) Supply of raw materials

Several brick making plants already exist in the Mahaweli Project area on cottage industry scale. However, the products being turned out from these factories are of low quality.

This is due to the fact that the production facilities are rather primitive and also due to the primitiveness of the production technique including the selection techniques of raw materials. If a modern production plant is constructed within the Mahaweli Project area and if the livelihood of these already existing cottage industry manufacturers were threatened by the mass-production of a modern plant turning out high quality bricks, it would not serve to carry out the true district development. Although there is a chance of employing these people in the new plant, it would not be a simple decision as the features of the traditional cottage brick manufacturer will be entirely lost. As it is expected that the demand for red bricks cannot be fulfilled by simply constructing one unit of a modern production plant, it is recommended that a realistic development project be studied including the fostering of the cottage industry brick production. The following points are recommended for studies in this respect.

Cottage brick factories :

Firstly the selection of the raw materials and the raw material excavating sites must be selected in view of the stable raw material supply. If any defect is caused in the products due to the direct utilization of the raw material clay, necessary adjustment such as blending of different raw materials should be undertaken and the well adjusted raw materials should

be supplied to each manufacturer. In other words, this provision boils down to the installation of the so-called raw material supply centre, which proved successful in the case of Japan, etc. The advantages of this method can be enumerated as follows.

1) By means of supplying already adjusted raw materials, the improvement in the product quality will materialize.
2) Technical guidance can be given to the cottage manufacturers through the supply of the raw materials, thereby contributing to the advancement of the overall product quality.
3) Due to the large integrated and centralized excavation and adjustment operation, the raw material cost can be reduced. In other words, without calling for any specific clay pretreatment facilities, the forming can be directly carried out on the side of the manufacturers.
4) Along with the enhancement of the quality, the standardization of the product quality can be materialized.

In view of the above advantages, the results will lead to the enhancement of the level of the industry as a whole and local development in a true sense can be carried out.

(3) Installation location for the raw material supply centre

In the case of installing a raw material centre, it is ideal that such an institution be constructed in an area adjacent to the excavation site for the raw materials. In such an event, the production facilities of the existing plants should also be moved to this site in order to centralize the clay pretreatment operation. This seems to be highly effective in increasing the potential of the operation for the future expansion. Of course, if the raw material excavation is in the vicinity of the plants, the construction cost will be reduced if the raw material supply centre is installed next to the neighbourhood of the existing facilities.

(4) Concerning the glazing materials

It is considered that the manganese blaze is suitable in the case of sintering by means of tunnel kiln. The manganese glaze normally consists of 65% of manganese ore, 5% of mill scale and 30% of feldspar as the standard specification and the required amount is 10 to 15 kg per ton of the body materials to be sintered. In the case of a ring kiln sintering operation, salt glaze will be sufficient. In this case, the required amount of salt glaze is 10 to 15 kg per ton of the body materials to be sintered. Although the manganese glaze will have to be obtained through imports, the salt can be fully supplied domestically.

4-4 Plant Construction

4-4-1 General

It is projected here that the construction of a red brick plant should be undertaken along with the rehabilitation and expansion of the existing roofing tile and brick factories in Tissawewa. The following paragraphs will explain the outline of construction costs of this project.

It is advantageous in view of the operation administration that the brick factory be constructed in the same site as the Tissawewa plant, the projection in this writing has been made on an assumption that a separate plant is to be constructed newly. The reason for taking this assumption is that the decision as to the solution of the rehabilitation should belong to the process of the Mahaweli development project proceedings and should therefore be solved in conjunction with the project schedule.

4-4-2 Rehabilitation of Tissawewa factories

(1) Machinery for Expansion (imported) F.O.B. ¥177,000,000 (Rs 4,116,300)

Transportation facilities	1 set
Forming, Drying facilities	1 set
Sintering facilities	1 set
Glaze preparation facilities	1 set

(2) Machinery for Expansion (Local procurement) Rs.451,000 Rs

Red bricks

Tanks

Foundation materials

Water supply/sewerage facilities

Electric substation/distribution facilities

(3) Land preparation Cost

10,000 m^2 x 0.85 = Rs.8,500

(4) Buildings

Factory building	4,100 m^2 x Rs.173 =	Rs.709,300
Warehouse	400 m^2 x Rs.157 =	Rs. 62,800
	Sub-total	Rs.772,100

(5) Construction cost

1) Supervising Fee

	persons		months		persons
Engineers and technicians	3	x	8	=	24

(in Rs)

Wages	24 persons	x ¥540,000	=	¥12,960,000
Advance allowance	3 persons	x ¥100,000	=	¥ 300,000
Air-ticket fee	3 persons	x ¥260,000	=	¥ 780,000
	Sub-total			14,040,000
				(Rs.326,500)
Living expenses	24 persons	x 5,000	=	Rs.120,000
	Total			Rs.446,500

2) Construction workers

Skilled Workers	2,000 workers	x 7.5	=	Rs.15,000
unskilled Workers	6,000 workers	x 4.7	=	Rs.28,200

3) Construction cost Rs.20,000

Grand total Rs.509,700

(6) Royalties ¥10,000,000
(Rs.232,600)

4-4-3 Construction Cost for Red Bricks Factory

(1) Imported Machinery F.O.B. ¥167,800,000

Transportation facilities 1 set

Forming, drying facilities 1 set

Sintering facilities 1 set

(2) Materials/equip. Local Procurement Rs.451,000

Red bricks

Tanks

Foundation materials

Water supply/sewerage facilities

Electric substation/distribution Facilities

(3) Land preparation cost $1,500^{m^2}$ x 0.85 = Rs.12,750

(4) Civil Engineering walls 500^{m^2} x 98.4 = Rs.49,200

Roads $1,500^{m^2}$ x 210 = Rs.315,000

Rs.364,200

(5) Buildings

Factory buildings $7,000^{m^2}$ x 173 =Rs.1,211,000

Offices 400^{m^2} x 193 = Rs.77,200

Sub-total Rs.1,288,200

(6) Construction cost

	person		month		Rs.
1) Supervising Fee	3	x	8	=	24
Wages		x	540,000	=	12,960,000
Advance allowance		x	100,000	=	Rs.300,000
Air-ticket fee	3	x	260,000	=	Rs.780,000
			Sub-total		Rs.14,040,000

					(Rs.326,500)
Living expenses	24	x	5,000	=	Rs.120,000
		Total			Rs.446,500

2) Construction workers

Skilled	2,000	x	7.5	=	Rs.15,000
Unskilled	6,000	x	4.7	=	Rs.28,200

3) Construction cost Rs.20,000

Grand total Rs.509,700

(6) Royalties ¥6,000,000

(Rs.139,530)

4-4-4 Construction cost of raw material supply centre

(1) Imported machinery

Clay preparation facilities		¥88,500,000
Excavation facilities	1	Rs.2,058,100
Weighing and transporting facilities	1	

(2) Materials/equipt. Local procurement Rs.32,000

(3) Land preparation Cost 10,000 x 0.85 = Rs. 8,500

(4) Civil engineering 2,500

Roads	1,000m^2	x	210	=	Rs.210,000
(5) Buildings	2,500m^2	x	157	=	Rs.392,510

(in Rs)

(6) Construction cost

1) Supervision cost	2 persons	x	4 months	=	8
Wages	8"	x	540,000	=	¥4,320,000
Advance allowance	2"	x	100,000	=	¥ 200,000
Air-ticket fee	2"	x	260,000	=	¥ 520,000
	Sub-total				¥5,040,000
					(Rs.117,200)
Living expenses	8"	x	5,000	=	40,000
	Total				157,200
2) Construction workers					
Skilled Workers	600 workers	x	7.5	=	Rs.4,500
Unskilled Workers	2,000"	x	4.7	=	Rs.9,400
3) Construction Cost					10,000
	Grand Total				181,100

(7) Royalties ¥4,000,000

(93,000)

4-5 Production Cost and Profitability

4-5-1 General

In order to calculate the production cost, it is necessary to settle the operation conditions prior to proceeding with such calculation. The basic philosophy in settling the operation conditions is as follows.

(1) Raw materials

Raw materials in this industry can be roughly classified into two categories, i.e., the raw materials to make up the body and the raw materials for the glaze.

Concerning the roofing tiles, the products without glaze are widely used in Sri Lanka. Therefore, the glazed tiles are considered to be one of the future projects. In other words, of all the products, the one calling for the application of the glaze is the earthen pipes only.

1) Materials for the Body

It is projected that the identical raw materials will be used for all the red bricks, roofing tiles and earthen pipes. The advantages in doing so are as follows:

a) The productivity will be high due to the possibility of clay adjustment in a large quantity

b) The production will be carried out under roughly the same production conditions for all the product items and in

some cases, the shifting and interchanging of the production facilities will be possible.

It is expected that the clay produced in the Mahaweli Project area can be employed as the chief body material. Depending upon the properties of the clay, it may be necessary at times to carry out such clay adjustment as the addition of sand or lithic raw materials, however, there is no doubt that all the body raw materials can be supplied from within the Mahaweli Project area.

2) Raw Materials for Glazing

As the glaze raw materials for earthen pipes Sri Lanka presently relies the supply upon importation, however, it is not always necessary to depend entirely upon the imports due to the following possibilities:

a) In the case of sintering by a tunnel kiln:

The manganese glaze is suitable for the case of carrying out high temperature sintering by a tunnel kiln. Generally the standard specifications of the manganese glaze are, 65% manganese are, 5% of mill scale and 30% of feldspar and approximately 10 to 15kg. of glaze per ton of products will be called for. In Sri Lanka, the mill scale and the feldspar can be domestically supplied. As manganese ore has not yet been located in Sri Lanka, it will have to be imported. This implies

that the production of 3,200 ton per year of earthen pipes is to be carried out, the importation of manganese ore will only be approximately 30 tons to satisfy the necessary quantity.

b) When sintering by a ring kiln

When sintering in a ring kiln, as the sintering temperature in this type of a kiln is comparatively low, the salt glaze will be sufficient to obtain the effect. In the case of producing 3,200 tons of earthen pipes per year, the necessary amount of salt will be 50 tons per year and it is fully possible to utilize the domestically available salt.

In the present project, a ring kiln is planned to be employed for the production of earthen pipes and therefore, the glaze material can therefore be entirely available domestically.

(2) As the Sub-materials

The sub-materials for this operation, are heavy oil, fuel, wooden materials, electricity and industrial water. All these items can be supplied domestically.

(3) Labour forces

As one of the objectives of the Mahaweli Project is to carry out the development of the industry and the enhancement of the employment rate. Although, depending upon the district, the concentration of labour force may be difficult, it is possible

that the supply of labour force can be materialized along with the implementation of this project.

(4) Depreciation cost

The depreciation costs have been settled as follows:

Machinery and equipment:	10% (10 year depreciation)
Buildings:	2.5% (40 year depreciation)

(5) Interest

It is assumed that the total funds will be financed by a loan and the interest thereupon is taken at a level of 7% p.a.

(6) Repair cost

The repair costs are taken as follows:

Machinery and equipment:	5% of the cost of machinery and equipment
Building:	5% of the cost of buildings

(7) General administration cost

The general administration cost was set at 15% of the production cost.

(8) Business administration cost

The business administration cost was taken at 5% of the selling price.

4-5-2 Prices of Raw Materials and the Raw Materials Supply

The raw materials were regarded as being free of charge and therefore, the total of the excavation cost and the clay pretreatment cost were taken as the price of the raw materials.

(1) Raw material excavation amount 60,000 t/year

(2) Sub materials (in Rs.)

Electricity:	300 KVA	x	Rs.7.5 = 2,250
	252,000 KWH	x	Rs.0.1 = 25,200
Fuel:	45,000 Litre	x	Rs.1.0 = 45,000
	Sub-total:		72,450

(3) Labour Cost

	person			month		
Works Manager	1	x	Rs.1,200	x 12	=	Rs.14,400
Officers	2	x	Rs. 700	x 12 "	=	Rs.16,800
Skilled Workers	10	x	Rs. 350	x 12 "	=	Rs.42,000
Unskilled Workers	11	x	Rs. 275	x 12 "	=	Rs.36,300
			Sub-total			Rs.109,500

(4) Maintenance Fee

Machinery	Rs.2,393,620	x	0.05	=	Rs.119,681
Buildings	Rs. 392,500	x	0.03	=	Rs. 11,775
	Sub-total				Rs.131,456

(5) Depreciation Cost

Machinery	Rs.2,393,620	x	0.10	=	Rs.239,362
Buildings	Rs. 392,500	x	0.025	=	Rs. 39,250
	Sub-total				Rs. 278,612

(6) Working Capital

	month	
Sub-material	2	Rs.12,075
Labour Cost	2 "	Rs.18,250
Preserved Parts	1 year	Rs.121,400
Preserved Fund		Rs. 18,275
	Total	Rs.170,000

4-5-3 The production cost after rehabilitation of the existing factories

(1) Production Roofing Tiles
Capacity 2,800,000 1 Piece (7,000 t)

Earthern Pipes 20,000 (3,200 t)

(2) Raw Material

		(in Rs)
Raw Materials	15,700t x Rs.15.4 =	Rs.241,780
Sodium Nitrate	50t x Rs.200 =	Rs. 10,000
	Sub-total	Rs.251,780

(3) Utilities

Electric Power	600 kVA x Rs.9.5 =	Rs.4,500
	525,000 kWH x Rs.0.1 =	Rs.52,500
	Sub-total	Rs.57,000
Fuel	1,230 kl x Rs.137 =	Rs.168,510
	Total	Rs. 225,510

(4) Labour Cost

	person		month	
Works Manager	1 x	Rs.1,700 x	12	= Rs.14,400
Senior Officers	4 x	Rs.1,200 x	12 "	= Rs.57,600
Officers	14 x	Rs. 700 x	12 "	= Rs.117,600
Skilled Workers	36 x	Rs. 350 x	12 "	= Rs.151,200
Unskilled Workers	80 x	Rs. 275 x	12 "	= Rs.264,000
		Total		Rs. 604,800

(5) Maintenance Cost (in Rs)

Macinery	Rs.5,196,320	x 0.05 =	Rs.259,816
Buildings	Rs. 772,100	x 0.03 =	Rs. 23,163
		Total	Rs. 282,979

(6) Depreciation Cost

Newly Constructed Machinery	Rs.5,196,320	x 0.10 =	Rs.519,632
Buildings Existing	Rs. 772,100	x 0.025=	Rs. 19,303
Machinery			Rs. 126,266
Buildings			Rs. 58,990
		Total	Rs. 724,191

(7) Working Capital

Raw Material	2 month	Rs.77,550
Sub-material	2 "	Rs.37,585
Labour Cost	2 "	Rs.100,800
Preserved-parts	1 year	Rs.254,334
Preserved Fund		Rs. 49,731
	Total	Rs. 520,000

4-5-4 Red Bricks Mill

(1) Production Capacity 12,000,000 pcs/year

(2) Raw Material 32,000t x Rs.15.4 = Rs.492,800

(in Rs)

(3) Utilities

Electric	300 kVA x Rs.7.5	= Rs.2,250
Power	420,000 kWH x Rs.0.1	= Rs.42,000
	Sub-total	Rs.44,250
Fuel	1,440 kl x Rs.137	= Rs.197,280
	Total	Rs. 241,530

(4) Labour Cost

	person				month		
Works Manager	1	x	Rs.1,700	x	12	=	Rs.14,400
Senior Officers	4	" x	Rs.1,200	x	12	" =	Rs.57,600
Officers	14	" x	Rs. 700	x	12	" =	Rs.117,600
Skilled Workers	15	" x	Rs. 350	x	12	" =	Rs.63,000
Unskilled Workers	24	" x	Rs. 275	x	12	" =	Rs.79,200
			Total				Rs.331,800

(5) Maintenance Cost

Machinery	Rs.5,036,100	x	0.05	= Rs.251,805
Buildings	Rs.1,288,200	x	0.03	= Rs. 38,646
	Total			Rs. 290,451

(6) Depreciation

Machinery	Rs.5,036,100	x	0.10	= Rs.503,610
Buildings	Rs.1,288,200	x	0.025	= Rs. 32,205
	Total			Rs. 535,815

(7) Working Capital

Raw Material	2 month	Rs.154,667
Sub-material	2 "	Rs. 40,255
Labour Cost	2 "	Rs. 55,300
Preserved Parts	1 year	Rs. 47,963
	Total	Rs. 540,000

4-5-5 Regarding selling price

The selling prices of the products were established in accordance with the following.

(1) Raw Materials

The raw materials which have been excavated by, and supplied from, the raw material supply centre are regarded as being supplied to the manufacturers of the cottage industry bricks and to each one of the larger brick factories at the production cost. In other words, this provision is considered due to the fact that the establishment of the raw material supply centre is based upon the philosophy that the already conditioned high class raw materials should be supplied to the manufacturers in order to develop the industrialization of the area.

(2) Roofing tiles and earthen pipes

The roofing tiles are to be produced by the most modern production facilities so that the quality of the product turned out shall be equivalent to the presently marketed grade I or better, however, the selling price level is settled here on the same level as the presently marketed price level. If, in the future, the production of the glazed roofing tiles, etc. can be produced, the production cost will be affected upward only slightly while it can be expected that the selling price will increase further. Regarding earthen pipes, the large-sized items are now being

exported so that the prices of these items are taken on the basis of the presently prevailing market prices. Consequently, the selling prices and the annual total sales amount of roofing tiles and earthen pipes will be as follows:

(in Rs)

		pieces			
Roofing titles	Standard	2,520,000	x	Rs.0.55	= Rs.1,386,000
		pieces			
	Bricks	280,000	x	Rs.1.20	= Rs. 336,000
			Sub-total		Rs.1,722,000
		pieces			
Earthern Pipes	9 "	1,650	x	Rs.17	= Rs.28,050
	12 "	450	x	Rs.26	= Rs.11,700
	15 "	400	x	Rs.36	= Rs.14,400
	18 "	1,650	x	Rs.46	= Rs.75,900
	24 "	15,850	x	Rs.70	=Rs.1,109,500
			Sub-total		Rs. 1,239,550
			Total:		Rs. 2,961,550

(3) Red Bricks

At present there are vast differences in the market prices of this commodity depending upon the grade thereof. The red bricks, the production of which is now being projected, will be sintered by means of modern tunnel kilns after being moulded by moulding machines so that they can be directly applied as the materials for construction works. Therefore, the commodity market prices of these items will be considerably high. Thus, the unit selling price can be expected to be on the level of Rs. 0.5, however, in this report, the price is kept lower, so that a level of Rs. 0.3 is established here.

This being the case, the yearly selling amount will be as follows:

12,000,000 pieces X Rs. 0.3 = Rs. 3,600,000.

(4) Total of Production Cost

(Rs)

	Raw materials	Roofing tiles	Bricks
Raw materials	-	224,543	439,489
Utilities Cost	72,450	225,510	241,530
Labour Cost	109,500	604,800	331,800
Maintenance	131,456	282,979	290,451
Sub-total	313,406	1,337,832	1,303,270
Depreciation	278,612	724,191	535,815
Interest	233,710	484,345	525,732
Sub-total	512,322	1,208,536	1,061,547
Production Cost Total	825,728	2,546,368	2,364,817
General Expenses		381,955	311,155
Business Expenses		123,522	180,000
Total Production Cost	825,728	3,051,845	2,855,972
Production Expenses per Unit	13.8	299	0.22
Annual Sales	825,728	2,961,550	3,600,000

4-6 The Method of Proceeding with the Project

4-6-1 Advantages in Promoting this Project

In the foregoing paragraphs various problems on the ceramic industry projects have been discussed amongst the projects contained in the Mahaweli Area Development Scheme. In view of the fact that Mahaweli Project Area is still underdeveloped, an integral development of this area will achieve a number of advantages in view of the development of national economy of Sri Lanka. At the present, the variety of the ceramic materials discovered so far in the Mahaweli Project Area is not wide so that it would not be possible for the time being to industrialize a variety of product items within the scope of ceramic industry. However, it seems that the following four projects are highly viable and advantageous:

a) Installation of raw material supply centre, capacity: 60,000t/year
b) Production of earthen pipes capacity: 20,000 pieces/year
c) Production of roofing tiles, capacity: 2,800,000 pieces/year
d) Production of red bricks, capacity: 12,000,000 pieces/year

In the event of executing these projects, the following merits will be obtained as the advantage:

1) As the materials which can be obtained within the Mahaweli Project Area will be applied for the most part so that in view of the development of underground resources and the effective utilization thereof, the project implementation will greatly contribute to the general expansion of national economy of Sri Lanka.

(2) The supply capacity of the necessary items for peoples' everyday life will be enhanced, thereby contributing to the enhancement of the living standard of the people.

(3) The domestic production of large sized earthen pipes can be undertaken, thereby contributing to the saving of foreign reserve.

(4) The replacement of the secondary cement product with the clay product will become possible so that the supply amount of the cement products to other fields of consumption can be enhanced.

(5) Employment opportunities will be advanced, thereby increasing industrial employment which will contribute to the development of the nation, and at the same time, will increase the income of the people, thereby contributing to the advancement of the peoples' standard of living.

(6) This project will stimulate the development of industries as a whole also encourage the expansion and the development of the related industries. In other words, it will contribute to the improvement and benefit of the technical level of the smaller industries of the same field or of such related industries as civil engineering, construction, mineral excavation, transportation, etc. an also the development of machining industries will be stipulated due to the necessity for the maintenance servicing of the plant.

(7) Training and fostering of ceramic industry technicians and engineers will be advanced, thereby stimulating the further development of the ceramic industrial technology. It will then be able to form a basis for the future expansion of the ceramic industry.

4-6-2 The Method of Implementation with this Project

As this project covers a wide field it is not possible to undertake partial development of the industry. Even if it were possible, no satisfactory result could be expected. It is recommended that the following action be undertaken in order to carry out integrated overall development standing firmly upon the national point of view.

(1) Concerning organizations:

Regarding the ceramic industry, it is recommended that there is an organization called the "Ceylon Ceramic Corporation" which is considered to be the main body for aspiring the advancement of this industry from a national global point of view. The Corporation recently amalgamated the clay products production so far undertaken by the National Small-Scale Industries Corporation and also there is a movement for undertaking the rehabilitation of standing idle in Tissawewa in cooperation with the State Engineering Corporation.

Thus, it seems necessary and appropriate to proceed with this project by assuming that the Ceylon Ceramics Corporation be the central body.

(2) Problems pertaining to the concentration of labour force

If this project is actually implemented, such organization and personnel as shown in Table VIII-19 will be called for as far as the ceramic industry is concerned. Apart from those shown in the table, a number of both medical and welfare facilities such as canteens, cafeterias, clinics and hospitals, etc, will become necessary to be substantiated. Simple installation of factories alone will not ensure any wholesome operation. The complete implementation of this project would be extremely difficult unless the project itself and the implementation thereof would encompass the welfare of the people presently residing within the areas concerned without affecting their present life in any way.
In other words, in order to make the implementation meaningful, cooperation from the general public is imperative and therefore it is necessary to substantiate such grounds upon which the general public support could be obtained.

(3) Pursuit of Profit

As has already been mentioned earlier, if the presently existing regulations are to be enforced, no monetary benefit will be generated from the project implementation. It should be realized in this connection that the present stage is the transitional stage so that simple pursuit of profit will not help progress these development projects. The development projects must be conceived as a national enterprise and the results thereof should contribute to the development of the industries as a whole and eventually to the

development of the national economy.

The above-mentioned points should be fully understood and accepted on the side of the parties proceeding with these projects, however, the practical points in this regard are as follows.

1) Execution of favourable treatment of importation:
   By means of this policy, the FEECS, duties, etc. upon the importation should be exempted in order to reduce the construction costs.

2) Reduction or exemption of interests:
   As these projects are considered to be national projects, all the payments and expenditures should be made by the government and the interest burden should be made zero or at least on a low level together with a provision for long-term loan application.

(4) Securing the appropriate raw materials

For the most part, the conventional enterprise form of Sri Lanka involved a number of cases where actual implementations were undertaken without scrutinizing the correlation between the situation existing at the factories and the availability of appropriate raw materials. The ceramic industry, the securing of a stable source of raw material supply is particularly important so that the problems pertaining to the production at the factories and the acquirement of a stable raw material supply source can never be studied independently. As has been repeatedly mentioned in this report, the securing of the appropriate raw materials and the establishment of appropriate excavation sites and excavation

methods as well as the establishment of practical policies concerning the sites for the projected factories and the methods of operation are indispensable conditions.

5. Evaluation of Each Industry

5-1 The basis for the methodology of the economic evaluation

(1) The evaluation should be made on the basis of standard profit and loss

(2) The primary judgement should be made upon the basis of the investment-profit ratio, i.e., profit/invested capital.

(3) All the necessary funds are taken as being made by loan at the interest rate of 7% p.a.

(4) For the estimated value for the amount of investment, the FEECS factor is not included.

(5) The judgement criteria other than the investment-profit rate will be additionally incorporated in accordance with the patterns of the respective industries.

(6) The reimbursement of the principal shall be made in equal installments over a period of 10 years.

(7) The depreciation period is taken on the basis of the experienced figures obtained in Japan and shall be applied in accordance with the specific characteristics of each industry.

(8) The conversion rate between Rs. and US$ shall be as follows:

US$1.00 = Rs. 5.95

(9) The quoted raw material prices and the product prices were, unless otherwise specified, based upon the Trade Year Book, 1971 of the FAO.

(10) The accuracy of the estimated figures are not particularly high as the plan at this stage is conceived in terms of the "Master Plan".

5-2 Economic Evaluation Calculation; Selected Industries

5-2-1 Forest Industry

The detailed scrutinization regarding the economic evaluation calculations shall be carried out in the following paragraphs by utilizing the estimate figures stipulated in the foregoing.

(1) Sawmill

a. Production capacity:

Sawn wood 173,000 ft^3/year

(Logs: 384,000 ft^3/y, yield rate: 45%)

b. Total Investment (in Rs. 1,000)

Foreign currency portion: 164,800

Domestic currency portion: 1,383,200

Total: 1,548,000

c. Total Labour Cost (33 persons): 127.8 (Rs.1,000/year)

d. Depreciation Cost: 2,017.0 (Rs.1,000/year)

e. Interest: 108.4 (Rs.1,000/year)

f. Annual Profit: (Rs.1,000/year)

Total Production cost: 825.2

Net sales earnings: 1,730.0

Net profit: 904.8

(a) Investment/Profit Ratio:

$$\frac{904.8}{1,548.0} \times 100 = 58.4 \ (\%)$$

(b) Capital Recovery Period

$$\frac{1,548.0}{904.8} = 1.71 \ \text{(year)}$$

(2) Logs for Plywood

a. Production capacity:

Logs for Plywood 192,000 ft^3/year

b. Total Investment (in Rs. 1,000)

Foreign currency portion: 146

Domestic currency portion: 0
Total: 146

c. Total Labour Cost (7 persons): 28.9 (Rs.1,000/year)

d. Depreciation Cost: 33.0 (Rs.1,000/year)

e. Interest: 10.2 (Rs.1,000/year)

f. Annual Profit: (Rs.1,000/year)

Total production cost: 234.2

Net sales earnings: 864.0
Net profit: 629.8

(a) Investment/Profit Ratio:

$$\frac{629.8}{146.0} \times 100 = 431 \ (\%)$$

(b) Capital Recovery Period

$$\frac{146.0}{629.8} = 0.23 \ (\text{year})$$

(3) Logs for Export

a. Production capacity:

Logs for Export 192,000 ft^3/year
(Mainly for use as face back layer of plywood)

b. Total Investment (in Rs. 1,000)

Foreign currency portion:	146
Domestic currency portion:	0
Total:	146

c. Total Labour Cost (7 persons): 28.9 (Rs.1,000/year)

d. Depreciation Cost: 33.0 (Rs.1,000/year)

e. Interest: 10.2 (Rs.1,000/year)

f. Annual Profit: (Rs.1,000/year)

Total production cost:	224.6
Net sales earnings:	1,344.0
Net profit:	1,119.4

(a) Investment/Profit Ratio:

$$\frac{1119.4}{146} \times 100 = 767 \ (\%)$$

(b) Capital Recovery Period

$$\frac{146}{1119.4} = 0.13 \ (\text{year})$$

(c) Foreign Exchange Savings Amount: (Rs.1,000/year)

Foreign exchange revenue 1,344.0

Foreign exchange expenditure		
Principal reimbursement	14.6	
Interest payable	10.2	
	24.8	
Foreign Exchange Savings Amount	1,319.2	(Rs.1,000/y)
	= 221.7	(US$1,000/y)

(4) Chipboard Industry

a. Production capacity:

Logs, Felling and Consumption: 2,050,000 ft^3/year

Chipboard: 36,000 ton/year

b. Total Investment (in Rs. 1,000)

Foreign currency portion:	23,400
Domestic currency portion:	8,600
Total:	32,000

c. Total Labour Cost (112 persons): 450.5 (Rs.1,000/year)

d. Depreciation Cost: 2,666.7 (Rs.1,000/year)

e. Interest: 2,135.0 (Rs.1,000/year)

f. Annual Profit: (Rs.1,000/year)

Total production cost:	12,681.7
Net sales earnings:	20,349.0
Net profit:	7,667.3

(a) Investment/Profit Ratio:

$$\frac{7,667.3}{32,000} \times 100 = 23.96 \ (\%)$$

(b) Capital Recovery Period

$$\frac{32,000}{7,667.3} = 4.17 \ (\text{year})$$

(c) Foreign Exchange Savings Amount: (Rs.1,000/year)

Foreign exchange revenue	20,349
Foreign exchange expenditure	9,904
Principal reimbursement	2,340
Interest payable	1,638
Sub-material cost*	5,926

* : Costs for adhesives, chemicals, heavy oil and other imported sub raw materials.

Foreign Exchange Savings	10,445 (Rs.1,000/y)
	= 1,755 (US$1,000/y)

Thus, the foreign exchange gain per ton of chipboard will be as follows: (in US$/t)

$$\frac{1,755,000}{36,000} = 48.75 \text{ (US\$/t)}$$

5-2-2 Oil Production, Feed Production

(1) Cotton Seed Processing Mill

a. Production capacity:

Cotton seed processing capacity:	6,000 ton/year
Products: Edible oil:	720 ton/year
	2,880 ton/year
	420 ton/year

b. Total Investment (Incl. interest payable) (in Rs. 1,000)

Foreign currency portion:	2,420
Domestic currency portion:	1,100
Total:	3,520

c. Total Labour Cost (36 persons): 123.0 (Rs.1,000/y)

d. Depreciation Cost: 420 (Rs.1,000/y)

e. Annual Profit (Rs.1,000/y)

Total production cost:	3,345
Net sales earnings:	2,966
Net profit:	- 379

(a) Investment/Profit Ratio:
(Without investment profit)

(b) Foreign Exchange Savings Amount: (Rs.1,000/year)

Foreign exchange revenue	2,966*
(* : Import substitution = Net sales earnings)	
Foreign exchange expenditure	411
Principal reimbursement	242
Interest payable	169
Foreign Exchange Savings	2,555

= 429.4 (US$1,000/y)

(2) Soya Bean Processing Mill

a. Production capacity:

Soya Bean Processing Capacity:	4,800	ton/year
Products: Edible oil	720	ton/year
Feed:	3,600	ton/year

b. Total Investment (Inc. interest payable) (in Rs. 1,000)

Foreign currency portion:	416
Domestic currency portion:	150
Total:	566

c. Total Labour Cost (13 persons): 43.2 (Rs.1,000/year)

d. Depreciation Cost: 72.0 (Rs.1,000/year)

Annual Profit:

Total production cost:	3,861.6
Net sales earnings:	3,625.2
Net profit:	- 236.4

(a) Investment/Profit Ratio:
(Without investment profit)

(b) Foreign Exchange Savings Amount (Rs.1,000/year)

Foreign exchange revenue	3,625.2*
(* : Import substitution = Net sales earnings)	
Foreign exchange expenditure	70.7
Principal reimbursement	41.6
Interest payable	29.1
Foreign Exchange Savings	3,554.5

= 597.4 (US$1,000/y)

(3) Rice Bran Processing Plant (Preliminary calculation)

a. Production capacity

Rice bran processing capacity:	6,000	ton/year
Products: Edible oil:	360	ton/year
Industrial oil:	360	ton/year
De-fatted oil:	4,800	ton/year

b. Total Investment
(By taking foreign currency portion as being 70%) (in Rs.1,000)

Foreign currency portion:	2,450
Domestic currency portion:	1,050
Total:	3,500

c. Depreciation Cost: 40 (Rs.1,000/year)

d. Annual Profit: (Rs.1,000/year)

Total production cost:	2,004.0
Net sales earnings:	2,310.8
Net profit:	306.8

(a) Investment/Profit Ratio:

$$\frac{306.8}{3,500} \times 100 = 8.8 \ (\%)$$

(b) Capital Recovery Period

$$\frac{3,500}{306.8} = 11.4 \ (\text{year})$$

(c) Foreign Exchange Savings Amount (Rs.1,000/year)

Foreign exchange revenue	2,310.8*
(* : Import substitution = Net sales earnings)	
Foreign exchange expenditure	416.5
Principal reimbursement	245.0
Interest payable	171.5
Foreign Exchange Savings	1,894.3

= 318.4 (US$1,000/y)

5-2-3 Cotton Ginning

a. Production capacity:

Seed Cotton Processing Capacity: (Cotton: 600t)
(Cotton seed: 1,200t)

b. Total Investment (in RS.1,000)

Foreign currency portion:	385
Domestic currency portion:	509
Total:	894

c. Total Labour Cost (30 persons): 116 (Rs.1,000/year)

d. Depreciation Cost: 93 (Rs.1,000/year)

e. Annual Profit (Rs.1,000/year)
(After income from cotton seed)

Total production cost:	3,421
Net sales earnings:	3,480
Net profit:	59

(a) Investment/Profit Ratio:

$$\frac{59}{894} \times 100 = 6.6\ (\%)$$

(b) Foreign Exchange Savings Amount: (Rs.1,000/y)

Foreign exchange revenue	3,480
Foreign exchange expenditure	65.5
Principal reimbursement	38.5
Interest payable	27.0
Foreign Exchange Savings	3,414.5

= 573.9 (US$1,000/y)

Thus, foreign exchange saving of US$957 will be materialized per ton of cotton.

5-2-4 Ceramic Industry: An assumption is made here that all the ceramic industry project facilities are to be installed at the idle plants in Tissawewa.

a. Production capacity:

Raw Material Supply Centre:	60,000 ton/year
Roofing tiles: Standard type:	2,520,000 pieces/year
Ridge tiles:	280,000 pieces/year
Earthen pipes:	20,000 pieces/year
Red Bricks	12,000,000 pieces/year

b. Total Investment (in Rs.1,000)

Foreign currency portion:	12,443.2
Domestic currency portion:	5,325.2
Total:	17,768.4

c. Total Labour Cost: 1,046.1 (Rs.1,000/year)

d. Depreciation Cost: 1,538.6

Idle facility portion 185.3

e. Annual Profit (Rs.1,000/year)

Total production cost:	6,733.5
Net sales earnings:	7,387.3
Net profit:	653.8

(a) Investment/Profit Ratio:

$$\frac{653.8}{17,768.4} \times 100 = 3.7 \ (\%)$$

Enhancement of profit rate due to rehabilitation of thus for idle facilities:

$$\frac{653.8 + 185.3}{17,768.4} \times 100 = 4.7 \ (\%)$$

5:3 Enhancement of Employment Opportunities by means of each Industry

The evaluations concerning the absorption amount of labour force and the assessment of the labour cost in each industry are as follows:

	Labour force (person)	Total labour cost (Rs 1,000)
Direct labour		
Forest industry	159	448.5
Oil production, feed stuff	49	166
Cotton ginning	30	116
Ceramic industry	193	936.6
Total	431	1,667.1
Indirect labour (For the marketing dept. of raw materials, products)		
Oil production, feed stuff, cotton ginning	40	120
Ceramic industry	24	109.5
Total	64	229.5

As it is considered difficult to procure the administrative personnel within the area, this factor is being taken as 20% of the direct labour section, then the contribution to the local area income through direct labour will be 344 persons and Rs.1,333.7 as the gross labour charges. In other words, in the industry as a whole, 408 persons will be absorbed and the income of these persons will be increased by 1,563,200 Rs. per year.

5-4 Economic Evaluation of Each Industry

5-4-1 Forest Industry

The forest felling along with the advancement of the development of the area has so far been undertaken as a part of the chena cultivation. It is proposed that, if this felling operation is rationally undertaken and a certain extent of fabrication is undertaken to the woods obtained by felling, it will be a considerably attractive project in view of the investment-profit rate and the acquirement of foreign reserve. In other words, the demand for such products is quite active internationally and the market will be, for some time to come, the so-called seller's market, and also the felling of these woods is absolutely necessary for the advancement of the Mahaweli development. Therefore, substantiation for the rationally organized operation and administration of this industry is strongly anticipated.

5-4-2 Oil and Feed Production Industries

The oil production from such oil producing crops as soya beans, groundnuts as well as the cotton seeds which are the by-products of the cotton ginning operation will play a major role in the increment of the added value to the agricultural products and for the foreign reserve savings.

Although the investment-profit ratio is expected to be minus, this project should be evaluated from the view point of the foreign exchange saving. Because the expectation of coconut oil and other coconut product may be fallen down by the increment of domestic demand for these coconuts product due to the increase in population and the advancement of the peoples' income.,

As a result of establishment of this project, these vegetable oils will supplement the expected domestic demand increment for some time. This supplementing effect displayed by the agricultural oil production will, therefore, be deemed as contributing to the savings of foreign exchange indirectly from this point of view.

5-4-3 Cotton ginning

The cotton ginning project in Sri Lanka is then necessary conditions called for by changing the pattern of cotton industry to be introduced on the basis of the seed cotton plantation project inside the Mahaweli Project area, i.e., the addition of such a step as from seed cotton→cotton ginning→cotton spinning to the presently existing industrial pattern in this field, i.e.,

imported cotton--spinning--weaving. Concerning the profitability of this operation, profitability from this industrial operation should be regarded as being of secondary nature rather than the primary object of this project being implemented. Therefore, a zero level of the investment-profit rate can even be justified in view of a gain in the realization of the addition of the necessary step of the production pattern to this industry. From the view point of the import substitution on the other hand, the foreign reserve saving extent per ton of cotton is US$957 so that the incentive for the advancement of this industry is considerably high.

5-4-4 Ceramic Industry

The government of Sri Lanka is now positively staging the industrial utilization of national mineral resources through public corporations as the central body in view of the effective utilization of the rich resources of the nation. The present feasibility project is based upon the intention of rationalization of the ceramic industry in general and of the clay production in particular, side by side with the rehabilitation of the presently idle factories existing in the development area. However, there seem to be several problems regarding the criteria for the economic evaluation of such project, once the rehabilitation of the plants are completed and if the plants are given the position and role of a model factory or as the raw material

adjustment and manufacturing technology centre, the effect of such an institution will be considerable. Also in view of the Mahaweli development project, the development of ceramic industrial products will be necessary as the supply source of the building materials for the infra-structures pertaining to the project.

In any event, concerning the establishment of the ceramic industry, it is not appropriate to conceive this project as a project particular to the development of this area alone. It should be added here that when scrutinizing the project from the viewpoint of rationalization of the project the ceramic industries of Sri Lanka as a whole must be undertaken.

6. Project implementation Organization and Site Problems

The evaluation of each industry has been discussed so far in the form of the continuous operation covering the whole process, however, at this juncture, mention will be made regarding the recommendable organizations and the recommendable sites in view of the present situation in Sri Lanka.

6-1 Forest Industry

There is a State Timber Corporation mill in Minneriya for the wood processing and sawing operation so that the organization of this mill and the site conditions thereof should be taken as the framework for the consideration.

Chipboard factories on the other hand should be incorporated as one of the sectors of the State Timber Corporation as far as the organization is concerned and the Trincomalee should be recommended as the site of the production in view of the fact that the products will be destined for export and also in view of the utilization of the residue which will be produced from the already existing mills and factories.

Also regarding the felling of the wood, it is desirable that the operations be undertaken by the organized plantation farmers such as in the form of multi-purpose cooperatives.

6-2 Oil and Feed Production

In view of the collection of the oil producing crops and also in view of the consumption sites of the feed, the expelling of the oil is to be located in the Mahaweli area under the control of Oil and Fats Corporation and the crude oil should be sent to the Corporation for refining. Regarding the consumption of feed, the possibilities are the fish cultivation undertaken on the basis of the abundant tanks existing inside the project area as well as chicken farms to be undertaken in the area.

6-3 Cotton Ginning

This industry should be scrutinized in two processes, i.e., the collection of seed cotton and the cotton ginning operation. The collection should be undertaken within the framework of the organization of cooperatives and the cotton ginning by the National Textile Cooperation. As to the sites, for collecting the cotton, each one of the cultivation areas will be

appropriate for this operation and for the cotton ginning site, Kekirawa is considered to be appropriate as it is located in the central part of the cotton cultivation.

6-4 Ceramic Industry

As one of the main objectives of this project is the rehabilitation of the idle factories in Tissawewa, the most economical method would be to select this area as the site. As the Ceylon Ceramic Corporation is now planning to handle the excavation of the raw materials and the supply thereof, after amalgamating the bricks and roofing tile production of the Small Scale Industries Corporation as of 1972. From this view point, all the ceramic industry activities should be incorporated into the organization of the Ceylon Ceramic Corporation. However, concerning the raw material excavation, the State Graphite Corporation is also contemplating this undertaking opportunity. In this respect, the application of the organizations of the cooperatives will also be feasible.

6-5 Reflection upon the Executing Organization

The foregoing paragraphs explained the direct executing organizations for each sector of the industries. As the auxiliary organizations or as technological administration sector of these direct execution organization, it is recommended that positive utilization of the organization of the IDB/TSA be undertaken.

Table VIII-2 Production Amounts of Seed Cotton, Cotton Lint and Cotton Seeds

(1,000 t)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Seed Cotton	1.8	3.6	5.4	7.2	9.0	9.5	10.0	10.5	11.0	11.4
Cotton Lint	0.6	1.2	1.8	2.4	3.0	3.2	3.3	3.5	3.7	3.8
Cotton Seeds	1.2	2.4	3.6	4.8	6.0	6.3	6.7	7.0	7.3	7.6

Table VIII-3 Each Area-wise, Year-wise and Utilization-wise Log Felling Project

(mil. ft^3)

Year	1	2	3	4	5	6	7	8	9	10	Total
Sawing	H .384	H .384	H .252 D .132	D .384	D .384	D .384	D .384	D .384	D .384	D .174 G .210	3.840
Plywood	H .192	H .192	H .126 D .066	D .192	D .192	D .192	D .192	D .192	D .192	D .087 G .105	1.920
Export	H .192	H .192	H .126 D .066	D .192	D .192	D .192	D .192	D .192	D .192	D .087 G .105	1.920
Chip Board	H 2.042	H 2.042	H 2.042	H .734 D 1.308	D 2.042	D 2.042	D 2.042	D 2.042	D 2.042	D .762 G 1.280	20.420
Total Annual Felling	2.810	2.810	2.810	2.810	2.810	2.810	2.810	2.810	2.810	2.810	28.100
Annual Total of H Area Production	2.810	2.810	2.546	.734							
Cumulative Total of H Area Production		5.620	8.166	8.900							8.900
Annual Total of D Area Production			.264	2.076	2.810	2.810	2.810	2.810	2.810	1.110	17.500
Cumulative Total of D Area Production											
Annual Total of G Area Production										1.700	1.700
Cumulative Total of G Area Production											

Table VIII-4 Production Process at Saw-Mills

Saw-Mills

Felling Sector (Operation 300 days)

Annual Felling for Sawing 0.384 mil.ft^3	Wood Gathering Annual 0.384 mil.ft^3	Wood Carrying Annual 0.384 mil.ft^3
Workers 4	Workers 4	Workers 4
Chain-saws 2	Tractor 1	Truck 1
Consumed Fuel Calculated by Fuel Oil 6 t	Consumed Fuel 24 t	Consumed Fuel 20 t

Lumbering Sector (Operation 300 days)

Annual Amount of Sawn Logs: 0.384 mil.ft^3 (Yield Percentage 45%)

Sawn Products 0.173 mil.ft^3

Larger bandsawing machine 1 unit Workers	Smaller bandsawing machine 1 unit	Circular cutting saw machine 1 unit	Log Arrangement	Products Arrangement	Total
4	3	2	4	3	16

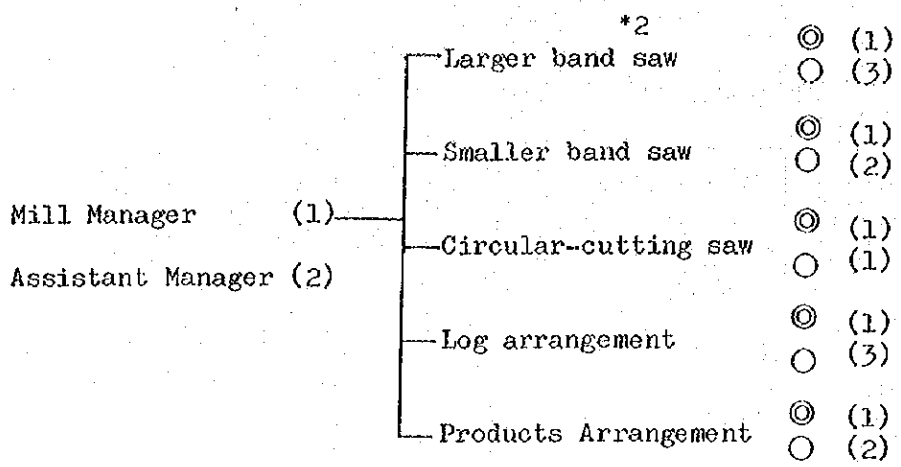
Folklifts used in arranging logs and sawn products

Consumed Electric Energy 480,000 KWH

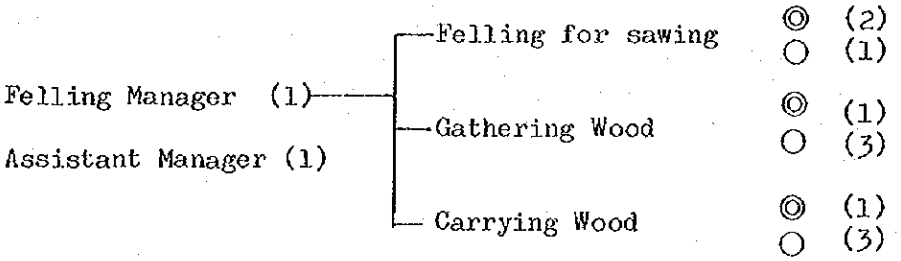
Certain portion of the felling is applied to produce logs (annual felling of 0.384 mil.ft^3 of logs) for exportation and plywood (incl. domestic consumption) manufacturing.

Table VIII-5 Organization of Production Section

Lumbering Section



Felling Section



*1 ( ) Persons ◎ Skilled Worker ◎ Unskilled Worker

*2 The saw mill machinery is an aggregate of lumbering sector machines and felling sector machines. In some cases there two pets of machines may be separately considered.

Table VIII-6 Facility Expenses and Production Cost at Saw Mill

Facilities

Items	Procurement and Construction Expenses(Rs)	Depreciation		Annual* Repair Expenses (Rs)	Annual* Interest (Rs)	Annual* Insurance Premium (Rs)
		Year	Amount(Rs)			
A Set of Sawing Machine (incl. Spare Parts, Mill Construction, Installation Costs) 1	1,068,000	10	106,800	10,680		
Forklift 1	120,000	5	24,000	2,400		
Housing for Employees 2	40,000	20	2,000	200		
Warehouse 1	10,000	20	500	50		
Mill Site 4mil.m^2	8,000	20	400	40		
Miscellaneous Items 1	10,000	5	2,000	200		
Total	1,256,000		A 135,700	B 13,570	C 87,920	D 12,560

*Repair expenses are taken as comprising 10% of depreciation.
Annual interest is taken as comprising 7% of procurement and construction expenses.
Insurance premium is taken as comprising 1%.

Operation Cost

Items	Numbers	Unit Price (Rs)	Amount (Rs)	Remarks
Wages for Sawing Workers (Skilled Workers)	4	4,500	18,000	Daily Rs15 Annual Work days 300
(Unskilled Workers)	12	3,000	36,000	Daily Rs10 Annual Work days 300
Electric Power Cost	480,000 KWH		52,800	200 KW x 8 hours x 300 days
Wear and Tear Cost			20,000	
Total			E 126,800	

Administration Expenses

Items	Numbers	Unit Price (Rs)	Amount (Rs)	Remarks
Mill Manager	1	6,000	6,000	Annual Rs6,000/person
Assistant-managers	2	5,000	10,000	Annual Rs5,000/person
Office Expenses			5,000	
Miscellaneous Expenses			5,000	
Total			F 26,000	

Table VIII-7 Facility Expenses and Production Cost at Felling
(Annual Felling 384,000 ft^3)

Facilities Concerned

Items	Procurement and Construction Expenses(Rs)	Depreciation Year	Depreciation Amount (Rs)	Annual* Repair Expenses (Rs)	Annual* Interest (Rs)	Annual* Insurance Premium (Rs)
Chain-saw for felling	12,000	3	4,000	400		
Tractor for gathering wood	150,000	5	30,000	3,000		
Truck for carrying wood	120,000	4	30,000	3,000		
Other facilities	10,000	5	2,000	200		
Total	292,000		[a]66,000	[b]6,600	[c]20,440	[d]2,920

* Repairation, interest and insurance are taken on the same basis as in the case of the sawmill

Expenses for Operation

Items	Numbers	Unit Price (Rs)	Amount (Rs)	Remarks
Wage for felling workers	12	3,900	46,800	Daily Rs 13, Annual work days : 300 days
Temporary hut expenses	2	3,000	6,000	
Felling facilities	1	10,000	10,000	
Fuel cost	50 t		5,000	
Total			[e]67,800	

Expenses for Management

Items	Numbers	Unit price (Rs)	Amount (Rs)
Manager	1	6,000	6,000
Assistant Manager	1	5,000	5,000
Office expenses			4,000
Others			5,000
Total			[f]20,000

Table VIII-8 Chipboard Production Processes

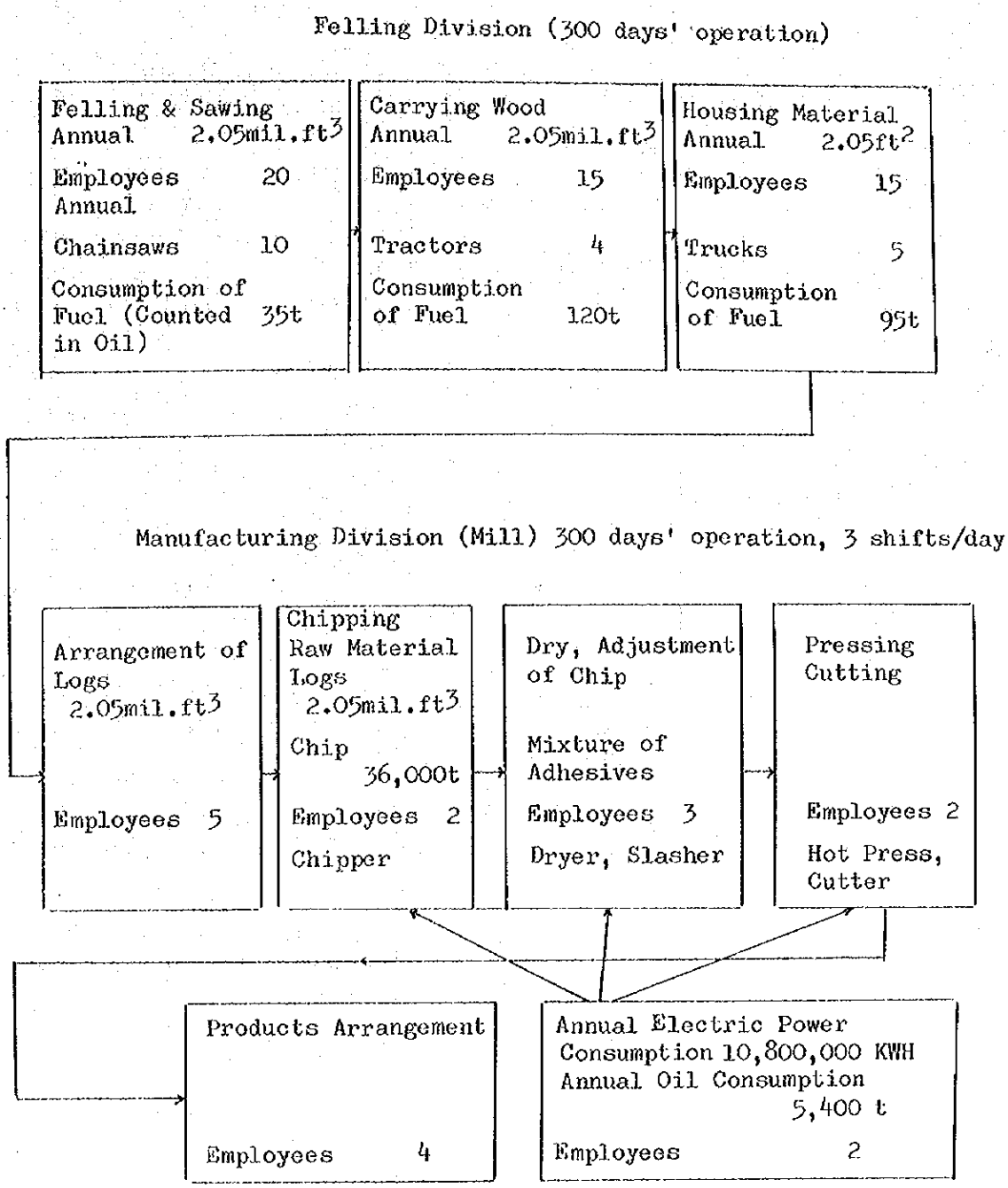
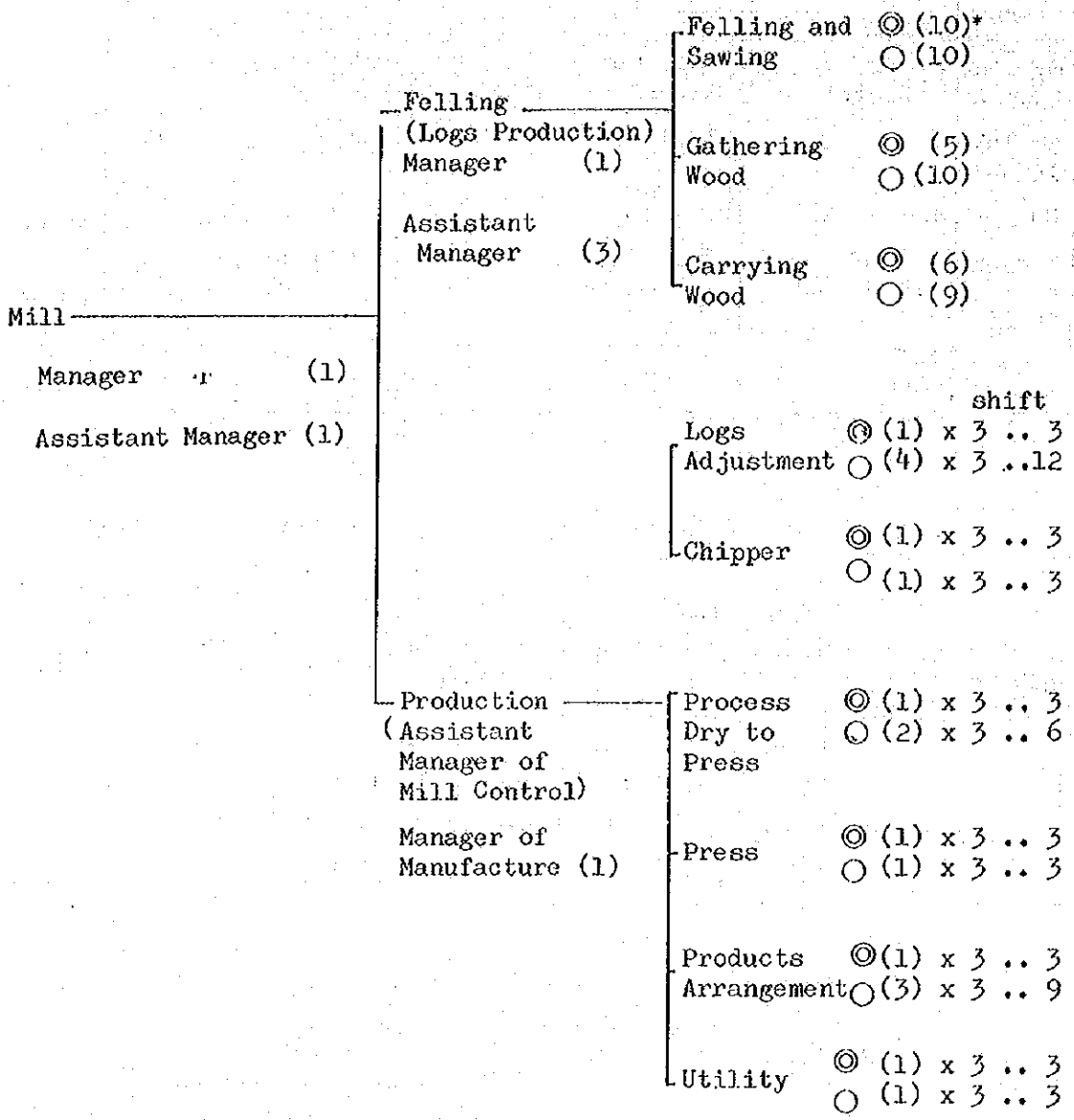


Table VIII-9 Organization of Chipboard Mill Production



* ( ) .... Number of Personnels

◎ .... Skilled Workers

○ .... Unskilled Workers

Table VIII-10 Production Facilities and Production Cost at Mill
Chipboard Products 120 t x 300 days = 36,000 t/year

Facilities Concerned

Items	Procurement and Construction Expenses(Rs)	Depreciation		Annual* Repair Expenses (Rs)	Annual* Interest (Rs)	Annual* Insurance Premium (Rs)
		Year	Amount (Rs)			
Mill Construction (of ferro-concrete)	4,800,000	15	320,000	6,400		
Machines and Installation	24,000,000	12	2,000,000	40,000		
Housing for Employees	200,000	20	10,000	200		
Total	29,000,000		[a] 2,330,000	[b] 46,600	[c] 2,030,000	[d] 14,500

* Repair expenses are taken as comprising 2% of depreciation. Annual Interest is taken as comprising 7%. Insurance premium is taken as comprising 0.5% of Import and Construction expenses.

Operation Cost

Items	Numbers	Unit Price (Rs)	Amount (Rs)
Wages for Mill Workers	55	annual 3,900	214,500
Adhesives 80 kg x 36,000t	2,880 t	1,700	4,896,000
Other Chemicals			490,000
Electric Power Cost 300 KWH x 36,000 t	10,800,000 KWH		1,188,000
Fuel Oil Cost 150 kg x 36,000 t	5,400 t	100	540,000
Others			10,000
Total			[e] 7,338,500

Administration Expenses

Items	Numbers	Unit Price (Rs)	Amount (Rs)
Wages for Mill Manager	1	8,000	8,000
Wages for Assistant Manager	2	6,000	12,000
Office Expenses Miscellaneous			20,000
Cost			20,000
Total			[f] 60,000

Table VIII-11 Material Wood Production Facilities and Facilities Cost (2,050,000 ft^3 Production)

Facilities Concerned

Items	Procurement and Construction Expenses (Rs)	Depreciation		Annual Repair Expenses (Rs)	Annual Interest (Rs)	Annual Insurance Premium (Rs)
		Year	Amount (Rs)			
Chain-saw for Felling 10	50,000	3	16,700	1,670		
Tractor for Gathering Wood 4	800,000	5	160,000	16,000		
Truck for Carrying Wood 5	600,000	4	150,000	15,000		
Other Facilities 1	50,000	5	10,000	1,000		
Total	1,500,000		A 336,700	B 33,670	C 105,000	D 15,000

* Repair expenses are taken as comprising 10% of depreciation.
Annual interest is taken as comprising 7% of procurement.
Insurance premium is taken as comprising 1% of procurement expense.

Operation Cost

Items	Numbers	Unit price (Rs)	Amount (Rs)
Felling: Wages for Workers	50	Annual 3,900	195,000
Temporary Hut Expenses	8(houses)	3,000	24,000
Felling Facilities	1	40,000	40,000
Fuel Cost	250 t	100	25,000
Total			E 284,000

Administration Expenses

Items	Numbers	Unit Price (Rs)	Amount (Rs)
Wages for Manager	1	6,000	6,000
Wages for Assistant Manager	3	15,000	15,000
Office Expenses			20,000
Others			20,000
Total			F 61,000

Table VIII-12 Summary of Sectors

	Sawing	Plywood Log	Export Log	Chipboard	Total
Facilities Investment Amount	Felling Rs92,000 Mill Rs1,256,000	Felling Rs146,000	Felling Rs46,000	Felling Rs1,500,000 Mill Rs29,000,000	Felling Rs2,084,000 Mill Rs30,256,000
Annual Profit	Rs904,790	Rs629,760	Rs1,119,360Bs	Rs7,667,300	Rs10,321,210
Annual Employees	Felling 14 Mill 19	Felling 7	Felling 7	Felling 54 Mill 58	Felling 82 Mill 77
Annual Consumption of Log	384,000ft^3	192,000ft^3	192,000ft^3	2,050,000ft^3	2,818,000ft^3
Annual Products	Felling 173,000ft^3	192,000ft^3	192,000ft^3	Chipboard 36,000t	
Required Period for Factory Construction	6 Months			1 Year	
Required Period for Purchasing the Felling Facilities	6 Months	6 Months	6 Months	6 Months	

Table VIII-13 Required Amount of Local and Foreign Currencies

(Rs, ( ) is U.S.$)

	Investment Amount	
	Local Currency	Foreign Currency
Sawing Mill { Felling	0	292,000
Sawing	164,800	1,091,200
Total	164,800	1,383,200
		(232,471)
Log for Plywood Production	0	146,000
(Half of Felling Above-mentioned)		(24,538)
Log for Export Production	0	146,000
(Half of Felling above-mentioned)		(24,538)
Chip Mill Felling	0	1,500,000
Production	8,600,000	21,900,000
Total	8,600,000	23,400,000
		(3,932,773)
Grand Total	8,764,800	25,075,200
		(4,214,319)

Table VIII-14 Each Section-wise Summary (Local and Foreign Currencies)

(Rs,$ is U.S.$)

(1) Sawing Section

Facilities Concerned

Items	Procurement Construction	Depreciation Amount	Repair Expenses	Interest	Insurance Premium	Annual Charge
Sawing Machine	$ 961,200	$ 96,120	$ 9,610	$67,280	$ 9,610	
New Factory Construction	106,800	10,680	1,070	7,480	1,070	
Machine Installation						
Forklift	$120,000	$24,000	$2,400	$8,400	$1,200	
Housing for Employees	40,000	2,000	200	2,800	400	
Warehouses	10,000	500	50	700	100	
Mill Site	8,000	400	40	560	80	
Items for Operation	$10,000	$2,000	$200	$700	$100	
Sub-Total	$1,091,200	$122,120	$12,210	$76,380	$10,910	$221,620
	164,800	13,580	1,360	11,540	1,650	28,130
Operation Cost						126,800
Administration Expenses						26,000
Total Foreign Currency	1,091,200					254,360
Rs	164,800					185,870

(2) Felling Section

Facilities Concerned

Items	Procurement Construction	Depreciation Amount	Repair Expenses	Interest	Insurance Premium	Annual Charge
Chainsaw etc.	$292,000	$66,000	$6,600	$20,440	$2,920	$95,960
Operation Cost						67,800
Administration Expenses						20,000
Total Foreign Currency						104,720
Rs						87,800

(3) Chipboard Mill (Felling and Production)

Facilities Concerned

Items	Procurement	Depreciation	Repairment	Interest	Insurance	Annual Charge
Chain-saw, etc.	$1,500,000	$336,700	$33,670	$105,000	$15,000	$490,370
Operation Cost						284,000
Administration Expenses						61,000
Fell Section Total Foreign Currency	1,500,000					490,370
Fell Section Total R.S	0					345,000
Chipboard Mill Construction	4,800,000	320,000	6,400	336,000	2,400	664,800
Machine	$ 20,400,000	$ 1,700,000	$ 34,000	$ 1,428,000	$ 10,200	$ 3,172,200
Machine Installation	3,600,000	300,000	6,000	252,000	1,800	559,800
Housing for Employees	200,000	10,000	200	14,000	100	16,300
Facilities Cost Foreign Currency	20,400,000	1,700,000	34,000	1,428,000	10,200	3,172,200
R.S.	8,600,000	630,000	12,600	602,000	4,300	1,248,900
Operation Cost, Wages and Others						1,952,500
Operation Chemicals and Adhesives						$5,386,000
Administration Expenses						60,000
Mill Total Foreign Currency	20,400,000					8,558,200
R.S.	8,600,000					3,261,400
Chipboard Mill Foreign Currency	21,900,000					9,048,570
Grand Total R.S.	8,600,000					3,606,400

Table VIII-15 Required Amount of Earthen Pipes

Diameter of Pipes	Length (m)			
	Turnouts	Drainage	Road	Total
0.75 (229 mm)	1,372	-	-	1,372
1.00 (305 mm)	366	-	-	366
1.25 (381 mm)	305	-	-	305
1.50 (457 mm)	1,372	-	-	1,372
2.00 (609 mm)	671	7,012	5,366	13,049
Total	4,086	7,012	5,366	16,464

Table VIII-16 Calculated Requirement of Quantity and Weight

	Quantity	Weight
0.75ϕ (229 mm)	2,078	72.73 t
1.00 (305 mm)	554	27.70
1.25 (381 mm)	462	34.65
1.50 (457 mm)	2,078	218.19
2.00 (609 mm)	19,766	3,459.32
Total	24,938	3,812.32 t

Table VIII-17 Capacity of Installed Equipment in Tissawewa Factory

Items	Number	Capacity	Usage
1. Multistage Tile Truck	5	100 kg/batch	For Transporting Raw Materials
2. Box Feeder	1	4-40 t/hr	For Supplying Raw Materials
3. Edge Runner	1	6-8 t/hr	For Pulverizing Raw Materials
4. Belt Conveyor	1		For Transporting Raw Materials
5. Roller Mill	1	5-10 t/hr	For Pulverizing
6. Plate Mixer	1	13-40 t/hr	For Blending
7. Vacuum Press	1	8-12 t/hr	For Extrusion Press Forming
8. Turn-table Feed Press	2	600-800 pu/hr	For Forming Standard Tiles
9. Slide Press	1	200 pu/hr	For Forming Bricks
10. Rotary Loader	2		
11. Reloader	2		
12. Chamber Dryer	1	20 t/day	For Drying
13. Ring Kiln	1	Bricks 4t/day Tiles 16t/day	For Firing

Source: State Engineering Corporation

Table VIII-18 Required Investment Cost

(Rs)

	Repairs of Existing Factories			Red Brick Plants			Raw Materials Supply Centre		
		Items			Items			Items	
	Total	Portion of Foreign Currencies	Portion of Domestic Currency	Total	Portion of Foreign Currencies	Portion of Domestic Currency	Total	Portion of Foreign Currencies	Portion of Domestic Currency
Material and equipment	4,567,300	4,116,300	451,000	4,353,300	3,902,300	451,000	2,090,100	2,058,100	32,000
Engineering Fee	8,500		8,500	376,950		376,950	218,500		218,500
Building	772,100		772,100	1,288,200		1,288,200	392,500		392,500
Construction Cost	509,700	326,500	183,200	509,700	326,500	183,200	181,100	117,200	63,900
License Fee	232,600	232,600		139,500	139,500		93,000	93,000	
Shipping Freight	200,000		200,000	160,000		160,000	60,000		60,000
Contingency (10%)	629,020	467,540	161,480	682,800	436,830	245,970	303,520	226,830	76,690
Total	6,919,220	5,142,940	1,776,280	7,510,450	4,805,130	2,705,320	3,338,720	2,495,130	843,590

(Notes) 1. The Conversion of the Japanese Yen and the Sri Lanka's Rs is as follows: 1 Rs = 43 Yen

2. The above Calculations are as of March 1973.

Table VIII-19 Organization Chart

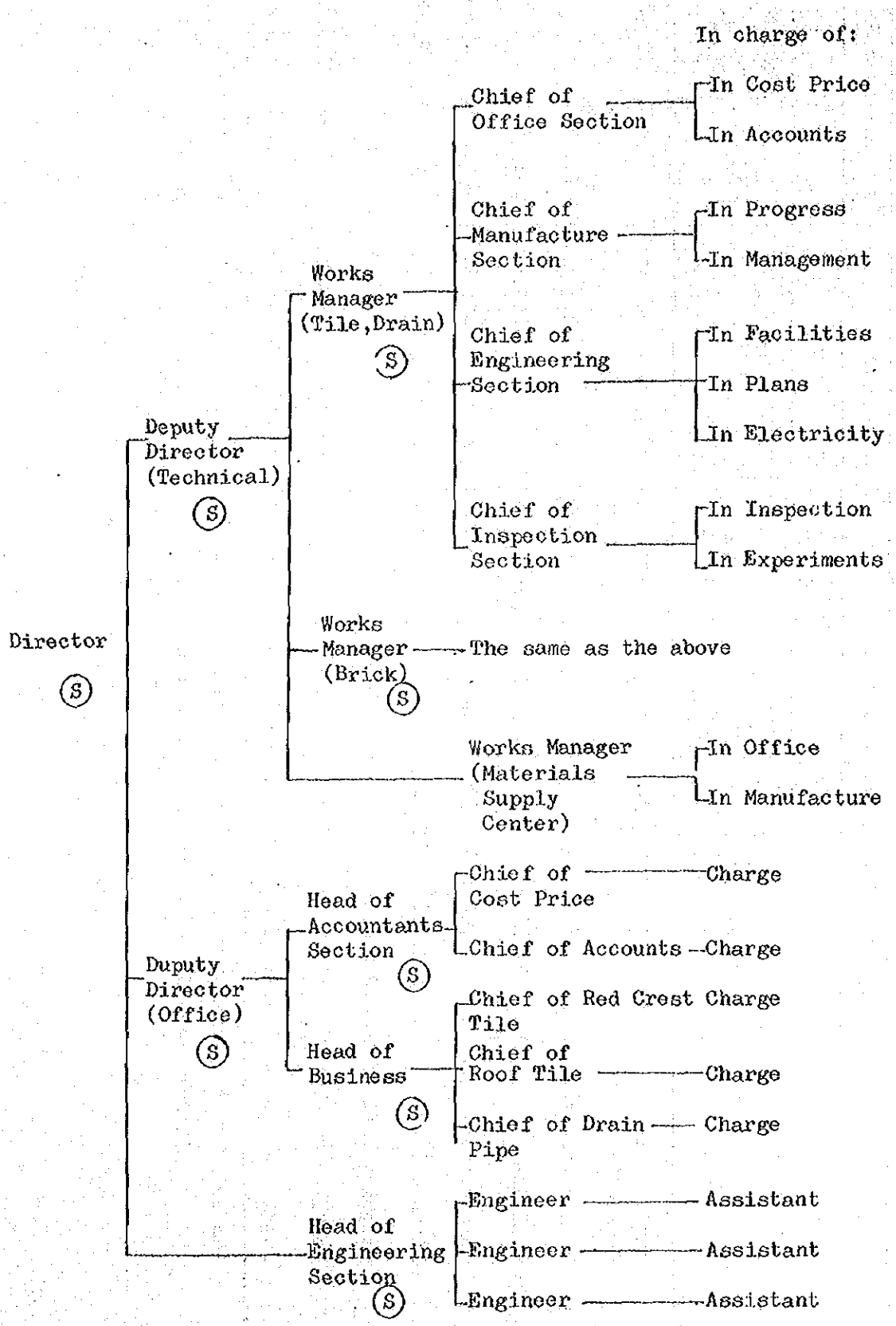


Fig. VIII-1 Production Processes of Cotton Seed Oil

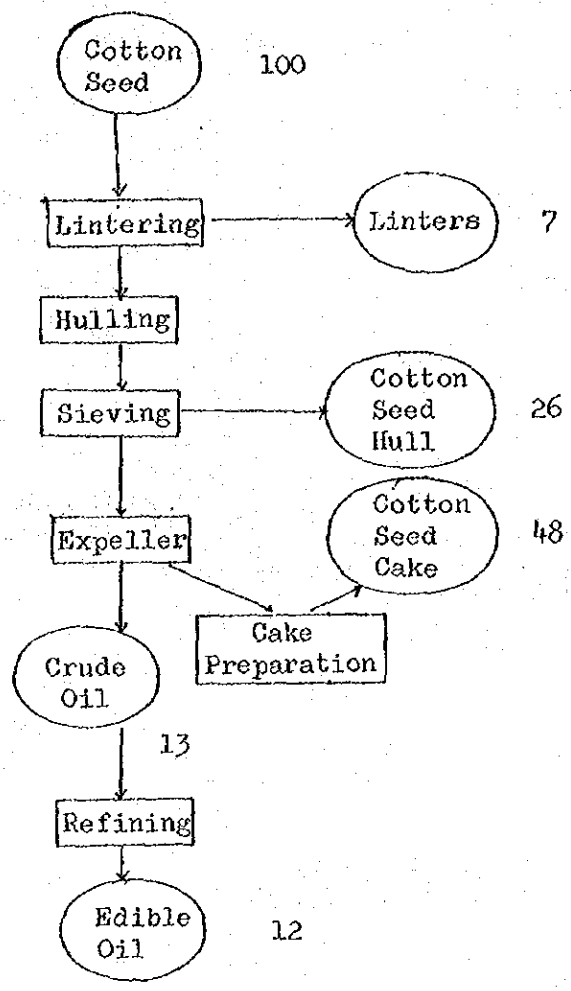


Fig.VIII-2 Production Process s of Groundnut Oil or Soyabean Oil

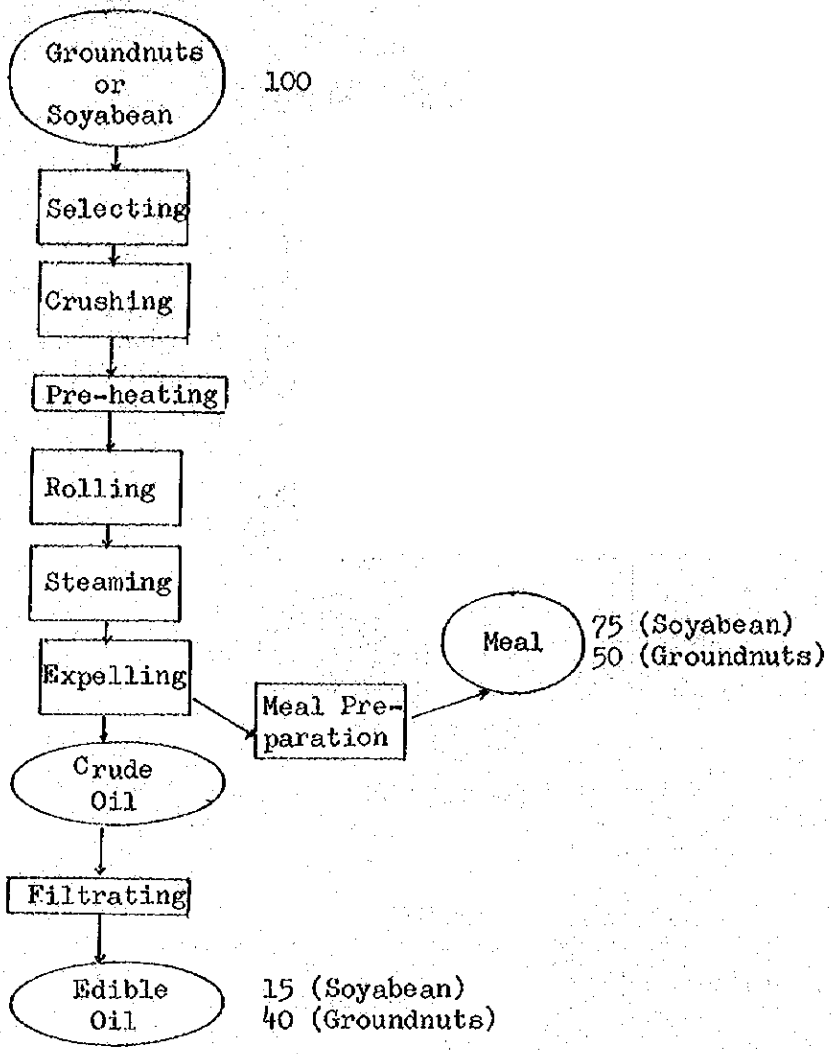


Fig.VIII-3 Production Processes of Rice Bran Oil