THE REPUBLIC OF SRI LANKA

SURVEY REPORT
ON
INDUSTRIAL DEVELOPMENT
AT MAHAWELI GANGA PROJECT AREA

APPENDIX

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Appendix 1 Fish Cultivation

According to the Five Year Plan, the yield of inland fisheries is to be increased to 21,000 tons by the end of 1976 from the yield of 11,000 tons achieved in 1970. It is expected that 7,600 tons out of the 10,000 ton increase portion is to be supplied by fresh water fish caught from reservoirs and 400 tons by cultivated fresh water fish. As has already been explained, the cultivation of fresh water fish is regarded as one of the most suitable industries for the Mahaweli project area, as there are a number of water surfaces and canals in this area.

The term "Catching" signifies the catching of fish living within the waters of the waterways, while the term "Cultivation" means the raising of a number of fish by means of positive feeding. At present, fresh water fish have been caught by people living in the vicinity of reservoirs by the use of extremely primitive fishing methods, so that the development of modern fishing techniques is highly desired.

According to the Five Year Plan, fishery experimental stations are to be installed in the southern and central areas for researches and extensions concerning fresh water fish.

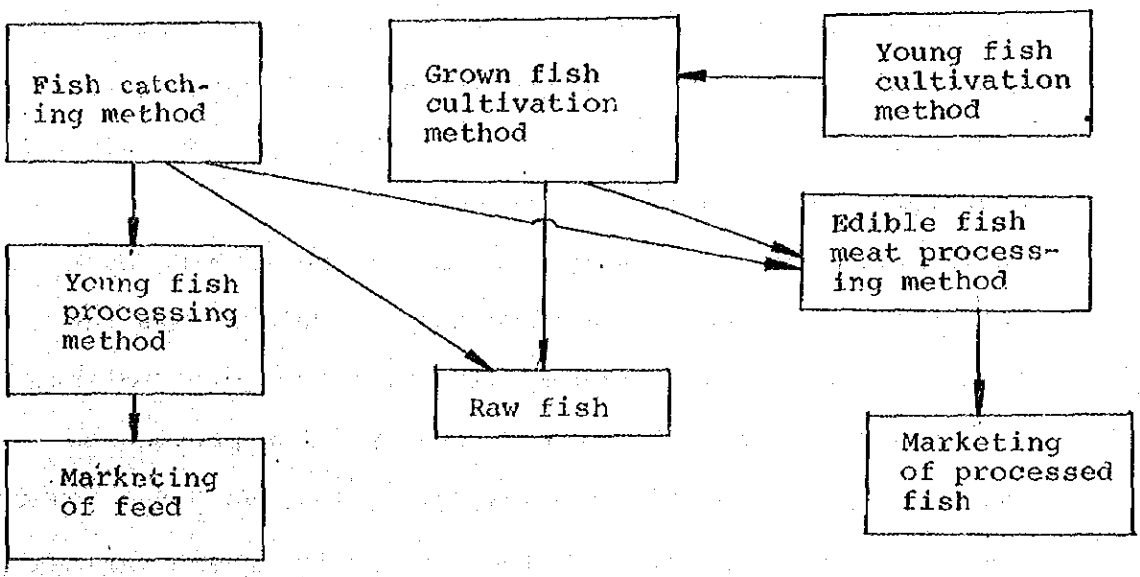
The installation and activities of these experimental stations, therefore, is strongly anticipated.

It is worthy of high evaluation that there is already a cultivation station of Japanese carp in Polonnaruwa for hatching and fostering young fish which are released into reservoirs in all parts of the country. The production efficiency is expected to be extremely low, as a few young Japanese carp were released into reservoirs where various types

of other fish are present. Researches should, therefore, be made to carry out the cultivation when the young fish are fully grown. Carp and Sogyo* should firstly be examined as the species to be cultivated in Sri Lanka. Japanese carp are presently cultivated and it seems that they are cross bred with native miscellaneous fish after being released into reservoirs and caught as such. Carp is recommended as the most suitable species for cultivation as consumption of this fish as food has already been practised among people in general.

Sogyo* should also be considered as a suitable species for cultivation as this fish features strongsurviving characteristics by simply eating water plants and water weeds thus requiring no special feeding once released into reservoirs. The following research and development works should be carried out in the event where the experimental stations are enforced.

Note: *Japanese term for Ctenopharyngodon itellus



Details of the above-mentioned items will be described in the following paragraphs. Production figures and relative cost data have been taken from data obtained in Japan as reference data in Sri Lanka are not fully substantiated.

1-1 Methods of Fishing

Utilization of abundant fish available from reservoirs and canals as food have not so far been sufficiently practised, although there are various types of fish available as a potential supply source of protein. Among these fish, there are many varieties of miscellaneous fish which have not been utilized as food at all. The growth rate of cultivated, young fish when released into such an environment is, therefore, extremely low. On the other hand Sri Lanka has been importing fish-meal, an important source of animal protein feedstuff, so that it would be doubly beneficial if such unedible fish were used for producing fish meal as feedstuff. The fishing method practised at the reservoirs seems mainly the use of gill nets. Other methods such as 4-armed scoop nets and drag nets should also be studied for practical use. These nets have been widely used in Japan especially in the Kasumigaura Lake where the water is generally shallow.

1-2 Processing Method for Miscellaneous Fish and Marketing Concerning Feed.

Small and edible miscellaneous fish (body length approximately 5 - 10 centimeters) can be caught during the dry season and

dried in the sun for several days. The fish can be dried after being boiled in water, should there be any danger of becoming stale. In some cases drying can be carried out by using thermal drying racks employing rice husks as fuel.
Fish thus dried can be ground into suitable sized grains by a simple grinding machine. Fish meal produced by such methods contains high purity protein in addition to calcium, phosphorous and various vitamins. This fish meal is extremely valuable as the protein source for domestic animals such as chicken, however, care should be taken not to feed too much of it to chickens in order to avoid a fishy smell in eggs and chicken meat. Blending fish meal, therefore, into normal chicken feed at 5% to 10% is considered to be the adequate rate in general. It will be a suitable cottage industry for the inhabitants of the Mahaweli project area to participate in the production of fish meal in such a manner for the purpose of increasing their income.
Special care should be taken not to let the fish go stale when producing fish meal. Stale fish meal would not only lose its value as feed but will give adverse nutrition effects to domestic animals. Animal protein is also an essential source of nutrition for cultivated fish. In this case the drying process is not necessarily required. Here, the unedible fish caught in nearby waters should firstly be placed into a fish preserve and can then be made into feed whenever necessary by passing them through a chopper. The feed thus produced from fresh water fish containing comparatively low degree of fatty substances is

superior to such other types of feed as chrysalis and soya bean meal for dried fish meal. The miscellaneous fish can be used as feed for cultivated fish after boiling if this process satisfies fish's appetite. It is one of the advantages that even large sized miscellaneous fish can be used raw for such an application.

1-3 The Cultivation Method of Young Fish and Grown Fish and the Marketing of Raw Fish

It seems that carp are suitable fish for cultivation in Sri Lanka.

As the necessary condition for fish cultivation, the two factors to be taken into consideration are the cultivation environment and the feed condition. Carp can live in water with a temperature ranging from a minimum of $0^{\circ}C$ to a maximum $35^{\circ}C$. The temperature range in which carp display a positive appetite and active growth reaction is from 22° to 28°C so that in Sri Lanka where the water temperature is generally high, it seems that the condition is highly favourable for this operation. Concerning the feed for carp, a wide range of items can be utilized and also the carp are capable of withstanding comparatively poor quality feed . Approximately 40 to 60% of the total cost necessary for the cultivation of carp here is comprised by feed cost, however, apart from the cost, the majority of expenses for the cultivation of carp will be the labour costs, provided that cultivation ponds are available. This implies that such cultivation operations will absorb the excess labour force at the farmer's family, thereby contributing to an increment in the income for the household. A certain extent of technique and experience will be necessary for carrying out fish cultivation, however, it is always possible to learn such techniques from countries with advanced fish cultivation, such as Japan. As has been mentioned earlier, the hatching and cultivation of young fish in Sri Lanka have

already been undertaken, however, in view of the total operation, merely hatching and young fish cultivation are not sufficient. It is strongly desired that the cultivation of fish up to grown fish status be undertaken. For the time being, however, it is recommended that hatching and young fish cultivation be undertaken intensively at the public cultivation station as is being undertaken at present, and the young fish thus obtained be distributed to cultivation facilities prepared in accordance with cooperatives where the young fish will be cultivated up to the stage of grown fish.

(1) Cultivation of young fish

Young fish are approximately 100 grammes in body weight. The operation of young fish cultivation can be divided into two stages, i.e. hatching of eggs and rearing of young fish.

The hatching of eggs starts with the egg collection from the parent fish. The egg collection can be undertaken in the cultivation pond where the parent fish are held or the egg collection can also be undertaken after moving the parent fish into a fish reserve, a net type fish reserve, etc. which can be prepared separately from the ponds. The collected eggs shall be transfered into the hatching pond. The hatching pond should be a shallow pond without running water. When the young fish attain a body weight of approximately one gramme the fish can be moved to the cultivation pond where they will be held until they reach approximately 100 grammes in body weight. This process

is called young fish cultivation. The growth rate of the young fish during the cultivation period depends upon such factors as the water temperature, the extent of feeding new water, quality of water, quality and quantity of feed and the level of cultivation technique. The growth rate will be conspicuously affected by these factors. On the basis of active examples taken from Japan, a production plan can be listed as follows:

Cultivation period: 4 to 5 months from hatching to the young fish stage.

Cultivation pond area : 1 ha

Young fish population : Approximately 100,000 fish (one gramme body weight)

Required feed amount: 6 to 10 tons

Production target : 4 to 7 tons (Number of produced fish: 50,000 to 70,000)

(2) Cultivation of grown fish

The cultivation of grown fish signifies the operation of fish of approximately 100 grammes which have been obtained through the young fish cultivation. Up to the body weight of 0.8 to 1.0 kilogrammes the fish are best suited for food. The period necessary for grown fish cultivation is approximately 1.5 years. The cultivation method of grown fish is classified into three main categories, the cultivation in running water pond, the net fish preserve

or in the reservoir.

1) Cultivation method by reservoir

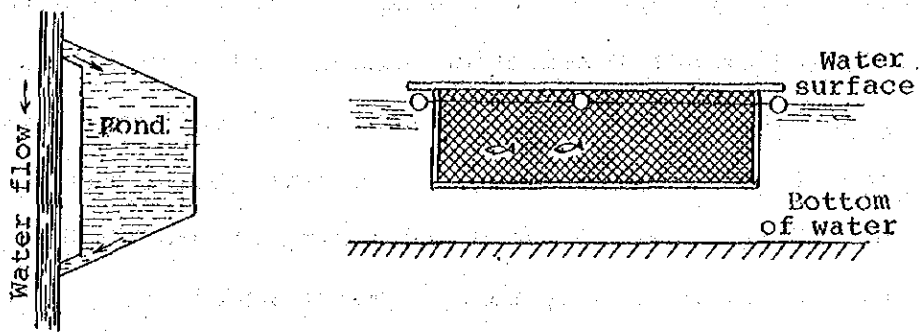
The production schedule of grown fish in a reservoir is almost identical to that for young fish. Approximately 5 to 10 tons of production per effective water area of 1 ha is possible, however, the target should be set at approximately 5 tons at the outset. In this cultivation method, the utility water pond can sometimes be directly used so that it is the simplest method, however, in the case of using such facilities, there are cases of a vast difference in the mud water depending upon the season due to the basic nature of such water. As the number of fish to be cultivated depends not only upon the area of the water body but also on the amount of water, the adjustment of the water quantity must be taken into account at the time of water reduction by means of aqueduction. If such a water quantity adjustment is not possible, the cultivation schedule must be based on the minimum amount of the water at the time of water reduction season. Also in the case of reservoir and utility water bodies, miscellaneous fish are prone to be present so that a certain device must be incorporated in order to avoid the mixing of undesirable fish.

2) Cultivation method by running water pond

A running water pond is a body of water into which new water is constantly fed. In such a pond, cultivation of a greater number of fish can be undertaken so that this method can be termed the most intensive fish cultivation method.

The relationship between the running water amount and the annual production amount can be described as follows as one example. An annual 3.1 tons of cultivation can be materialized if 50 litres per second of feed incoming water is available at 50m^2 of water area with a depth of 1.5 meters. However, if the fed water amount is 350 litres per second, approximately 6 tons of yield can be expected which is almost twice as much as the above case. In the case of running water ponds, a remarkably higher production efficiency can be obtained than in the case of a stagnant water pond. Therefore, if an appropriate location along the water way is selected, effective fish cultivation can be undertaken by providing a running water pond of 100 to 180 m^2 area with a water depth of 1.2 to 1.5 meters.

Example of
Running water pond



3) Cultivation method by means of net type fish preserve

This method employs reservoirs and other large areas of water. As a cubic cage is formed by a net and the cage is set underwater, it is convenient to harvest the fish and also full utilization of a large body of water can be undertaken. Another advantage of this method is that the feeding can be undertaken on schedule. Due to the numerous advantages it possesses, this method has been developed quite extensively in recent years. If the area of the net type fish preserve is $100m^2$, it is possible to produce fish of approximately 2.5 to 3.0 tons in such unit area. The cost for producing one unit area of the net fish preserve is approximately ¥25,000 and approximately ¥6,000 yearly depreciation including the auxiliary facilities will be required. However, in the case of this net-type fish preserve, a large extent of damage may result if tearing of the net takes place through which the fish can escape from the preserve.

(3) Harvesting of the cultivated fish

After cultivating the young fish or grown fish in stagnant water ponds, a four-armed net should be employed to catch the fish cultivated in the pond. Therefore, it would be necessary to harvest the fish by using a drag-net after reducing the amount of water. Thus, it is desirable that the pond itself be so designed as to facilitate such water reduction operation. In the case of a running water pond, the quantity of water is comparatively small and it is also possible to provide a design by means of which the water reduction can be attained by blocking the incoming

water.

(4) Feeding

In the carp cultivation, half of the production cost is comprised by the feed cost, so that it is in order to produce carp at a low cost and completion of cultivation must be undertaken by employing low-cost feedstuff. For this purpose, it seems necessary to formulate a feeding schedule on the basis of the lowest possible cost feed procurable in the cultivation area. The main items of the self-suppliable feedstuff are as follows.

Animal feed	:	Chrysalis, fishmeal, fresh fish
Vegetable feed	:	Rice bran, soya bean meal coconut meal, manioc.

Unprocessed manioc contains a certain extent of poison so that it is necessary to boil it well to reduce the effect and at the same time to convert the starch into an easily digestable state for the fish. The nutritional composition of feed to be fed to growing fish in general should be as follows.

Approximately 40% of protein

Approximately 10% of fatty substance.

However, in Sri Lanka where the source of feed is not readily available, it may be necessary to feed the fish with feed of a lower level of nutrition, however, in such a case it is inevitable that a certain extent of deterioration in the growth rate of the fish will result. There are certain degrees of likes and dislikes displayed by fish depend-

ing upon the nature of the feed and the method of feeding. The basic technique of fish cultivation is the improvization of the blending of the feed in accordance with the likes and dislikes of the fish in order to obtain the highest productivity at the lowest possible cost of feed. In the case of carrying out on-the-spot blending of the feed by utilizing several single feed raw materials, it is necessary to have a mixer, chopper and boiling pot. The value which presents the required amount of feed for increasing 1 kg. of the body weight of fish is called the feed coefficient. Under normal conditions of fish cultivation, the coefficient is within the range of 1.3 to 1.7. In other words, in order to increase the fish body weight by 1 kg., 1.3 to 1.7 kg. of feed will be necessary. However, in this case, the feed contains approximately 10% of water and is weighed under the air-dried weight so that in the case of assessing the feed coefficient of unprocessed chrysalis or fresh fish meat employed as feed, it is necessary to convert the above figure, reducing it by one-third.

(5) Marketing of grown fish

At present, the market for grown fish is not very large and the distribution channel of fresh food in the Dry Zone is extremely under-developed. The daily catch of fish at present is very small in order to fill up the daily demand. Even in this case, the left-over fish becomes stale quickly because of the hot climate. It will take a long time

before Sri Lanka becomes substantially equipped with refrigeration and freezing facilities to preserve such fresh fish for any length of time. Consequently, the market itself does have the consumption capacity of fresh fish if they are harvested in large quantities. Therefore it is necessary to have such facilities to preserve the catches until the fish are sold. In other words, small fish reserve ponds should be installed in various places of the market in which the fish are preserved until sold.

As carp are strong fish they can be transported for as long as 10 hours while contained in tanks and loaded on trucks.

(6) Processing Method for Edible Fish and Processed Fish Products

It is expected that carp will be traded in a fresh status for some time to come. However, in the event where the production of cultivated carp drastically increases in the future, adequate storage and preservation of the yield, i.e., the processing problems, will eventually be present.

The following are the methods available for processing fish meat.

(1) Salt water pickling

This method is to pickle fish meat in salt water under pressure so that the water content inside the meat and a part of the salt water are substituted.

(2) Salting

By this method, the water content inside fish meat will be dewatered and substituted by the addition of a large amount of salt to the fish body.

(3) Salt drying

Drying of fish meat after pickling in a high concentration of salt water or after boiling in such salt water.

(4) Smoking

Drying of fish meat under a smoking process

(5) Canning

Canning of fish meat after boiling or boiling and seasoning

Appendix-2 Chicken Farming

It is reported that the chicken egg production in 1970 amounted to 278 million. The per capita annual consumption of eggs can be computed as follows from this production amount.

278 million eggs divided by 13 million people = 21.4 eggs.

Although this figure is more than 11 eggs per year, the consumption figure of Indonesia, it is drastically low when compared with 100 in the case of Taiwan and 300 in the case of Japan. In advanced countries such as Scandinavia or the U.S.A., the figure is approximately 320 to 330. In Indonesia, a target is set to increase the per capita egg consumption amount to 40 eggs, and chicken farming is strongly encouraged. It is assumed that in Indonesia, the latest figure is approaching the level of 20 eggs per capita per year.

As it is reported that the number of chickens being farmed in Sri Lanka at present is 600 million, the egg laying amount per chicken per year is 46. The egg laying rate of a grown chicken based on this figure seems to be extremely low. For the most part, it appears that the chickens farmed in this country are local species which are closer to the wild chicken. Also it may be due to the fact that the feeding has not been undertaken substantially. The method

of farming is also the so-called open rearing in general which does not call for any particular chicken farming facilities. In Sri Lanka it is recommended that the chicken farming industry be based upon the egg production rather than chicken meat in view of the objective of improving the nutrition status of the population. The term "egg laying rate" used in chicken farming for the purpose of egg production signifies the ratio of number of eggs produced as against the total number of days during the period of one year after the day of the first egg laying of a chicken. For instance in Japan the rate has attained the order of 70%. This signifies that one chicken produces 250 eggs per year.

In tropical countries such as Sri Lanka, however, it should be considered to be a success if the rate attains approximately 60% considering the climatic conditions. In other words, a target for the egg productivity of chicken farming should be set at 200 to 230 eggs per year. In the Five Year Plan of Sri Lanka, the target is set at 342 million eggs which is 64 million eggs higher than the figure attained in 1970. However, the present situation is that, due to the shortage of feed, even the farming of the presently existing chicken is facing difficulties.

As mentioned above, in the Five Year Plan, it is projected that the self-sufficiency plan be implemented by the supply of various residues of oil producing crops. Undoubtedly, the

very basic condition for chicken farming operation to be practicable is to secure a stable source of feed supply. Under these circumstances, a prospect has finally emerged in Sri Lanka that the production of eggs will be undertaken in the near future with an ultimate object of complete self-supply of the eggs within the country. It goes without saying that the feeding of feed to chickens of low egg laying rate would be a great waste of time and funds. Therefore, it would not be feasible for Sri Lanka to become successful in chicken farming, if the feeding alone were improved without modifying the conventional method of farming and without employing better types of chickens than the present ones. It seems necessary therefore to import specially bred chicken species suitable for farming under the existing climatic conditions and, at the same time, to introduce modern farming techniques in order to proceed with positive egg production chicken farming operations.

Actually at the Trincomalee Chicken Farming Station to which the survey team paid a visit, the farming of the leghorn type chickens showed a great success, thereby yielding a high extent of profit. Examples such as this should be followed in the general improvement of chicken farming in Sri Lanka. In this Trincomalee Station, a project was made for the farming of 3,000 to 5,000 high egg laying rate type chickens and the rate achieved was 60%.

In the Mahaweli project it is planned that by 1980, the population in the Stage I area will be approximately 78,400 and in the Stage II area, approximately 141,400, totalling 220,000 in "H" area. If an assumption is made that one household consists of 6 people, the total number of households in both areas would be 37,000. The objective of carrying out egg producing chicken farming in these areas is to increase the production of eggs as the protein supply source food for the people and also to increase the farmers' income by shipping the eggs to urban consumption areas.

An assumption is made here that the consumption of eggs by the farmers in the area will increase by ten per year per head, and that the equivalent amount of eggs are to be shipped outside the area, the amount of eggs then required will be as follows:

220,000 people x ten eggs x two = 4.4 million eggs

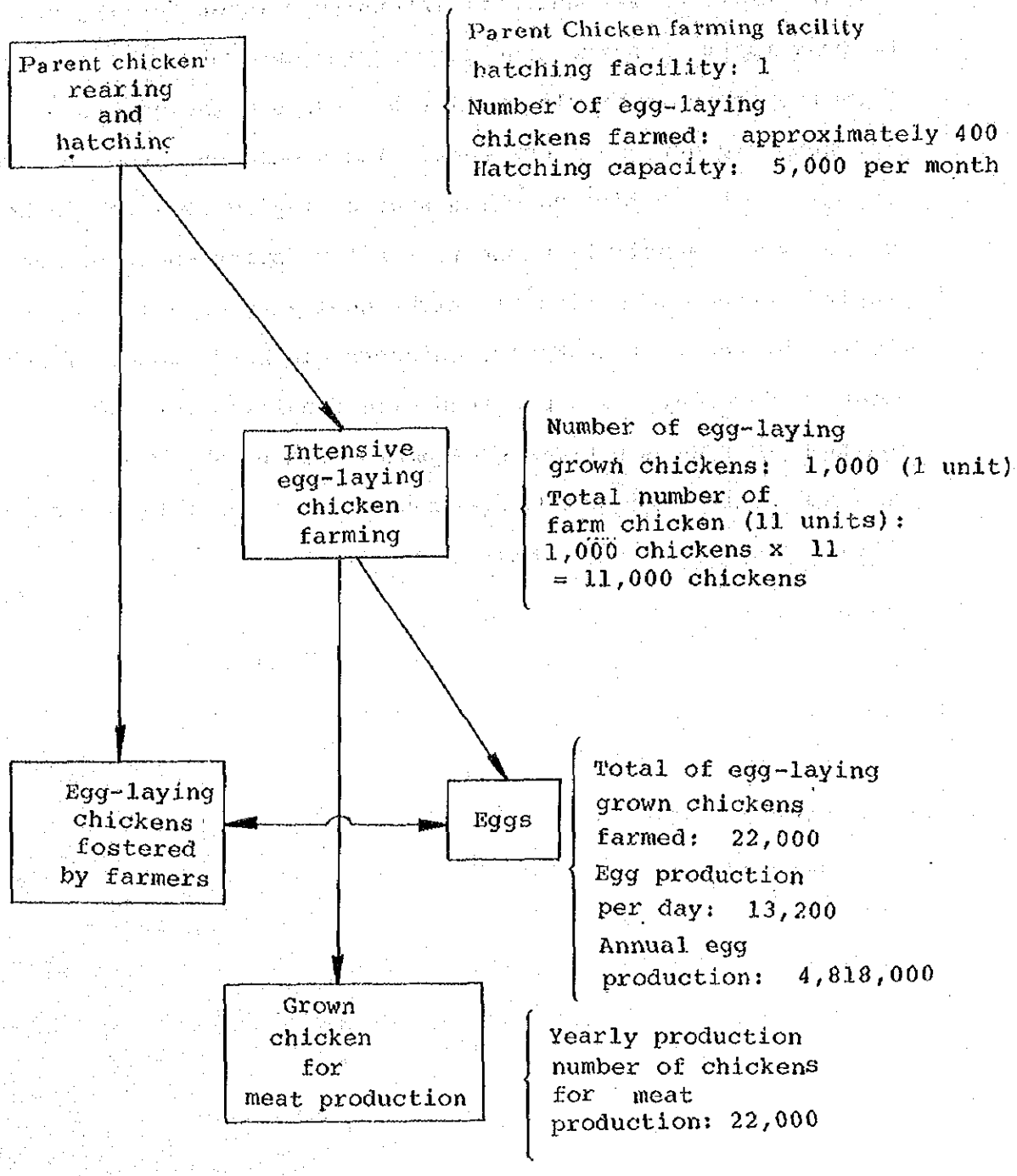
If the above number of eggs are converted into the number of grown hens, each one of which produces 200 eggs per year, the number of chickens required will be as follows:

4.4 million eggs ÷ 200 = 22,000 chickens

This figure, when compared with the cultivation population of egg-laying grown chickens against agricultural population in the developed countries, is extremely low. However, in Sri Lanka where no full-fledged chicken farming has so far been experienced, the above level will be suitable to start with as the primary stage. After succeeding at this stage, a remarkable development can be expected along with the self-supply project of the feed on the subsequent stages. At farmers' houses, the conventional open farming of the available chicken species will be undertaken in accordance with the traditional farming method. However, half of these egg-laying chicken farming projects will be undertaken by progressed farmers each

comprising thirty to fifty chickens as a unit flock of farming. It is then desirable that the remaining half of the farming operations be administered in the form of intensive chicken farming by the agricultural cooperatives in each area. In other words, by taking 1,000 egg-laying chickens as one farming unit, eleven units of intensive chicken farming should be undertaken. In the case of carrying out intensive chicken farming, one unit should consist of 1000 egg-laying grown chickens and 500 young chickens. Young chickens grow in five to six months. Chickens which started laying eggs should be farmed for approximately one year after commencement of egg laying during the period of which egg-laying capacity of a chicken is the highest. Thereafter, chickens can be disposed of for meat production. As a pre-requisite condition for egg production, the cultivation of parent chicken and hatching are necessary. The relationship among these operations can be illustrated as follows (Fig. (Append.)-1).

Fig. (Appendix) - 1 Relationship between Parent Chicken, Chicken Rearing and Hatching



In other words, upon completion of Stage I and Stage II of the Mahaweli project Phase I-Project I, the quantity of egg production additionally made by means of chicken farming will be 4,818,000 per year which corresponds to approximately 7.5% of the figure of 64 million eggs which is projected as the additional production amount in the Five Year Plan. The following paragraphs will explain the method of intensive egg production chicken farming.

2-1 Parent Chicken Rearing and Hatching

The parent chicken rearing and hatching should be undertaken in one place. The hatched young chickens can be transported without feeding for 48 to 60 hours so that the selection of the hatching place should be made in the center of the Project Area in a location where transportation systems and supply of electricity is substantiated and the parent chicken farming can be conveniently undertaken. Grown male chickens in adequate numbers should be farmed together with approximately 400 female grown chichens.

It is desirable that the good species should be imported from overseas during the initial stage of the farming. For hatching, an electric incubator should be employed.

A Japan-made incubator with a capacity of 5,000 egg hatching is approximately US$1,800 to $2,000 (FOB. Japan). Approximately half the hatched young chickens will be male so that the discrimination should be carried out immediately after hatching and the screened male chicken must be disposed of. For discrimination, there are two available methods.

One is by manual direct observation and another by employing a tester. The tester method requires high extent of skill and involves danger of damaging the chicken so that the manual method is more desirable. However, the manual method also calls for an extremely high degree of skill and therefore, it is necessary to train discrimination specialists. The rearing of parent chickens and hatching will be the basic foundation for the promotion of the chicken farming enterprise of Sri Lanka. Therefore, it is recommended that the government of Sri Lanka undertake this operation as a part of governmental enterprises, thereby, simultaneously undertaking the research and studies of chicken farming techniques and extension of the techniques to actual application.

2-2 Intensive Egg Production Chicken Farming

This operation can be carried out by taking 1,000 grown egg-producing chickens as one unit. On one farm, one unit or several units of farming will be undertaken. In carrying out such chicken farming, the administration cost and labour cost can be saved when the number of chickens to be farmed is higher. The productivity will therefore be improved. This being the circumstance, there is conspicuous tendency in Japan that the number of chickens per farm is increasing. At the chicken farm which the survey team observed in Trincomalee, the farming capacity was 5,000. The chicken farming portion of the project seems possible to be undertaken in one or two

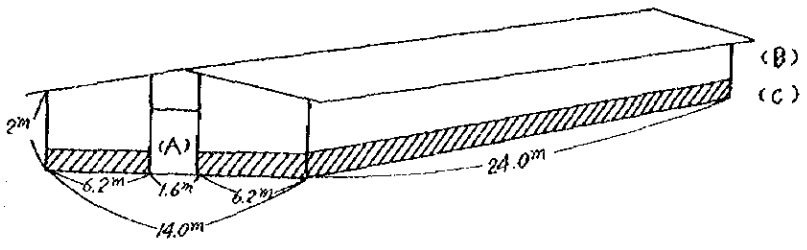
farms if the intensification is effected. However, when taking into consideration the future extention of this industry, it is also justifiable in view of the effects, to scatter a number of comparatively small scale farms over the area. In any event, an implementation programme on the basis of 1,000 chickens per unit will be formulated here in order to facilitate the project assessment, and the cost of such an operation will be calculated hereunder.

(1) Chicken houses and auxiliary facilities

In carrying out intensive chicken farming for egg production, the required facilities include a main chicken house capable of housing 1,000 grown chickens, an auxiliary houses for housing 500 young chickens where the rearing is to be undertaken and auxiliary buildings will be necessary. In the case of one story farming, the main chicken house should contain 3 to 4.5 chickens per 1 m^2. Therefore in the case of farming 1,000 chickens, the effective area of 220 to 330 m^2 will be called for. A plan of a standard chicken house will be as shown in the Fig. (Appendix)-2.

Fig. (Appendix)-2 Sketch of a Standard Chicken House

Doorway (A)
Wiremesh (B)
Bricks (C)



The building shown in the figure has an aisle of 1.6-meters width so that the effective area will be approximately 300 m^2.
The young chicken rearing house can be sufficiently built within 1/3 of this area so that including an auxiliary building (warehouse), the total required building area will be 500 m^2.
If an assumption is made that the average construction cost per 1 m^2 is Rs.50, the total construction cost will be Rs.25,000.
Supposing that this cost is to be depreciated in 7.5 years, the depreciation cost per day will be approximately Rs.9.0.

(2) Young chicken rearing cost

In order to constantly maintain 1,000 grown chickens for egg production, it is necessary to rear approximately 500 young chickens to grown chickens twice a year. The first group of young chickens will start producing eggs after a rearing period of approximately five months. The young chicken rearing cost consists of the procurement cost of the young chickens in the outset, the feed cost, and the yield rate of grown chickens out of the initially procured young chickens. The total cost for fostering the first group of young chickens to grown chickens can be calculated as being Rs.8,660 per 1,000 grown chickens. Therefore, the per day amount of young chicken rearing cost will be as follows:

Rs.8,660 ÷ 365 = approx. Rs.24

(3) Feed cost

A grown chicken consumes an average of 110 grammes of feed per day. Therefore, the amount of feed required for 1,000 chickens will be 110 kilogrammes. The feed for grown chickens produced by the Oils and Fats Corporation of Sri Lanka costs Rs.14 per 25.3 kilogrammes. Therefore, the feed cost for 110 kgs will be Rs. 61.00. The above case is made on the assumption of procuring ready-blended feed, however, in the case of blending in the farm after collecting less expensive single feed components separately in the surrounding areas, it would be possible to save feed cost to a considerable extent. It is necessary to calculate the blending ratio of the feed for grown chickens by taking into consideration, such factors as the total amount of protein and fatty substances and digestible total nutrition required as well as the likes and dislikes of the chicken, however, the details of such calculation will be abbreviated here. One example of on-the-farm blending details is as follows:

Grains such as maize, broken rice: 38%
Rice bran: 20%
Coconut oil residue: 30%
Fish meal:8%
Minerals: 2%
Shell, feed additives, etc.: 2%
Total: 100%

As a great portion of chicken farming cost will be taken up by the feed cost, the most important problem to be solved by the chicken farming enterprise is to discover the method as to how to fulfill the required nutrition at the lowest possible feed cost.

(4) Labour cost

In the developed countries whose labour cost is high, the chicken farming facilities are automated and mechanized as much as possible and, at the same time, the number of farming units is being increased in order to save the proportionate labour cost. In the most mechanized facilities such as the ones found in Japan, there are some cases where one direct farming person in charge looks after 2,000 chickens. However, in Sri Lanka where the labour cost is low and labour forces are abundant, it is more rational to save the facility cost by supplementing the operation by labour force. If three female and one male direct farming persons in charge look after 1,000 chickens and another male person in charge of general coordination is employed, the total labour cost per day will be sufficiently covered with Rs.35.

(5) Direct Miscellaneous Charges

In addition to the various cost items discussed above, Rs.10 per day shall be appropriated as direct miscellaneous costs.

The revenue as against the expenses will be as follows:

(6) Revenue

(1) Egg Sales Profit

If the egg laying ratio is taken at 60%, the per day egg

production of the farm will be 600 eggs. The retail price of an egg is approximately Rs.0.28 and the wholesale unit price is approximately Rs.0.26. Therefore, the total sales amount of eggs will be as follows:

Rs.0.26 x 600 pieces = Rs.156.

(2) Sales profit of grown chicken sales

The chickens whose egg laying ratio is lowered after passing one year are sold off for chicken meat production. The number of chickens thus disposed of is 1,000 and if one grown chicken (1.8 Kg) can be sold at Rs.8.0, the per day sales profit in this respect can be calculated as follows:

(Rs.8.0 x 1,000) ÷ 365 = Rs.22.

The above-mentioned are the main items of the profit. If these figures are related with the various cost items, the production profit can be obtained as follows (in terms of farming 1,000 grown chickens, per day figures)

Item	Expenses (Rs.)	Revenue (Rs.)
Egg sales		156
Grown chicken sales		22

Young chicken rearing cost	24	
Feed cost	61	
Labour cost	35	
Depreciation cost	9	
Miscellaneous cost	10	
Sub total	139	178
Balance		39

In accordance with the above calculation, the gross profit rate as against the total sales is more than 20%, however, the above-enumerated figures are of a highly rough nature and there is ample possibility of fluctuation depending upon the adequacy of the administration. The major problems to be taken into consideration are as follows:

(a) Since chickens are livestock, they are particularly prone to be affected by collective diseases. If such diseases, such as the Newcastle plague, should spread, a chicken farm will often receive unrecoverable damages. Therefore, in carrying out chicken farming, perfect facilities and administration for the prevention of intrusion and spreading of various diseases should be undertaken. At the same time, it is necessary to carry out preventive measures such as vaccination, etc.

b) As the methods of chicken farming become more modernized, much higher levels of specialized technique and ability will be required for running chicken farms. Therefore, the activities of the specialists of the governmental organizations and chicken farming technology extension personnel are indespensable in progressing the chicken farming industry in general in addition to the technical training to the employees who are directly in charge of the farm administration.

c) The feed cost is the largest item by far of the expenditures so that the economical viability of chicken farming can be greatly affected by whether or not improvisation will be carried out in preparing the feed not only by simply purchasing the marketed blended feed, but also producing on the farm the adequate feed by blending less expensive feed components which can be obtained within the farm area. However, if erroneous blending is carried out, the growth of chickens will be impaired, thereby resulting in the deterioration of the egg laying ratio. Therefore, when intending to carry out the farm's own feed blending, thorough advice from specialists should be sought. The composition of feed for the egg laying grown chickens are different from each other. Generally speaking, the nutritional composition of feed employed at the time of rearing young chickens contain a higher extent of protein substances.

d) At the time of chicken farming, a large amount of excrement will be produced. This substance is highly valuable as fertilizer or as one of the raw materials for producing manure. Appropriate utilization of the excrement will greatly contribute to the economical viability of chicken farming.

e) Since the main product in the chicken farming enterprise is eggs, the fluctuation in the egg market price will make the chicken farming operation highly unstable. It is therefore desirable that the government establish a guaranteed price for eggs in order to protect the chicken farming enterprises.

Attached Table IV-1

Main Features of the Three Phases of the Mahaweli Ganga Scheme

	Phase I			Phase I	Phase II	Phase III	Entire Scheme
	Project 1	Project 2	Project 3				
1. Irrigated area (1,000 ha)							
Total	74	35	22	131	42	137	360
New area brought under irrigation	34	30	10	74	84	104	262
Improvement to existing facilities	41	6	11	58	8	32	98
Equivalent irrigated area 1/	46	31	14	91	86	120	297
2. Hydroelectric power							
Installed capacity (megawatts)	40	120	40	200	15	293	508
Annual power production (million kWh)	200	470	150	820	48	1,169	2,037
3. Capital cost (million rupees current prices)							
Total	576	676	298	1,550	920	3,113	5,583 2/
Allocated to agriculture (idem)	540	476	233	1,249	898	2,659	4,806
Allocated to power (idem	36	200	65	301	22	454	777
Rupees per of equivalent irrigated land	11,589	15,073	16,926	13,590	10,329	21,819	15,987
Rupees per kW of installed capacity	900	1,600	1,630	1,505	1,465	1,550	1,530
4. Benefits (million rupees current prices)							
Total	130	118	42	290	291	521	1,102
Value added from agriculture	118	92	34	244	288	456	988
Revenue from sale of power	12	26	8	46	3	65	114
5. Capital cost/benefit ratios							
Total	4.4	5.7	6.9	5.3	3.2	6.0	5.1
Agriculture	4.6	5.2	6.9	5.1	3.1	5.8	4.9
Power	3.0	7.7	8.1	6.5	7.3	7.0	6.8
6. Internal rate of return (% of capital cost)	17	13	12	14	20	12	15

NOTE: 1/ One acre of improved land is taken as equivalent to 0.3 acres of newly irrigated land in the case of Phases I and II and 0.5 acres in the case of Phase III.

2/ Cost of the Scheme proper, excluding activities resulting from the Scheme.

Source; FAO Report (FAO/SF; 55/CEY-7)

Attached Table IV-2 Areas Under Proposed Irrigation Systems
(1,000 ha)

	Total	Existing	New
Phase I			
D, G		22.66	18.01
AD		–	3.68
C		1.34	29.79
B		4.25	–
D_1		7.37	–
H		18.70	23.03
IH		4.05	–
Sub-Total	132.88	58.37	74.51
Phase II			
B		2.75	47.80
A-AD		5.67	36.78
Sub-Total	93.00	8.42	84.58
Phase III			
F		0.20	3.32
D_2		–	3.68
E		–	4.05
I-IH		17.08	35.53
k		0.24	7.85
L		8.05	30.96
M		4.45	10.08
J		2.83	10.04
Sub-Total	138.36	32.85	105.51
Grand Total	364.24	99.64	264.60

Source: FAO Report (FAO/SF:55/CEY-7)

Attached Table IV-3

ORGANIZATION OF MAHAWELI DEVELOPMENT BOARD

I. Ministries concerned
   1. Ministry of Irrigation, Power and Highways
      a. Dpt. of Irrigation
      b. Dpt. of Land Development
      c. Territorial Civil Engineering Organization
   2. Ministry of Agriculture and Lands
      a. Dpt. of Agriculture
      b. Land Commissioner's Dpt.
      c. Dpt. of Agrarian Services
      d. Paddy marketing Board
      e. Fertilizer Corporation
   3. Ministry of Public Administration, Local Government and Home Affairs
      a. Dpt. of Rural Development
      b. Government Agents
      c. Local Authorities
   4. Ministry of Foreign and Internal Trade
      a. Dpt. of Cooperative Development
      b. Marketing Dpt.
   5. Ministry of Finance
      a. People's Bank

II. Divisions of M.D.B.
   1. Agriculture
   2. Engineering
   3. Planning and Evaluation
   4. Settlement
   5. Planning and Development
   6. Finance and Administration

Source; Mahaweli Development Board

Attached Table V-1 Production Targets for Public Sector Industry

Industrial Corporation	Unit	Capacity 1970	Production 1970	Production 1976	Remarks
1. National Milk Board					
(i) Processed Milk	thousand l	33,770	18,300	33,630	
(ii) Condensed Milk	thousand cans	25,000	14,676	25,000	
(iii) Powdered Milk	thousand cans (1 pound content)	12,000	11,921	12,000	
2. Ceylon Oils & Fats					
(i) Feed Stuff	t	60,000	48,720	100,000	Maximum capacity after Expansion 120,000t
(ii) Fatty Acids	t	5,400	1,527	3,000	
(iii) Glycerine	t	5,400	170	300	
3. Sri Lanka Sugar					
(i) Sugar (Kantalai and GalOya)	t	40,200	8,219	36,000	Product mix is variable within the 1970 total capacity
(ii) Spirits (Kantalai and GalOya)	thousand l	6,140	6,250	7,280	
4. State Flour Milling					
(i) Flour	t	51,800	48,700	74,200	Total capacity to be expanded to 102,000 tons by 1973.
(ii) By-products	t	20,300	20,300	29,500	
5. National Salt (including private Salterns)					
Salt	t	91,000	62,067	130,000	Capacity to be expanded during the Plan period
6. National Textile					
(i) Yarn (Thulhiriya, Veyangoda, and Pugoda)	thousand t	9.35	1.04	6.99	Capacity from existing and approved projects 9.94 thousand tons of yarn and 29.0 million m^2 of textiles

	(ii) Textiles (Thulhiriya, Veyangoda, and Pugoda)	million m^2	22.7	4.3	26.8	
7.	Ceylon Leather Products					
	(i) Footwear	thousand shoes	350	359	456	Increased production in 1976 obtained working two shifts.
	(ii) Chrome Leather	thousand m^2	111	104	158	
	(iii) Tanned Leather	t	191	98	185	
8.	Eastern Paper Mills					
	(i) Paper	t	10,000	9,665	22,000	New capacity for 15,000 tons
	(ii) Paperboard	t	–	–	12,000	To be installed after 1970.
9.	Ceylon Plywood					
	(i) Gintota Factory-3Ply Board of which Tea Chests	thousand m^2	2.78	2.23	3.99	Capacity in 1972 is 3.99 thousand m^2.
	(ii) Avissawella	thousand chests	–	1.04	1.20	
	Tea Chests		–	–	3,250	
	Ply Boards	million m^2	–	–	1.11	
	Chipboard	thousand m^3	–	–	7.50	From new capacity to be
	Sliced Veneer	million m^2	–	–	0.47	commissioned in 1972..
	Doors, Door Frames, Window	thousand sets	–	–	360	
	Lodging Furniture	set	–	–	8,500	
	School Furniture	set	–	–	2,000	
10.	Paranthan Chemicals					
	(i) Caustic Soda	t	1,600	1,373	3,200	From expansion of Paranthan factory maximum capacity
	(ii) Chlorine	t	1,200	577	2,500	3,200 tons of Caustic Soda and 2,500 tons of Chlorine
	(iii) Table Salt	t	400	276	600	From improvements to existing plant
	(iv) Hydrochloric Acid	t	1,000	190	1,000	From expansion of Paranthan factory expansion of the existing capacity to 250 tons
	(v) Calcium chlorate	t	30	–	150	

(vi)	Potassium Chlorate	t	50	4.5	230	
11.	Ceylon Tyre					
(i)	Tyres	thousand tyres	250	84	342	Mould capacity will be increased
(ii)	Tubes	thousand tubes	152	99	256	
12.	Ceylon Petroleum					
(i)	Petroleum crude processed at Sapugaskanda	million t	2.04	1.81	2.27	Increased capacity from removal of bottlenecks in existing plant
(ii)	Blending plant	million l	22.8	18.9	24.1	1970 capacity on one shift, additional output by increasing working hours
13.	Ceylon Fertilizers	thousand t	300	193	290	
	Mixed Fertilizer					
14.	Ceylon Fertilizer Manufacturing	thousand t	–	–	250	Capacity to be installed is under investigation
	Urea					
15.	Ceylon Ceramics					
(i)	Ceramic Ware	t	2,540	1,879	3,200	Expansion of kilns at Negombo and new capacity.
(ii)	Clay	t	5,000	3,610	5,000	
(iii)	Floor Tiles	t	600	182	540	
(iv)	Sanitaryware	t	500	545	1,230	From additional capacity
(v)	Electrical Porcelain	t	–	–	300	From new capacity
16.	Ceylon Cement					
	Cement KKS and Galle	thousand t	350	225	270	
	Puttalam	thousand t	220	89	440	Additional Capacity 220 thousand tons from Stage II
17.	National Small Industries					
	Bricks and Tiles	million pieces	10.7	10.6	30.0	1970 capacity on one shift Additional capacity of 23 million
					from	Hanwella (17 million) Uswewa (2 million) Anuradhapura (2 million) Gal Oya (2 million)

Attached Table V-2 Estimated Investment to Public Sector Projects (Five Year Plan)

Project	Capital Expenditure Estimate (in Rs. Million)
1. Spinning and Weaving Mill	140.0
2. Power Looms (500 machines)	5.8
3. Paper Mill	110.5
4. Urea Fertilizer Project	340.0
5. Oleo Chemical Industry	53.0
6. Ilmenite Factory (Expansion)	48.4
7. Titanium Dioxide Project (Preliminary Expenses)	10.0
8. Oil Refinery (Removal of Bottleneck)	16.3
9. Steel Foundry	5.5
10. Structural Shop and Galvanizing Plant	4.6
11. Boron Rubber Wood Project	0.9
12. Ligno Plastic Wood Project	0.7
13. Paranthan Chemicals Plant (Expansion)	5.0
14. Potassium Chlorate Plant (Expansion)	0.9
15. Mahaweli Development Scheme Timber Project	5.0
16. Graphite Mining and Processing	10.0
17. Flour Mill (Expansion)	5.0
Total	761.6

Attached Table V-3 Projects which Need More Survey

1. Textile Industry
   (a) Finishing Plants
   (b) Waste Spinning Mill
2. Third Cement Plant
3. News-Print Substitute Mill
4. Tissue Plants
5. Chlorinated Rubber Project
6. Oil Refinery
7. Iron and Steel (The Second and The Third Projects)
8. Vinyl Chloride Plants
9. Carbide Plants
10. Limestone Plants
11. Fibre Glass Plants
12. Aluminium Roll Plants
13. Chassis of Buses and Trucks Project
14. Ceramics (Extension)
15. Farm Machines and Implements Factories
16. Tractor Assembling and Manufacturing Factories
17. Superphosphate Plants
18. Tin-plate Plants
19. The Second Caustic Soda and Chlorine Plant
20. The Second Flour Mill
21. Machinery and Tool Plants
22. Strawboard Mills
23. Millboard Mills
24. Soda Ash Mills
25. Jaffna Lagoon Plan (1st stage)
26. Synthetic Fibre Plants
27. Plate Glass Project
28. Cardboard Mills
29. Match Mills
30. Electric Measuring Apparatus and Motors
31. Sponge Iron Project

Source: Five Year Plan

Attached Table V-4

Development Project List by IDB (For the promotion of development of small sized industries) (Budget, 1973, IDB of Ceylon.)

1. Manioc Starch

It is expected that before the year is over, a small-scale project will be set up for the processing of manioc starch at Hanwella. After a short period of operation the unit would be handed over as a running concern to the DDC of the area.

The Ministry of Planning & Employment has agreed to finance the entire project. The unit will have the capacity to process ½ ton of starch per day. A block of land to house the project has been obtained on lease from the DDC Hanwella and the buildings are nearing completed.

The machinery inclusive of rasper & sieves has been fabricated by the TSA. The raw materials necessary for this project will be made available by the Ministry of Planning & Employment.

It is decided to sponsor 6 other units in the following electorates:- Nikaweratiya, Medawachchiya, Soranatota, Kurunegala, Dambulla and Attanagalla.

2. Straw Board

It was decided at a meeting in which the Minister of

Industries and Scientific Affairs, and the Chairman, IDB participated, that 17 units for the manufacture of Straw Board should be set up and the following electorates were selected for this purpose.

Tissamaharama	Katugampola
Mahara	Kurunegala
Wariyapola	Matara
Mahiyangana	Dampe
Kekirawa	Kesbewa
Kotmale	Polonnaruwa
Vaddukoddai	Beliatte
Gampaha	Divulapitiya
Balangoda	

These units are expected to be operated by the District Development Councils, and the actual location of the site will be done in consultation with the member of the National State Assembly of the area. The principle factors of location will be the availability of (1) an adequate supply of water, i.e., 10,000 gallons a day; (2) 3 phased electricity; (3) Raw materials, i.e., straw of an acreage of at least 340 acres of paddy.

The projects at Piliyandala in the Kesbewa electorate and Tissamaharama will be given priority. Projects not taken up by the DDC will be set up by the Joint Stock

Company. Financial provision is made under Joint Stock Company for this purpose.

3. Agar-Agar

A complete study on the feasibility of the manufacture of agar-agar from sea weed in collaboration with the Research Division of the Fisheries Department was made in 1971 for the purpose of setting up a pilot project. Subsequently, this project was offered to the Ministry of Planning and Employment to be set up as a DDC Project which however, did not materialize. Following many inquiries from the private sector, it has been recently decided to invite applications from the private sector. Two units for the manufacture of agar-agar are expected to be set up in 1973.

4. Processing of sugar-cane

IDB will undertake the processing of sugar cane into jaggery, sakkara and syrup for small holders in areas which are being newly planted with sugar cane. A small-scale Kirloskar sugarcane crushing machine has been modified by the TSA for this purpose. The work of this machine has already been demonstrated by the TSA.
It is expected that demonstrations on an islandwide basis will be organized in 1973. This program is being implemented in consultation with the Ministry of Agri-

culture and the Sri Lanka Sugar Corporation.

5. Boron Treated Rubber Wood and Ligno Plastic Project

With erect from 1st October, 1972, the Boron-treated rubber project and the Ligno Plastic Project were taken over from the National Small Scale Industries Corporation on a directive by the Minister of Industries and Scientific Affairs.

Further development of this chemically treated rubber wood project will be the responsibility of the IDB.

The NSIC began a pilot project at Kuda Uduwa in Horana in 1970 by hiring out and operating on a private sawmill in this area. Approximately 2,000 to 2,500 cu. ft. of rubber wood planks are sawn per month at this mill.

Initial work for the establishment of a Boron Rubberwood Factory at Kandana in Horana with a projected output of 67,500 cu. ft. per annum is also completed. The anticipated annual profit from this project is Rs. 202,000/-.

The entire Boron Rubberwood project is significant in that;

a. It has been approved as one of the projects in the five year plan;

b. It will use approximately 120,000 cu. ft. per annum of rubberwood in log form from the nearly 10,000 acres of rubber replanting programme;

c. It will produce a large part of the country's requirements of school desks and chairs and also office furniture at rates cheaper than that of other furniture:

d. Rubberwood furniture can find a market abroad and this project would be export oriented;

e. It will give the IDB practical experience of handling an important development project engaged in manufacture activity.

It is proposed to set up 2 more units one in Kegalle and the other in Matara.

6. Coir Dust Board

The IDBC has conducted certain experiments with the view of processing hard board and floor tiles out of coir dust. Initial tests have been conducted utilizing machinery already available at the State Engineering Corporation, Plywood Corporation at Salawa and the CISIR.

A study was carried out on the market potential for hardboard. This study indicates that if hardboard can be marketed at an economical price, sales possibilities are

good. The possibility of exporting this product in the form of floor tiles is also being investigated.

7. Industrial Co-operatives for the manufacture of mammoties and other agricultural implements

The Ministry of Planning and Employment has, in collaboration with the IDBC, launched a programme for the establishment of Industrial Co-operatives in the regions for production of mammoties and agricultural implements. This programme has as its aim successful organization of Industrial Co-operatives on the lines of the Kotmale Project which has proven to be a great success. Mr. D.L.O. Mendis, Deputy Director, Ministry of Planning & Employment, who is in charge of this project, has already commenced a survey of the availability of raw material, i.e., scrap iron and the market possibilities for agricultural implements to be produced by these Industrial Co-operatives. Mr. Mendis and Mr. Nihal de Mel, Director TSA, are also going into the question of how to raise the level of technology of the rural black smith. In this study, Dr. Ranjith Silva, Professor of Metallurgy, University of Ceylon and his officers are also assisting us.

Mr. Bertie Gunasekera, the Development Assistant at Kotmale, has completed a major part of this survey in

the districts as to the pattern of the spread of black-smiths, the type of implements they are making and also the use of the local udella and other agricultural implements in the regions. Our RMM, GAA, and the District Staff are assisting in this programme. Preliminary discussions and action for the establishment and organization of Industrial Co-operatives in certain districts have already been held. It is hoped that before the end of the year several of these Co-operatives will be successfully organized so that in 1973 a still larger number of such co-operatives could be organized based on the experience gathered by that time. When these co-operatives come into production it will be possible to greatly reduce the import of mammoties and other agricultural implements.

Attached Table V-5 Major Private Oil Mills and Animal Feed Makers

Oil Mills

- The British Ceylon Corporation
- Ja Ela
- Kelaniya Mills
- G.S. Fernands
- Bowyer and Co.
- Seedawatte Mills

Animal Feed Makers

- Moosarjees Ltd.
- British Ceylon Milling Co., Ltd.
- Roberts Forage Works
- Maxilay Poultry Feed Co.

Source; Ceylon Investment Guide 1968.

Attached Table V-6 Production of Ceylon Oils & Fats Corporation

Unit: t

1964/65	:	Coconut oil	—	1,653
		Provender	—	16,881
1965/66	:	Coconut oil	—	2,263
		Provender	—	23,728
		Extracted Meal	—	5,845
1966/67	:	Coconut oil	—	1,772
		Provender	—	29,337
		Extracted Meal	—	9,776
1967/68	:	Coconut oil	—	1,352
		Provender	—	34,359
		Extracted Meal	—	11,418
		Fatty Acids	—	464
1968/69	:	Glycerine	—	46
1969/70	:	Coconut oil	—	1,468
		Provender	—	40,202
		Fatty Acids	—	1,557
		Glycerine	—	168
		Gingelly oil	—	22
1969/70	:	Coconut oil Deodorised oil	—	468
		Provender	—	51,234
		Fatty Acids	—	600
		Glycerine	—	52
		Gingelly oil	—	108
		Coconut meal	—	9,959
1970/71	:	Coconut oil Industrial oil	—	1,321
		Provender	—	48,837
		Fatty Acids	—	1,587
		Glycerine	—	170
		Gingelly oil	—	326
1971/72	:	Provender	—	56,105
		Fatty Acids	—	1,889
		Glycerine	—	308

Source; Review of Activities Corporation 1971 – 1972 Ministry of Industries and Scientific Affairs

Attached Table V-7 Processing Facilities and Production Capacity of Textile

	Facilities	Capacity
Cotton Yarn Spinning	229,014 spl.	14,682 t
Cotton Weaving (Power loom)	7,445	97.7 mil. m
(Hand loom)	90,000	45.7 mil. m
Synthetic Filament Yarn Weaving (Power loom)	900	15.5 mil. m
Knitting (Tricot)	46	15.4 mil. m
Cotton Dyeing & Finishing	–	103.9 mil. m

Source: Ministry of Industries and Scientific Affairs

Attached Table VI-1 Meteorological Data of Project Area

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
A	Max. Temp. (°C)	28.6	30.7	33.2	33.3	32.7	32.2	32.2	33.0	33.4	31.8	29.8	28.5	31.6
	Min. Temp. (°C)	20.7	20.7	21.9	23.6	24.6	24.7	24.3	24.2	24.0	23.1	21.9	21.3	22.9
	Rain Fall (mm)	120.90	50.55	80.26	176.02	77.72	24.64	33.53	44.45	54.61	251.46	253.24	251.71	1,419.04
M	Max. Temp. (°C)	29.8	32.1	32.8	33.3	32.6	33.2	33.0	33.8	33.2	30.3	30.5	28.9	32.0
	Min. Temp. (°C)	21.7	21.7	23.0	23.4	25.2	24.6	24.8	24.8	24.0	23.0	22.3	21.7	23.4
	Rain Fall (mm)	111.00	50.55	89.15	187.96	81.28	22.61	32.77	46.99	69.09	266.19	272.80	256.54	1,486.93

A; Anuradhapura

M; Maha-Illuppallama

Source; Feasibility Study Stage II

Attached Table VI-3 Result of Soil Analysis

Soil No.*	Moisture (%)	Gravel (%)	Colour		Texture	pH		NH_3-N	NO_3-N	Available Phosphorus	C.E.C	Exchangeable Bases m.e./100g		
			Dry	Wet		H_2O	IN KCl	mg/100g	mg/100g	P_2O_5mg/100g	m.e./100g	Ca^{++}	Mg^{++}	K^{+}
1.	1.95	8.55	7.5YR5/4	5YR3/6	L	6.49	4.95	0.31	0.14	0.14	11.71	6.11	2.15	0.20
2.	1.95	51.21	5YR4/4	2.5YR4/6	L – CL	6.97	5.80	0.30	0.76	0.10	15.45	9.75	1.69	0.76
3.	1.40	3.21	7.5YR5/3	5YR3/3	SL – L	7.04	5.74	0.26	0.31	0.47	11.76	7.69	1.72	0.64
4.	3.13	18.56	2.5YR4/6	10YR3/6	CL	6.51	5.10	0.26	0.15	0.07	19.23	9.69	3.54	0.14
5.	2.00	22.04	5YR5/4	2.5YR3/4	CL	7.11	5.95	0.39	2.22	1.37	16.09	7.72	4.29	1.77
6.	1.60	28.71	7.5YR6/4	5YR4/6	L	6.80	5.50	0.24	0.26	2.87	12.72	7.90	1.97	0.60

* Soil Sampling Sites are shown in Attached Fig. VI-1

Attached Table VI-2. Soil Series of Sri Lanka

1. Reddish Brown Earths
2. Noncalcic Brown Soils
3. Red-Yellow Podzolic Soils
4. Red-Yellow Latosols
5. Reddish Brown Latosolic Soils
6. Immature Brown Loams
7. Solodized Solonetz
8. Grumusols
9. Regosols
10. Bog and Half-Bog Soils
11. Low Humic Gley Soils
12. Alluvial Soils

Source; "Soils of Ceylon and Fertilizer Use"
C. R. Panabokke

Attached Table VI-4 Colonization Schemes in Area II

Scheme	Paddy land (ha)	Highland (ha)	Total (ha) Acreage	No. of lots	Total population	Date of inception
Kandalama	747	966	1,714	656	2,100	1954
Kagama-Kattiyawa	1,645	799	2,443	971	6,300	1949
Rajangana	5,249	3,692	8,941	5,492	30,200	1964
Usgala Siyambalangemuwa	607	405	1,012	500	5,000	1954
Total	8,248	5,862	14,110	7,619	43,600	–

Source; Land Commissioner's Department

Attached Table VI-5 Physical Features of Major Reservoirs in 'H' and 'IH' Areas

	Reservoir	Gross Capacity (million tons)	Active Capacity (million tons)	Farm Area (ha)	
				Stage I	Stage II
H	Kandalama	33.8	29.4	1,600	5,700
	Kalawewa	123.4	119.5	5,300	23,000
	Maha Iluppallama	5.6	4.9		
	Kattiyawa	3.5	3.2		
	Usgala Siyambalangamuwa	27.1	24.7	600	–
	Rajanganea	100.7	94.5	6,900	
	Angamuwa	15.8	12.8		–
IH	Nechchaduwa	55.9	54.3	4,000	
	Nuwara Wewa	44.5	38.5		
	Basanakkulama	2.2	2.3		
	Tissawewa	3.6	3.6		
		416.1	387.7	18,400	28,700

Source; Feasibility Study Stage II

Attached Table VI-6 Educational Level of Heads of Households

Unit: percent of households

	Illiterate	1 to 5 standard	5 to 8 standard	GCE*(O)	GCE*(A)	University degree
Stage I area	17.5	47.7	27.6	4.9	5.6	1.7
Stage II area	19.0	44.8	28.6	6.0	0.8	0.9

Source: Agro-Socio-Economic Survey MDB 1971

* General Certificate for Education (Ordinary Level, Advanced Level)

Attached Table VI-7 Economic Activity of Members of Households

	Percent of the heads of households	Percent of other males	Percent of the females	Percent of the children	Percent of the total population
Family farm work	81.0 to 88.5	69.0 to 76	65 to 70	6 to 8.5	42 to 43
Hired farm work	27.0 to 29.0	13.0 to 14	3 to 5	0.1 to 0.2	7 to 7.5
Non Agri-cultural jobs	25.5 to 26.0	16.0 to 23.0	1 to 2	0.1 to 0.4	6.5 to 7

Source: Agro-Socio-Economic Survey MDB 1971

Attached Table VI-8 Land Use Pattern

	Paddy land	Coconut plantations	Home Garden area	Exist. Settlement area	Brushwood & chena	Brushwood land	Forest land	Rocky land	Water surface & stream	Total
Stage I Area (ha)	15,441	2,302	1,676	1,868	4,257	3,935	428	326	2,255	3,610
(%)	47.5	7.1	5.1	5.7	13.1	12.1	1.3	1.0	6.9	100.0
Stage II Area (ha)	8,004	622	910	1,592	12,675	21,283	9,983	–	4,628	58,725
(%)	13.6	1.0	0.5	2.7	22.0	36.3	17.0	–	6.9	100.0

Source: Land Use Division 1971

Attached Table VI-9 Distribution of Different Land Classes for The Proposed Upland Crop Rotations - Stage II Area H

Rotation	Land Class	Extents ha	Extents %	Reqd. Extents %
1. Onions - Chilli - Pulses	2s	1,151	4.9	4
2. Chilli - Paddy (Maize)	2t 2st	2,212 1,214	14.7	15
3. Miscellaneous crops	2st	932	4.0	4
4. Cotton - Maize	2d 2sd 2td	2,671 1,605 3,053	31.4	30
5. Paddy - Oilseed - Pulses	2td 2std 2tk/2sk 3s 3t 3std 3td 3st 3sk 3tk	2,914 4,085 133 590 1,030 359 195 882 186 91	45.0	47
		23,303	100%	100%

Source: Feasibility Study Stage II

Attached Table VI-10 Characteristics of New Variety
(Maha, 1970 ~ 1971)

Variety	Grain Yield	Pedigree	Growth Period (Days)	Plant Hight (cm)			No. of Panicles/m^2
				Culm	Panicle	Total	
BG 11-11	5.56	(Engkatek x H-8) x H-8	123	63.1	20.2	83.3	373.5
LD 66	5.26	H-501 x Dee-Geo-Woo-Gen	123	58.9	19.9	78.8	317.5
BG 34-8	4.73	IR8-24-6 x (PP x Mas) x H501	95	56.8	19.9	76.7	317.5
BG 34-1	4.41	IR8-24-6 x (PP x Mas) x H501	94	52.1	18.7	70.8	310.0
IR-8	5.52	Peta x Dee-Geo-Woo-Gen	123	50.2	20.4	70.6	356.3
IR-20	5.43	IR262-24-3 x TkM-6	119	56.0	21.3	77.3	433.8
H-4	3.66	M302 x Mas	122	88.0	23.1	111.1	301.4

Source: Central Agricultural Research Institute

Attached Table VI-11 Data on Yield Component of Paddy

(kg/ha)

	Total Dry Matter	Straw	Grain (Total)	Grain (Filled)	Grain (Hulled)
Treatment 1	9,375	4,030	5,281	5,062	3,757
Treatment 2	8,998	3,791	5,119	4,933	3,723
Treatment 3	9,058	3,922	5,096	4,945	3,684
Treatment 4	9,377	4,025	5,308	5,117	3,839
Average	9,202	3,942	5,201	5,014	3,751

Source: Central Agricultural Research Institute

Season; Yala '70
Variety; BG-11-11, IR-22

Attached Table VI-12 Yield of Sugar Cane

(t/ha)

	66/67	67/68	68/69	69/70	70/71
Sri Lanka	30.3	28.5	17.7	37.3	33.8
India	40.3	46.7	49.2	49.1	48.5
Indonesia	79.6	80.8	75.6	73.0	72.5
Philippines	53.1	54.2	48.5	51.0	53.9
Ryukyu	58.7	70.3	69.6	65.3	68.9
Taiwan	74.8	86.2	75.1	69.5	89.0

Source: FAO Production Yearbook 1971

Attached Table VI-13 The Distribution of Plants in the Dry Zone

Local Names	Botanical Names	Local Names	Botanical Names
ARU	Morinda tinctoris Roxb.	HIK	Lannea coromandelica (H) Merr.
AMBERELLA	Spondias pinnata (L) Kurz.	HINGUL	Amoora robituka (R) W. & A.
ARALU	Terminalia chebula Retz.	HULANHIK	Chukrassia velutina M. Roem.
BAK-HIK	(See HIK)	HULANHIK	Chukrassia tabalaris A. Juss.
BORADAMINIYA	Grewis polygama Roxb.	INGINI	Strychnos potatorum L. f.
BUK-MI	Nauclea orientalis (L)	KADURU	Strychnos nux-vomica L.
BU-SERU	Premna tomentosa Willd	KAHAPENELA	Sapindus trifolistus L.
BULU-PETHA	(Unknown)	KALATIYA	Polyalthia subersa (R) Thw.
BURUTA	Chloroxylon swietenia DC.	KALUHABARALA	(See THURANA)
DAMINIYA	Grewia tiliifolia Vahl	KALUWARA	Diespyros ebenum Koenig
DAWU	Anogeissus latifolia (R. ex DC.) Wall	KALUWELLA	Diospyros spp.
DIKWENA	Pityrantha verrucosa Thw.	KATU-IMBUL	Salmalia insignis (W) S. & Endl.
DIVUL	Feronia limonia (L) Swingle	KARA	Canthium coromandelicum (B. F.) Alston
DUNUMADALA	Stereospermum personstum (H) Chatterjee	KARUKKUVACHCHI	(See NERALU)
EBONY	(See KALUWARA)	KAYA	Memecylon spp.
EHELA	Cassia fistula L.	KELA	Butea monosperma (Leth.) Taub.
ELA-LIYAN	Prosorus cyanospermum Thw.	KEERIYA	Acasia leucophlosa (R) Willd.
ET-DEMATA	Gmelina arborea Roxb.	KIHIRIYA	(See KEERIYA)
ET-LIYAN	(See ELA-LIYAN)	KIRIKON	Walsura piscidia Roxb.
ETA-TIMBIRI	Diospyros affinis Thw.	KIRIWALLA	Holarrhena mitis (V) R. Br. ex
GAL-SERU	Tricalysis dalzelii (Thw.) Alston	KOHOMBA	Azsdirachta indica A. Juss.
GAL-SIYAMBALA	Dialium ortidum Thw.	KOKKATIYA	Garcinia spicata (W. & A.) Hk. f.
GAMMALU	Pterocarpus marsupium Roxb.	KOLON	Adina cordifolia (R) Brandis
GODAKADURU	(See KADURU)	KON	Schleichera Oleosa (Lnr) Chen
GODAKIRILLA	Holoptelea integrifolia (Roxb.) Planch.	KORAKAHA	Memecylon Umbellatum Burm. f.
GODARATMAL	Ixora arborea Roxb. ex Sm.	KORAKAHA	Memecylon angustifolium Wight
HALMILLA	Berrya cordifolia (W) Burret.	KUMA	Gienica unijuga (Thw.) Radlk.
HAMA	(See MUGNNU)	KUMBUK	Terminalia arjuna (Roxb.) W. & A.
HAMARUTHU	(Unknown)	KUNUMELLA	Diospyros ovalifolia Wight
HELAMBA	Mitragyna parvifolia (R) Korth.	KURATIYA	Phyllanthus spp.
HEENKENDA	Xylopia nigricans Hk. f. Thons.	KURUNDU	Atalantia monophylla DC.

LABU	Gyrocarpus americanus Jacq.
LOLU	Cordia domestica Roth.
MADAN	Syzygium cumini (L.) Skeels
MAGULKAKADA	Pongamia pinnata (L.) Pierre
MALLA	(See MAYILA)
MAKULU	Hydnocarpus venenata Gaertn.
MARA	Albizzia lebbek (L.) Benth.
MARAILLUPAI	(See OWILA)
MAYILA	Baubinia racemosa Lam.
MI	Madhuca longifolia L. J. F. M.
MASMORA	(See MORA)
MILLA	Vitex pinnata L.
MORA	Euphoria longana Lam.
MUGUNU	Tetrameles nudiflora R. Br. ex Benn.
MUKUDU	(See MUGUNU)
NAWA	Sterculia balanghas L.
NEBODA	Vitex leucoxylon L. f.
NERALU	Elacodendron glaucum (R.) Pers.
OWILA	Polyalthia longifolia (S.) Thw.
PALU	Manilkara (R.) Dubard
PAMBURU	Atalantia missionis (W.) Oliv.
PANAKKA	Pleurostylia opposita (Wall.) Alst.
PANDERU	Canthium dicoccum (G.) Merr.
PANUKARAUW	(See PANDERU)
PEDURU	(See PANDERU)
PENELA	Sapindus emarginatus Vahl.
PILA	(See THURANA)
RANAI	(See WEWARANA)
RATAMBALA	(See GODARATMAL)
RATU-WA	Cassia roxburghii DC.
SATIN	(See BURUTA)
SIYAMBALA	Tamarindus indica L.
SURIYAMARA	Albizzia odoratissima (L. f.) Benth.
TAMMANA	Mischodon zeylanicus Thw.
TAMARIND	(See SIYAMBALA)
TELAMBU	Sterculia foetida L.
TELKADURU	Sapium ineigne (Royls) Trim.
THEBU	(Unknown)
THORA	(See THURANA)
THENTHUKKI	(See WELIWENNA)
THUVARAI	(See THURANA)
THURANA	Maba buxifolia (Rott.) Pers.
TILLAT	(See TELKADURU)
TIMBIRI	Diospyros malabarica (Lam.) Kostel.
TUMPALAI	Vatica obscura Trim
ULKENDA	Polyalthia korintii (D.) Thw.
WA	Cassia siamea Lam.
WAL-AMBERELLA	(See AMBERELLA)
WAL-NELLI	(See KURATIYA)
WAL-SAPU	(See OWILA)
WELANG	Pterospermum canescens Roxb.
WELIWENNA	Dimorphocalyx glaklius Thw.
WEWARANA	Alscodaphne senceszpifolia Nees
WIPPANA	(See DIKWENNA)
WIRA	Drypetes sepiaria (W. & A.) Pex. & Hoffm.
YAK DEHI	(See KURUNDU)

Other Plants at the Sawing Mill (Minneriya)

KINA	Calophyllum tomentesa Wight

Source: A Forest Inventory of Ceylon

Attached Table VI-14 (1) Tree Species-wise Accumulation Amount in H Area

Tree Species	7 L D 8,000 ha					7 N D 4,000 ha					Total
	Diameter 10-28 cm		Diameter 50 cm		Sub-Total	Diameter 10-28 cm		Diameter 30 cm		Sub-Total	
	ft^3/ha	ft^3	ft^3/ha	ft^3	ft^3	ft^3/ha	ft^3	ft^3/ha	ft^3	ft^3	ft^3
Wira	2073	1658000	2385	1914000	3572000	1660	664000	438	175000	839000	4411000
Mora	720	576000	330	264000	840000	193	77000	45	18000	95000	935000
Welang	660	528000	550	440000	492800	250	100000	88	35000	135000	627800
Kaluwara	460	368000	700	560000	596800	245	98000	273	109000	207000	803800
Milla	160	128000	443	354000	382000	115	46000	130	57,000	98000	480000
Sâtin	370	296000	840	672000	968000	228	71000	385	154000	245000	1213000
Hal-milla	188	150000	213	170000	320000	48	19000	25	10000	29000	349000
Kuma	338	270000	165	132000	402000	128	51000	30	12000	63000	765000
Kon	28	22000	205	164000	184000	48	19000	43	17,000	36000	220000
Kunamelle	490	392000	33	26000	418000	198	79000	08	3000	83000	501000
Ronai	183	147,000	133	106000	253000	53	21000	18	7,000	28000	281000
Timbiri	38	30000	118	94000	124000	/	/	/	/	/	/
Kaya	340	272000	28	22000	294000	65	26000	03	1000	27000	321000
Eta -Timbiri	/	/	/	/	/	/	/	/	/	/	
Palau	208	166000	1495	1,196000	1362000	405	162000	850	340000	502000	1864000
Makulu	/	/	/	/		/	/	/	/	/	/
Dumpalai	/	/	/	/		/	/	/	/	/	/
Gal-Seru	145	116000	38	30000	146000	/	/	/	/	/	146000
Weliwenna	105	84000	80	64000	148000	/	/	/	/	/	148000
Madan	35	28000	98	78000	106000	/	/	/	/	/	106000
Panu -nedun	253	202000	55	44000	245000	203	81000	25	10000	91000	337000
Bu-Sew	198	158000	48	38000	196000	73	29000	05	7000	31000	227000
Penela	/	/	/	/	/	105	42000	38	15000	57000	57000
Panakka	88	70000	145	116000	186000	88	35000	63	25000	50000	246000
Wel-Kopi	/	/	/	/	/	83	33000	13	5000	38000	38000
Etamba						08	3000	63	25000	28000	28000
Kurundu						58	23000	08	3000	26000	26000
	7110	mil. ft^3 57	8098	mil. ft^3 65	mil. ft^3 122	4248	mil. ft^3 17	2545	mil. ft^3 10	mil. ft^3 27	mil. ft^3 149

Attached Table VI-14 (2) Tree Species-wise Accumulation Amount in D Area

Tree Species	7 M D 5,600 ha					7 L D 10,400 ha					Total
	Diameter 10-28 cm		Diameter 30 cm		Sub-Total	Diameter 10-28 cm		Diameter 30 cm		Sub-Total	
	ft^3/ha	ft^3	ft^3/ha	ft^3	ft^3	ft^3/ha	ft^3	ft^3/ha	ft^3	ft^3	ft^3
Wira	1390	778400	3748	2098800	2877000	2073	2155400	2385	2480400	4635800	7512800
Mora	1748	978800	1788	1001000	1979800	720	748800	330	343200	1092000	3071600
Welang	815	456400	1613	903000	1359400	660	686400	550	572000	1258400	2617800
Kaluwara	400	224000	1370	767200	991200	460	478400	700	728000	1206400	2197600
Milla	50	28000	1340	750400	778400	160	166400	443	460200	626600	1405000
Satin	95	53200	1005	562800	616000	370	384800	840	873600	1258400	1874400
Halmilla	455	254800	550	308000	562800	188	195000	213	221000	416000	978800
Kuma	355	198900	545	305200	504100	338	351000	165	161600	512600	1016700
Kon	05	2800	878	491400	494200	028	28800	205	213200	241800	736000
Kunumella	783	448200	58	30800	479000	490	509600	33	33800	543400	1022400
Ranai	295	165200	430	240800	406000	183	189800	133	137800	327600	733600
Timbiri	98	54600	518	289800	344400	38	39000	118	122200	161200	505600
Kaya	523	242600	45	25200	267810	340	353600	28	28600	382200	650000
Eta -Timbiri	18	9800	535	299600	309400	/	/	/	/	/	
Palau	23	12600	455	254800	267400	208	215800	1495	1554800	1770600	2036000
Makulu	73	40500	353	197400	238000	/		/	/	/	
Tumpalai	118	15800	340	190400	256200	/		/	/	/	
Gal-Seru	265	148400	125	70000	218400	145	150800	38	39000	189800	408200
Weliwenna	360	201600	08	4200	205800	105	109200	80	83200	192400	398200
Madan	20	11200	318	177800	189000	35	36400	98	101400	137800	326800
Panu -Nedun	/		/			253	262600	55	57200	319800	319800
Bu-Seru	/		/			198	205400	48	49400	254800	254800
Penela	/		/			/		/	/	/	
Panakka	/		/			68	91000	145	150800	241800	241800
Wal-Kopi	/		/			/	/	/	/	/	
Etamba	/		/			/	/	/	/	/	
Kurundu	/		/			/	/	/	/	/	
	7885	mil. ft^3 44	16018	mil. ft^3 90	mil. ft^3 134	7110	mil. ft^3 74	8098	mil. ft^3 84	mil. ft^3 158	mil. ft^3 292

Attached Table VI-14 (3) Tree Species-wise Accumulation Amount in G Area

Tree Species	7 L D 1,800 ha				
	Diameter 10-28 cm		Diameter 30 cm		Total
	ft^3/ha	ft^3	ft^3/ha	ft^3	ft^3
Wira	207.3	373,000	238.5	429,300	802,300
Mora	72.0	129,600	33.0	59,400	189,000
Welang	66.0	118,800	55.0	99,000	217,800
Kaluwara	46.0	72,800	70.0	126,000	198,800
Milla	16.0	28,800	44.3	79,700	108,500
Satin	37.0	66,600	84.0	151,200	217,800
Halmilla	18.8	33,700	21.3	38,200	71,900
Kuma	33.8	60,800	16.5	29,700	90,500
Kon	2.8	4,900	20.5	36,900	41,800
Kunumella	49.0	88,200	3.3	5,800	94,000
Ranai	18.3	32,900	13.3	23,900	56,800
Timbiri	3.8	6,700	11.8	21,100	27,800
Kaya	34.0	331,200	2.8	4,900	336,100
Eta -Timbiri	/	/	/	/	
Palau	20.8	37,400	149.5	264,100	301,500
Makulu	/		/	/	
Tumpalai	/		/	/	
Gal-Seru	14.5	26,100	3.8	6,800	32,900
Weliwenna	10.5	18,900	8.0	14,400	33,300
Madan	3.5	6,300	9.8	17,500	23,800
Panu -Nedun	25.3	45,400	5.5	9,900	55,300
Bu-Seru	19.8	35,600	4.8	8,600	44,200
Penela	/		/	/	/
Panakka	8.8	15,700	14.5	26,100	41,800
Wal-Kopi	/	/	/	/	/
Etamba	/	/	/	/	/
Kurundu	/	/			/
	711.0	mil. ft^3 1.3	809.8	mil. ft^3 1.5	mil. ft^3 2.8

Source; A Forest Inventory of Ceylon

Appendix VI-15 Analysis of Ceramic Industrial Materials

1. Test Method:

Material tests and product tests have been carried out as the fundamental test.

1.1. Specimens and Test Items

Table No. 1 shows the details of the specimens and the test items.

Table No. 1

Markings	Raw Materials	Test Items
A	Siliceous Stone	Refractoriness, chemical & X-Ray diffraction analysis
B	Feldspar	Refractoriness, chemical & X-Ray diffraction analysis
C	Mica	Refractoriness, chemical & X-Ray diffraction analysis
D	Refined Kaolin	Refractoriness, chemical analysis, X-Ray diffraction analysis, physical properties & refractoriness under load
E	Crude Kaolin	Refractoriness, chemical analysis, X-Ray diffraction analysis, physical properties, & refractoriness under load
F	B-clay	Refractoriness, chemical analysis, X-Ray diffraction analysis, physical properties, fractoriness under load, thermal expansion

		additional water contents & test production
G	C-clay	Refractoriness, chemical analysis, X-Ray diffraction analysis, physical properties, fractoriness under load, thermal expansion additional water contents & test production
H	Sand	Refractoriness, chemical analysis & X-Ray diffraction analysis

1.2. Test Method

Tests for each material were based on the following methods.

1.2.1 Refractoriness (P.C.E. Value)

The measurement of refractoriness was carried out in accordance with the method specified in JIS R 2204 using a standard gas furnace which employs oxygen/propane gas.

1.2.2. Chemical analyses

The preparation of specimen was carried out in accordance with the method specified in JIS R 2212.

Analyses of ignition loss (Ig. loss) and silica (SiO_2) were carried out in accordance with the weight method.

Analyses of alumina (Al_2O_3), ferric oxide (Fe_2O_3) calcium oxide (CaO) and magnesium oxide (MgO) were carried out in accordance with the chelate analysis method using E.D.T.A.

Analyses of sodium oxide (Na_2O) and potassium oxide (K_2O)

were carried out in accordance with the flame photo-metric analysis method using a flame photo-meter.

1.2.3. X-Ray diffraction analysis

The obtained diffraction chart was analized in accordance with the powder method using an X-Ray diffraction analysis apparatus.

1.2.4. Physical properties

Measurements were carried out on unblazed speciments regarding apparent porosity, water absorption, apparent specific gravity and bulk density in accordance with JIS R 2205.

1.2.5. Refractoriness under load

Measurements were carried out on a sintered specimen of 50mm in diameter, 50mm in height under a load of 2 Kg/cm^2, in accordance with JIS R 2209.

1.2.6 Thermal expansion

Measurements were carried out on a sintered specimen of 10mm in diameter, 20mm in length regarding thermal expansion rate at 1,000°C with the standard heating speed at 4°C/min. in accordance with JIS R 2207.

1.2.7. Additional water content

The forming performance displayed during moulding operation is largely affected by the extent of water to be added when employing the wet moulding method is applied.
Water is added to each pretreated body with varied extent and kneaded completely to form test specimens. The tests were carried out on the specimens to determine the optimum water content for the display of mouldability during the forming operation.

1.2.8. Unblazed firing test

Generally, ceramic industrial materials change in their external quality, by presenting such phenomena as melting cracking and/or discoloration through firing. The quality of a certain raw material and its applicability can be roughly judged with this method.
If a material is deemed acceptable through this method, test specimens shall be made in conjunction with the foregoing fundamental test. The tests shall then be carried out in order to confirm the optimum firing conditions regarding the tested material. The test production shall also be conducted.
The moulding conditions for test specimen were as follows.
The material was pre-dried in a dryer for 24 hours at 110°C, and then it was ground to 50 mesh-pass. Water was then added

to form test specimen pieces of 50mm in diameter, 50mm in height. When the specimens were formed, they were dried for 48 hours (two days) under natural drying conditions and then further dried positively for 7 hours at 110°C. The specimen were then sintered in a small laboratory electric kilm for 4 hours at 1,030°C. The forming characteristics of the test specimens after firing were examined.

1.2.9 Product Tests

When the results of the basic tests and firing tests of the single raw material have been obtained, the applicability and its judgement of various materials for the manufacturing of certain ceramic products will become possible.

In this Project, tests have been carried out regarding the applicability of such products as red bricks, earthen pipes, roofing tiles, etc., which utilize the abundantly reserved yet unused mineral resources in the Mahaweli area in general and the clay in particular. The production conditions of the test specimens are as follows:

1) Blending ratio

The blending ratio figures of the test specimens are shown in Table No. 2.

Table No. 2

Symbol / Raw material	S-1	S-2
F. (B-Clay)	50	50
G. (C-Clay)	30	30
Chamotte	20	10
H. (Sand)	–	10

2) Drying and forming

The forming conditions are identical to those stipulated in the foregoing 1,2,8, concerning the production of the test specimens. The specimen dimensions are 50mm in diameter x 50mm in height. The extent of applied water at the time of forming was 15%.

3) Firing conditions

The green bodies were glazed with two different glaze materials, i.e., black glaze (manganium glaze) and reddish brown glaze (iron glaze). Firing was carried out at 1,110°C for 4 hours in a tunnel kiln designed for producing earthen pipes. The total firing hours from feeding the specimens into, and removing them from, the kiln was 36 hours.

2. Test Results

2.1 Single Material Test Results

2.1.1 Refractoriness

The measuring results of the refractoriness of the test specimens are shown in Table No. 3.

Table No. 3

Symbol / P.C.E	A	B	C	D	E	F	G	H
SK	34	20^{+}	35	36^{-}	34	20	20^{-}	8^{-}
Suitable Temp. (°C)	1,750	1,530	1,770	1,790	1,750	1,530	1,530	1,250

2.1.2 Chemical Analyses

Table No. 4 shows the results of chemical analyses.

Table No. 4

Symbol / %	Ig. loss	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O
A	0.17	98.55	0.85	Tr	0.41	0.52	Tr	Tr
B	0.33	67.74	19.41	Tr	Tr	Tr	1.08	10.94
C	14.37	48.90	32.96	2.76	Tr	Tr	0.09	0.38
D	13.94	45.88	36.02	1.45	0.74	0.63	0.09	0.33
E	13.57	51.15	29.47	2.22	0.83	0.56	0.87	0.94
F	15.79	39.94	36.52	6.67	Tr	Tr	0.17	1.06
G	12.78	48.24	31.18	6.22	Tr	Tr	0.39	1.59
H	2.14	79.55	10.29	5.76	Tr	Tr	0.61	1.21

2.1.3 X-ray diffraction analyses results are shown in Table No. 5 and Figs. 1 through 8.

Table No. 5

Symbol \ Minerals.	Main Components
A	α-Quartz (SiO_2)
B	Orthoclase ($K_2O \cdot Al_2O_3 \cdot 6SiO_2$), Albite ($Na_2O \cdot Al_2O_3 \cdot 6SiO_2$)
C	Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$), α-Quartz ($SiO_2$)
D	Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$), α-Quartz ($SiO_2$)
E	Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$), α-Quartz ($SiO_2$)
F	Kaolinite, Muscovite, α-Quartz, Organic materials.
G	Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$), α-Quartz, Organic materials.
H	α-Quartz (SiO_2), Kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$)

2.1.4 Physical Properties

Concerning the single material test specimens, the results of the evaluation of the physical properties are shown in Table No. 6.

Table No. 6

Symbol \ Item	Apparent porosity (%)	Water absorption rate (%)	Apparent density	Bulk density
D	21.5	10.0	2.71	2.12
E	32.3	17.8	2.69	1.82
F	12.5	5.5	2.52	2.20
G	28.6	14.1	2.80	2.00

Note: Firing temperature of test specimens
D and E : 1,350 °C x 4 hr
F and G : 1,030 °C x 4 hr

2.1.5 Refractoriness under Load

The refractoriness under load regarding the single material test specimens are stipulated in Table No. 7.

Table No. 7

Temp. / Symbol	Load: 2 kg/cm² T_1 °C	T_2 °C
D	1,425	1,520
E	1,280	1,360
F	1,020	1,140
G	1,020	1,090

2.1.6 Thermal Expansion

Table No. 8 shows the measurement results of the thermal expansion of the single material test specimen at 1,000°C.

Table No. 8

Conditions \ Symbol	F	G
1,000 °C	0.51 (%)	0.55 (%)

2.1.7 Additional Water Content

Table No. 9 shows the suitable extent of additional water content for extrusion forming.

Table No. 9

Symbol	F	G
Added water content (%)	24.8	45.1

2.1.8 Firing Tests

1) External Characteristics

Table No. 10 shows the results of test firing conducted by employing a laboratory kiln.

Table No.10

Symbol		External Characteristics
D	Firing Temperature:	1,350°C x 4 hrs.
	External appearance:	Pure white, low extent of hair cracks on the surface, with satisfactory hardening after firing.
	Sound tests:	Clear sound
E	Firing temperature:	1,350°C x 4 hrs.
	External appearance:	Pure white, with unsatisfactory hardening after firing. Due to the fine quartz sand contained inside, hardening is not satisfactory and the material is porous.
	Sound test:	Unclear sound
F	Firing temperature:	1,030°C x 4 hrs.
	External appearance:	Light brown colour with satisfactory hardening. Fine hair cracks which were generated at the time of forming are noted on the surface. No sign of significant intensification

		of the cracks due to firing noted. Characteristics considered satisfactory.
	Sound test:	Clear sound
G	Firing temperature:	1,030°C x 4 hrs.
	External appearance:	Reddish brown colour similar to the body colour. Hardening extent is inferior to the "F", however, acceptable. A number of hair cracks appeared on the surface.
	Sound test:	Clear sound

2) Contraction ratio

Table No. 11 shows the contraction ratio figures caused by drying and firing operations conducted to the single material test specimens. The contraction rates were calculated on the basis of the dimensions in the direction of the diameter of the specimen

Table No. 11

Contraction Rate \ Symbol	D	E	F	G
Drying (%)	2.8	2.7	8.0	7.2
Firing (%)	6.1	2.3	17.5	17.4
Total (%)	8.9	5.0	25.5	24.6

2.2 Results of Product Tests

2.2.1 External Appearance of Test Products

Table No. 12 shows the external appearance and characteristics of the test specimens which have been fired under the same conditions as for the production of earthen pipe production.

Table No. 12

Symbols		External appearance and Characteristics
S-1	External appearance:	Test specimens applied black glaze and reddish brown glaze and presented satisfactory surface gloss and hardening of the body. No deformation was noted and the shapes were found to be stable.
	Sound test:	Clear sound
S-2	External appearance:	Both the black glazed and reddish-brown glazed specimens presented exactly the same external appearance as the above "S-1". The similarity of these two is so close that identification of these two is not easy. It is therefore considered that "S-1 and "S-2" are identical.
	Sound test:	Clear sound

2.2.2 Contraction Rate

Table No. 13 shows the contraction ratio figures after the drying and firing operation.

Table No. 13

Contraction Rate \ Symbol		S-1	S-2
Drying	(%)	7.2	7.1
Firing	(%)	7.7	7.8
Total	(%)	14.9	14.9

2.2.3 Physical Properties

Table No. 14 shows the physical properties of the fired materials.

Table No. 14

Item / Symbol	Apparent porosity (%)	Water absorption rate (%)	Apparent density	Bulk density
S-1	12.5	5.8	2.45	2.14
S-2	12.5	5.8	2.47	2.16

3. Summary

The following paragraphs will summarize the results of the basic tests conducted concerning the above-mentioned eight types of raw materials which have been selected from various ceramic raw materials obtained within Sri Lanka, especially in areas centering around the Mahaweli Project Area.

3.1 Results of Single Material Tests

3.1.1 Siliceous Stone

This material is a siliceous stone pure white in colour and with almost a 99% degree of purity. Unlike the quartzite, this material possesses large crystals and is semi-transparant. This is called the white quartzite which presents almost no impurities even on the basis of the results obtained by X-ray diffraction analyses. This material is best suited for the production of flat glass, chinaware, sanitary ware, tiles and for the production of metallic alloy items. This material is considered to be a substitute for good quality quartz sand. This material mainly consists of alpha-quartz, and due to its high purity, it is not suitable as a raw material for the production of refractories.

3.1.2 Feldspar

On the basis of X-ray diffraction analyses and chemical ana-

lyses, it has been confirmed that this material mainly consists of Orthoclase together with Albite. This is good quality feldspar and is suitable as a raw material for the production of chinaware, sanitary ware and tiles.

3.1.3 Mica

Although this is called mica, this material contains a low extent of alkali, and judging from the results of chemical analyses, refractoriness tests, and X-ray diffraction analyses, it seems that this material can be classified as one of the varieties of clay of the kaoline type. However, compared with kaoline, it has a slightly higher extent of impure iron substances. Nevertheless, it is a clay mineral material consisting of kaolinite and alpha-quartz so that it is not one of the mineral materials which belongs to the mica group. As to the application of this material, it can be sufficiently applied to the production of refractories in view of its high refractoriness. Also by means of purifying this material, it is possible to use it as a portion of the raw materials for producing whiteware.

3.1.4 Refined Kaoline

The general characteristics of kaoline are: (1) poor in plasticity, (2) poor in sintering characteristics, (3) high in refractoriness, (4) contains a low degree of pigment impurity.

The kaolin materials produced in Sri Lanka usually accompany, when exploited, a comparatively high extent of quartz sand, however, this material obtained after removing quartz sand by means of a purifying operation, will possess a comparatively good extent of sintering characteristics. This is the point in which the Sri Lanka kaoline is different from that produced in other countries. Although the cause for this phenomenon is not clear, it is suspected that the extent of crystalization of kaolinite is low, or, it accompanies an cerisite although extremely low in quantity. Due to the fact that this material possesses satisfactory sintering characteristics and also a high degree of refractoriness, it is not only suitable for the production of chinaware, sanitary ware, tiles and other whiteware, but is also applicable as a raw material to produce high-grade refractories.

3.1.5 Crude Kaoline

Due to the fact that this material contains quartz sand inside its structure, the sintering characteristics of this material are poor and it is porous even if formed after being pulverized into fine particles in order to even the composition. Therefore, application of this material as a ceramic product raw material without processing would not only degrade the quality of the products, but would also effect the yield rate of production. Therefore, this material should be used

after purification in order to remove the impure substances such as quartz sand and other minerals. This material consists of kaolinite and alpha-quartz.

3.1.6 B-clay

Crude B-clay is a light yellowish grey colour having partial spots of a brownish colour. This material is high in plasticity and by adding adequate amounts of water, the workability will become satisfactory. This material seems to be particularly suited for application as a raw material for extrusion forming products. From chemical analyses it was confirmed that the ignition loss is high, and from X-ray diffraction analyses results, it became clear that this material mainly consists of kaolinite of a low crystalization degree. Further, a slight amount of alpha-quartz and muscovite were confirmed to be present as composition materials as inorganic substances. Also it was confirmed that some unspecific organic substances are contained. Because of its high plasticity, workability and characterists of presenting good sintering effects at a comparatively low temperature of about 1,000°C, it is considered to be the most suitable material for the production of red bricks, earthen pipes and roofing tiles.

3.1.7 C-Clay

The crude status of this material is reddish brown in colour,

and when compared with B-clay, the plasticity is slightly low, however, the forming characteristics are generally satisfactory and the sintering effect is high. As the components of this material, a slight amount of alpha-quartz was confirmed in addition to kaolinite of a low crystalization degree. Similar to B-clay, this material also involves some organic substances. When this material is fired at a temperature level of approximately 1,000°C, the external appearance will be reddish brown in colour with some gloss possessing sufficient strength to make it suitable for use as a raw material for the production of earthen pipes , red bricks and roofing tiles.

3.1.8 Sand

The composition of this material is mainly alpha-quartz with some degree of kaolinite. By blending this material with high plasticity clay, it is possible to achieve the adjustment of the material plasticity and the product contraction adjustment. Because of the fact that this material possesses a low extent of refractoriness, it can also be utilized as an agent for the purpose of lowering the sintering temperature level of the products. When used in large quantities, this material has the effect of decreasing the softening point so that the stability range of the sintering operation will be narrowed. Because of this effect, the use of this material in large quantities is not desirable as it may cause deformation of

the products due to softening when producing earthen pipes, roofing tiles and other specially shaped products.

3.2 Results of Single Material Firing Tests

Test specimens were produced by employing four materials, i.e., refined kaolin, crude kaolin, B-clay and C-clay with dimensions of 50mm in diameter x 50mm in height. Sintering tests were conducted under conditions which are considered to be suitable for each one of the specimens. The following is the summary of the obtained results.

3.2.1 Refined kaolin

The suitable sintering temperature of the single material is desirably set at 1,350^{0}C. The sintering effect further progresses at this temperature, however, no drastic change in the structure will take place. It is therefore assumed that a considerably stable status will be maintained until a comparatively high temperature zone is attained. As the refractoriness under load is also high, this material seems to be suitable for use as a raw material for the production of high-grade refractories.

3.2.2 Crude kaolin

Even when this material is fired at a temperature of approximately 1,350^{o}C, the sintering effect is not satisfactory due to

the influence of the quartz sand it contains. If the firing is conducted at a high temperature level of over 1,350°C, clearance will be produced in the peripheral area of the quartz sand particles, thereby producing a number of hair cracks within the structure. In other words, by the effect of these hair cracks, the strength of the product will be uneven. Therefore, when this material is to be applied as a raw material for the production of refractories, it is necessary to purify it in order to remove the quartz sand.

3.2.3. B-clay

This material presented an extremely satisfactory sintering effect at a temperature level of approximately 1,000°C. As is clear from Table No. 6 (Physical Characteristics of Single Material Test Specimens), the porosity is low and bulk specific weight is also on a high level. On the other hand, the dry contraction and sintering contraction is high so that, when it is desired to produce earthen pipes, roofing tiles or red bricks by employing the single raw material alone, cracks will take place during the firing operation due to contraction.

By means of this provision, the total contraction rate can be reduced to a level lower than 18%.

3.2.4 C-clay

The firing temperature of this material is slightly higher than that of B-clay single material, however, it is estimated that the difference thereof is within a range of 20 to 30°C. As in the case of B-clay, the sintering effect is satisfactory and also due to the fact that the contraction rate is high, it is necessary to blend chamotte or other suitable materials to control the contraction rate to a sufficiently low level as much as practicable.

3.3 Product Test Results

It became clear, as the results of the basic tests conducted for the various materials, that B-clay, C-clay and sand are the materials which are useable as raw materials for the production of red bricks, earthen pipes and roofing tiles. As a preliminary step for actual industrialization, test blending of the prospective raw materials was undertaken in order to assess the feasibility of product manufacturing. The obtained results are outlined in the following paragraphs.

3.3.1 Contraction Rate and Physical Properties

No difference was noted between the test products made by

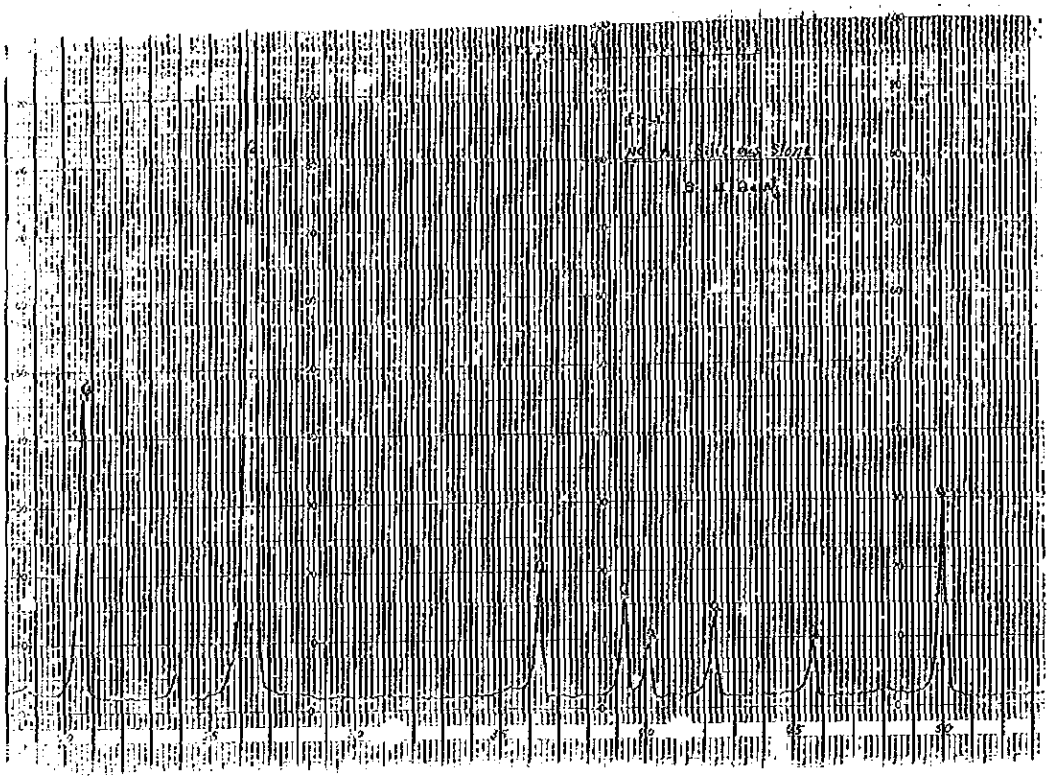
"S-1" and "S-2", and satisfactory results were obtained concerning these materials. In other words, the total extent of contraction by drying and firing was 15%, which is lower than the maximum level of the Japanese standard which is 18%. The porosity rate is also low so that a sufficient degree of strength will be present.

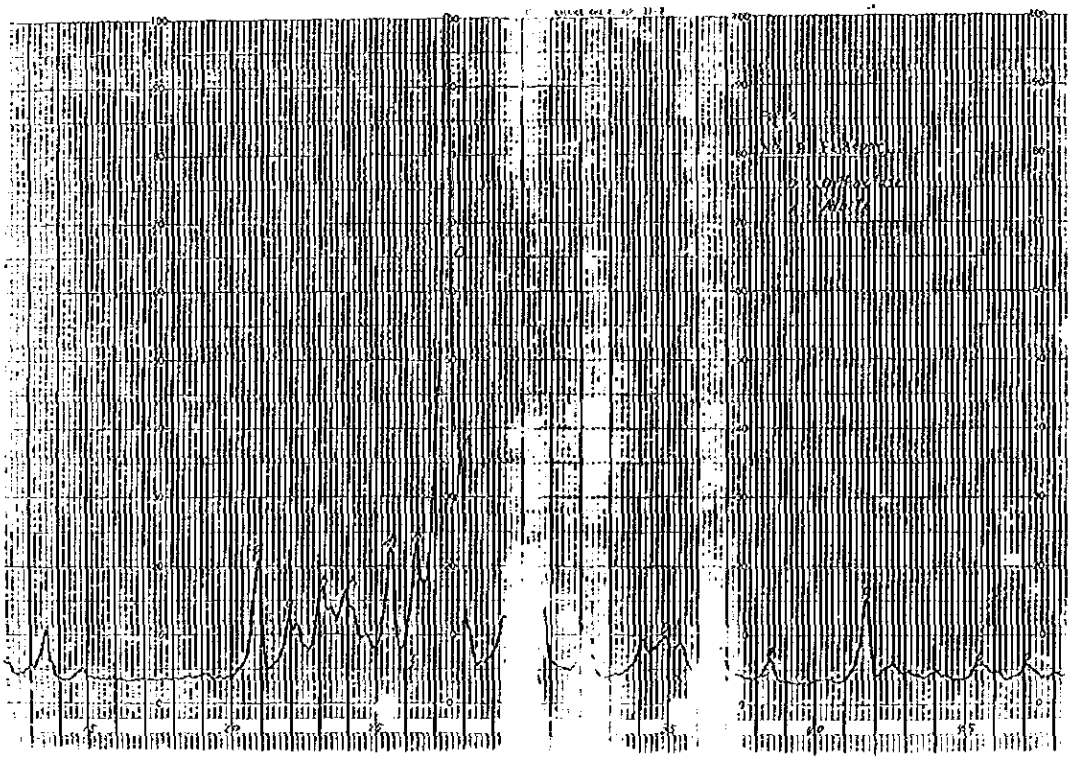
3.3.2 Product Turning Out Feasibility

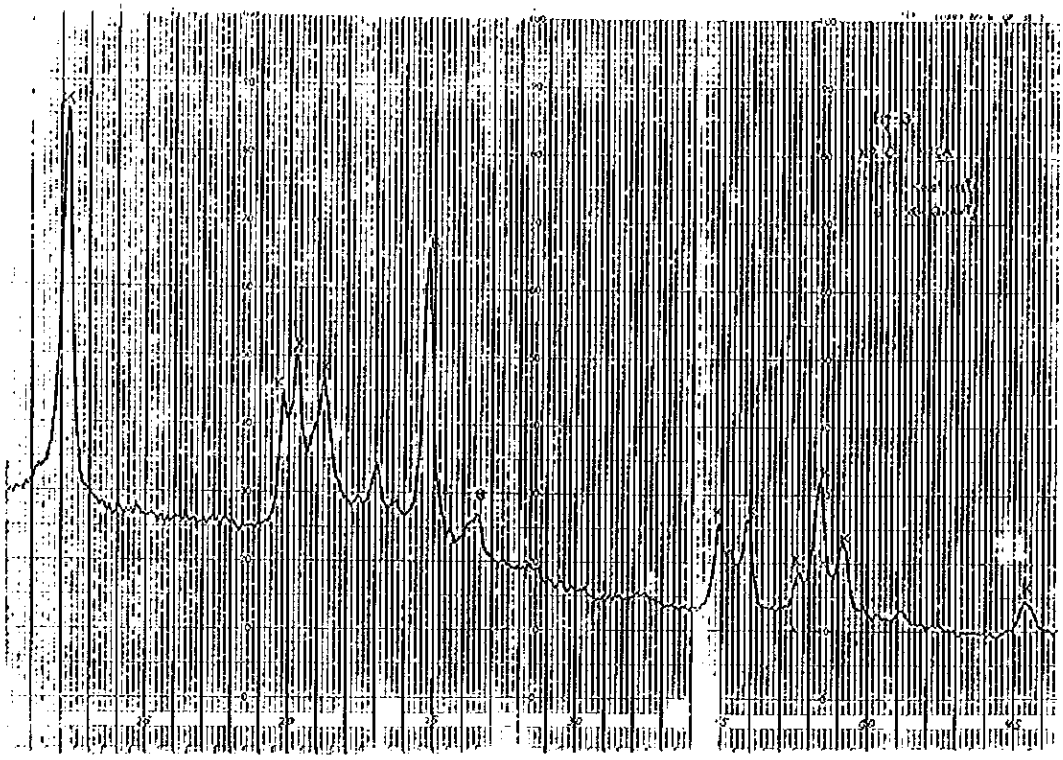
Due to the lack of test specimen materials, it was not possible to produce large-sized or actual size product specimens. However, on the basis of the results obtained by employing small-sized test pieces, it became clear that there is ample possibility for the production of earthen pipes, red bricks and roofing tiles by utilizing ; B-clay, C-clay, sand and chamotte (residues of earthen pipes, red bricks, etc.), all of which are reserved under the ground of Mahaweli Project Area.

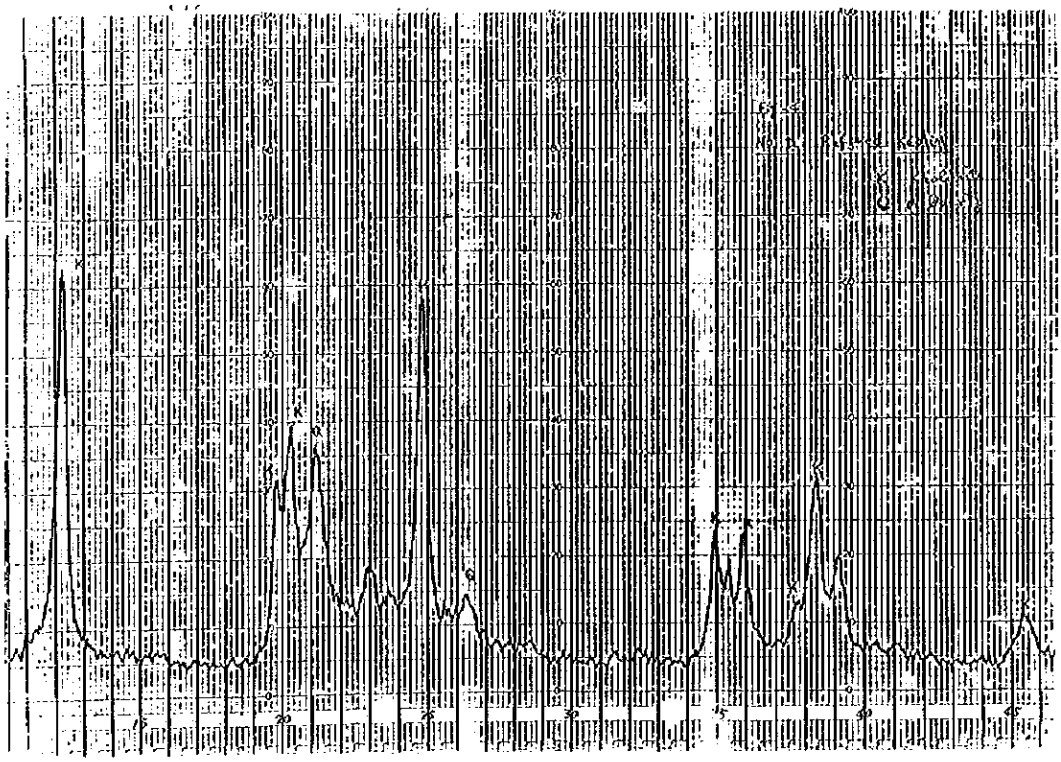
Due to the fact thast the present experiments had to be conducted on the basis of small-sized test specimens, it is necessary that in subsequent tests, larger test specimens be employed. With results of such subsequent tests, it will become possible to confirm detailed production conditions such as the raw material blending ratio, firing conditions, etc.

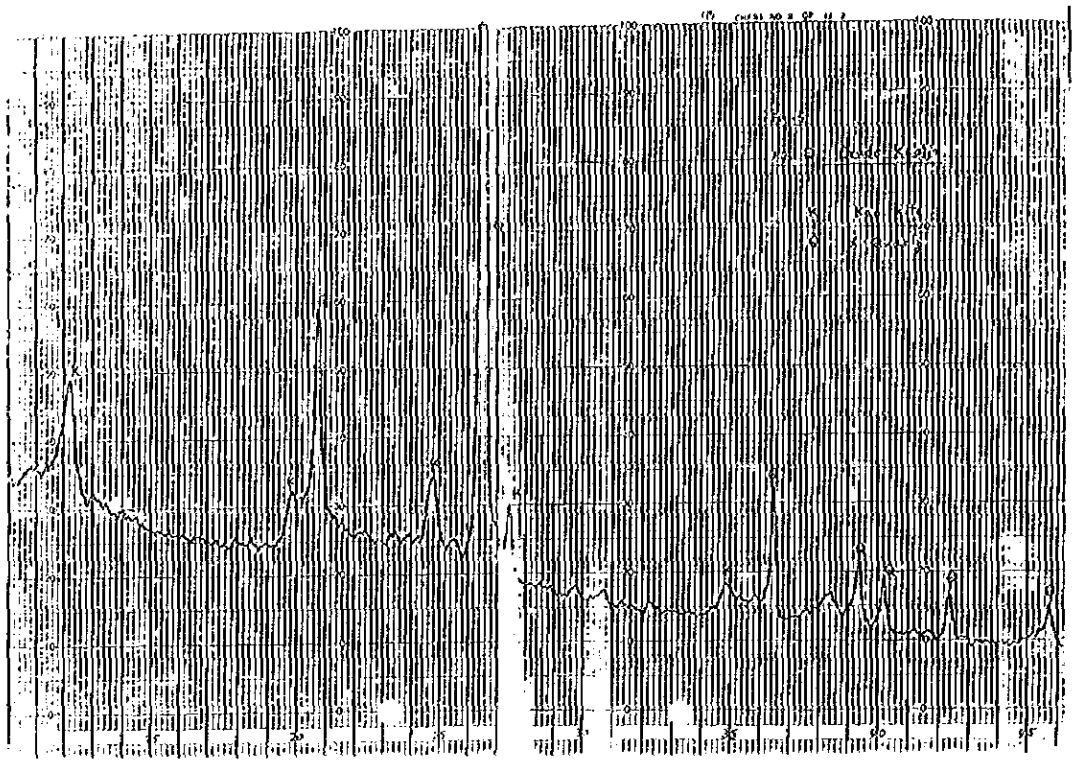
As it is not always the case that there is a coincidence between the test results of small-sized specimen utilization and large-sized test piece employment, it is desirable that tests by employing a large quantity of materials be undertaken prior to the implementation of the industrialization of the production. In any case, B-clay and C-clay should be taken as the main materials, and the production of commercial products is possible by employing sand materials in order to carry out the adjustment of the contraction and for the control of other sintering conditions for these two major clay materials.

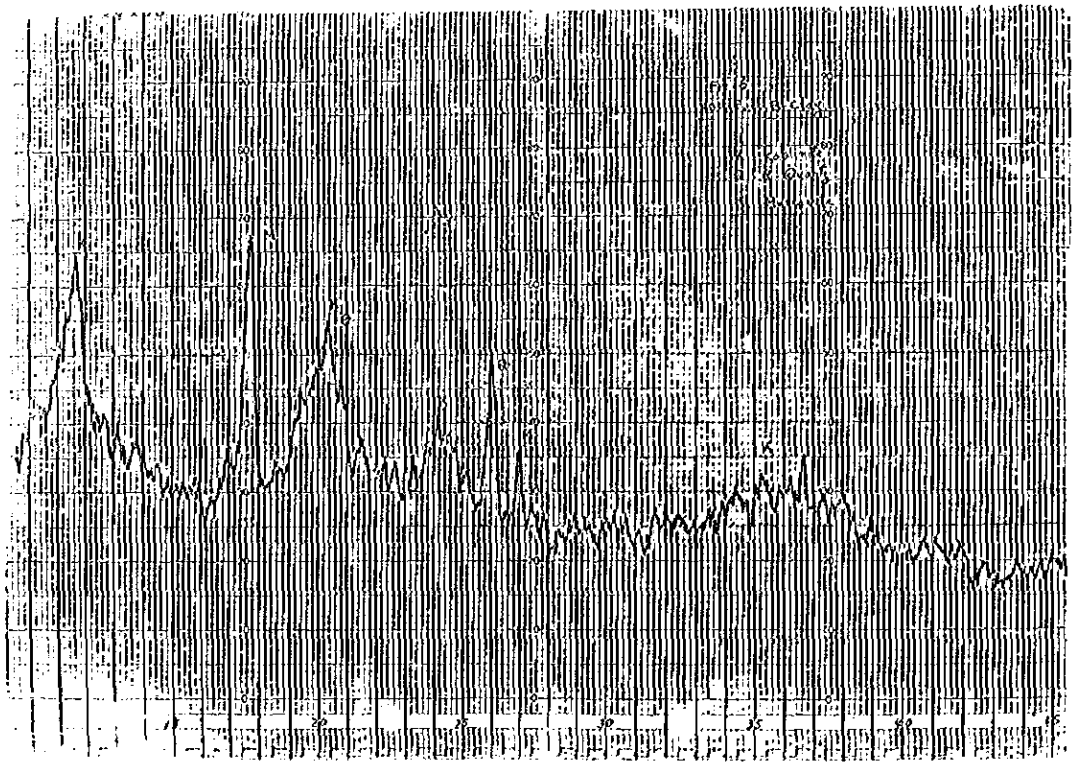


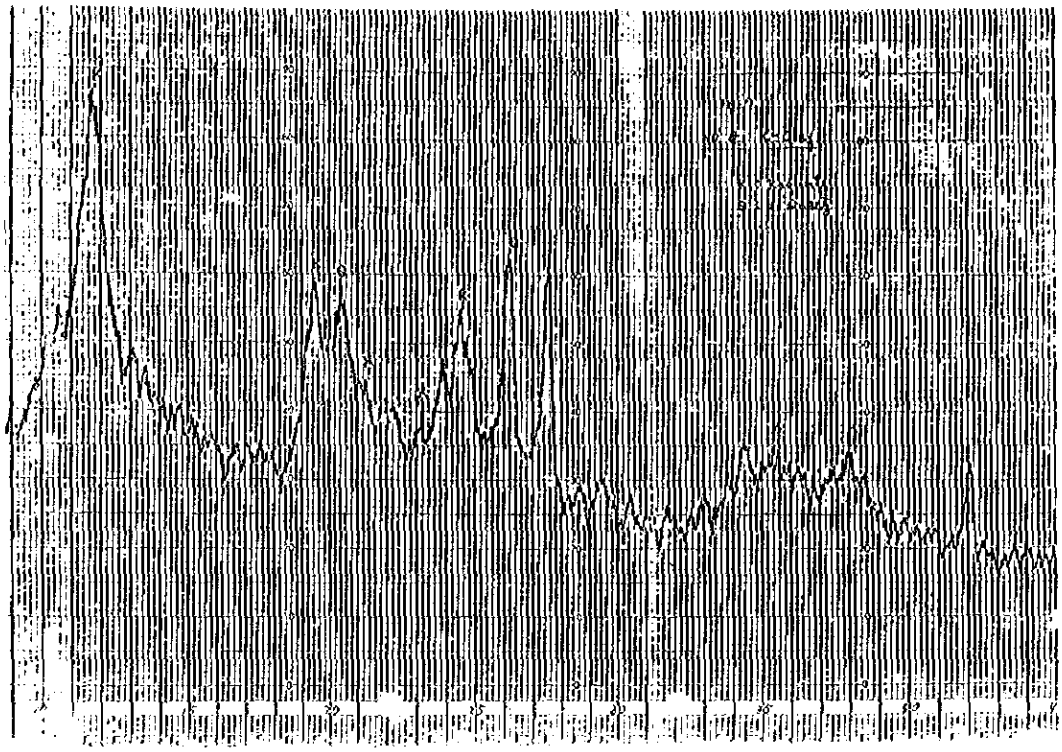


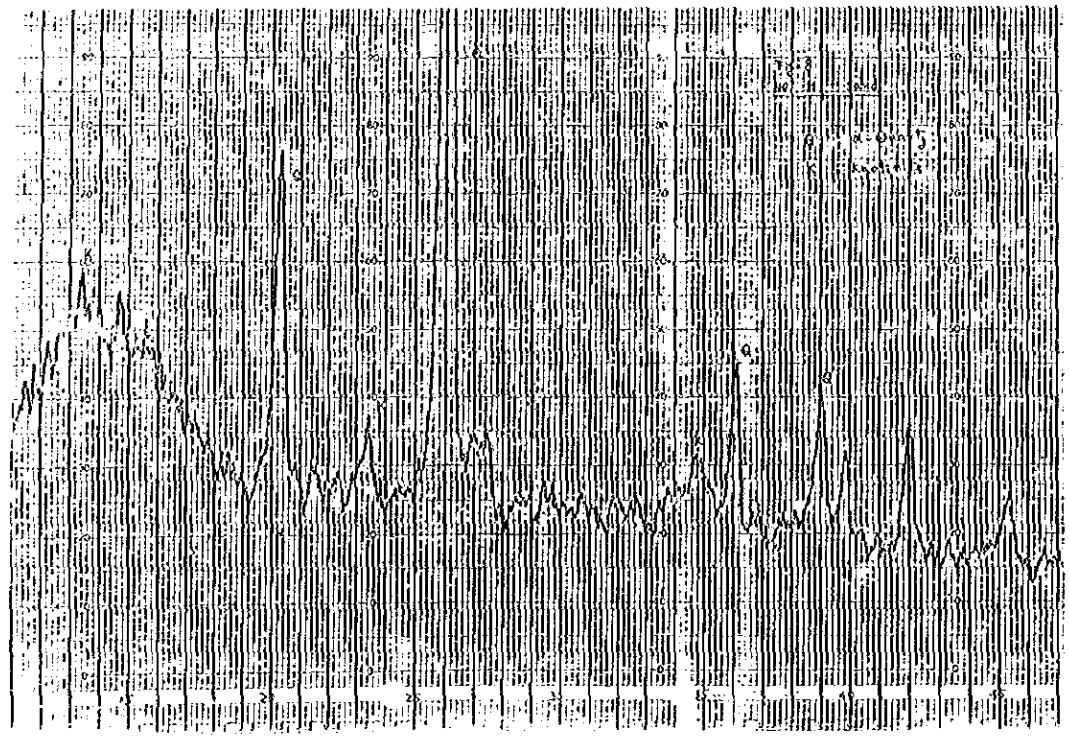












Attached Table VI-16 Chemical Characteristics of Waters of The Mahaweli Ganga and The Principal Reservoirs in Areas H and H

Location		Sampling Date	EC m mhos/cm at 25°C	Meq/litre Ca+Mg	Na	K	Cl.	S04	HCO3
Mahaweli Ganga	Primrose Hill	Nov. 1960	0.035	0.146	0.140	1.33			
	Elahera Anicut, about	Jul. 1961	0.040	0.250	0.110	0.020			
		Nov. 1960	0.075	0.208	0.166	0.089			
Stream of Area "H"	1.6 Km down stream of Polgolla	Jul. 1961	0.170	1.752	0.200	0.030			
Reservoirs in Area "H"	Kalawewa Reservoir	Nov. 1961	0.300	1.066	1.070	0.322			
		Jul. 1961	0.475	3.570	1.500	0.115			
		Jul. 1970	0.472	3.33	2.18	.100	1.93	0.23	3.40
	Maha, Illuppallama Reservoir	Nov. 1960	0.350	1.200	1.500	0.311			
		Jul. 1961	0.550	3.570	1.500	1.115			
Reservoir in Area "H"	Nachchaduwa Reservoir	Nov. 1960	0.200	0.680	0.696	0.374			
		Jul. 1961	0.350	2.250	1.200	0.140			

Source: Feasibility Study Stage II

Attached Table VII-1 Material-wise Estimated Import Amount

(t)

Year	Cotton	Wool	Regenerated Fibre	Synthetic Fibre	Total
1962	13,494	--	4,152	--	17,646
1963	9,585	--	1,065	--	10,650
1964	19,620	--	2,180	--	21,800
1965	21,204	1,116	2,232	--	24,552
1966	22,880	1,144	2,288	1,144	27,456
1967	16,380	1,170	2,340	1,170	21,060
1968	16,786	1,199	2,398	1,199	21,582
1969	17,150	1,225	2,450	3,675	24,500
1970	17,514	1,251	3,753	2,502	25,020

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

Attached Table VII-2 Cotton Production Amount

	Cultivated Area (ha)	Seed Cotton Yield (t)	Cotton Lint Yield (t)
1967/68	182	209	69.7
1968/69	122	93	31.0
1969/70	170	151	50.3

Source: National Textile Corporation, Annual Report

Attached Table VII-3 Country-wise Cocoon and Raw Silk Production Amount and Yield Rate of Raw Silk

(1970)

	Cocoon Production Amount (in 1,000 t)	Raw Silk Production Amount (in 1,000 t)	Rate of Raw Production against World Total (%)	Silk Yield Rate of Raw Silk (%)
Japan	112	20.51	49.6	18.3
China	130.2	11.00	26.6	8.4
U.S.S.R.	38	3.00	7.3	7.9
South Korea	21.4	3.02	7.3	14.1
India	34.3	2.26	5.5	6.6
Italy	1.5	0.31		20.7
North Korea	2.9	0.29		10.0
Bulgaria	2.2	0.25		11.4
Brazil	2.1	0.26		12.4
Iran	2	0.14		7.0
Turkey	1.6	0.07		4.4
Others	6.8	0.20		2.9
Total	355.0	41.31	100.0	–

Source: Silk Yarn Year book

Attached Table VII-4 Major Country-wise Chipboard Production Capacity

Countries	Production Capacity (1,000 t)				
	1967	1968	1969	1970	1971
Austria	200	225	280	350	450
Belgium	395	460	575	640	705
Czechoslovakia	172	172	172	184	197
Denmark	95	110	130	140	150
Finland	165	202	215	260	367
France	620	715	845	950	1,050
West Germany	1,530	1,800	2,150	2,580	2,900
East Germany	300	350	380	410	450
Greece	22	26	37	42	48
Hungary	69	73	82	49	94
Italy	450	485	620	650	710
Holland	55	65	68	68	71
Norway	130	145	150	160	180
Poland	206	206	218	231	238
Portugal	50	65	85	95	100
Rumania	138	158	171	217	
Spain	210	225	315	450	650
Sweden	185	260	310	360	390
Switzerland	165	175	195	215	220
Turkey	15	22	27	27	45
England	217	217	217	217	217
Yugoslavia	207	212	215	225	235
U.S.S.R.	847	980	1,120	1,120	1,450
Canada	169	177	179	317	377
U.S.A.	1,850	1,950	2,200	2,600	–
Iran	8.5	13	22	35	38
Iraq	2.7	2.7	2.7	2.7	2.7
Israel	35	38	40	–	–
Kuwait	1.1	1.1	1.1	1.1	1.1
Lebanon	7.5	10	12	12	12

Syria		4	6.5	6.5	6.5
India	51	51	51	51	51
South Korea	36	36	36	61	97
Malaysia	2	2	2	2	2
Pakistan	15	15	15	15	21
The Philippines	4	4	4	11	11
Ryukyus	16.5	16.5	16.5	16.5	16.5
Taiwan	24	24	31.5	39	39
Thailand	7	7	12	14.5	14.5
South Vietnam	3.8	3.8	3.8	7.0	7.5
Japan	182	203	223	280	390

Source: Association of Hard Fiberboard Manufacturers of Japan, 1973

Attached Table VII-5 Characteristics of Charcoal

Items	Ash Content	Volatile Content	Surface Area	Contents of Sulphur	Reaction with Sulphur	Reduction Reaction Rate of CO_2
	(%)	(%)	(m^2/gr)	(%)	(%)	(%)
Oak White Charcoal	2.4	5.2	247	0.05	–	43
Oak Black Charcoal	1.3	13.2	399	0.06	56.2	61
Gas Coke	11.9	1.32	3.42	1.0	2.2	6.8
Graphite	–	–	–	–	0.6	–
Carbon Black	0.1	–	52.0	0.5	–	4.1

Note: Reaction Temperature S: 800°C CO_2: 900°C

Source: Forestry Experiment Station, Ministry of Agriculture and Forestry

Attached Table VII-6 Yield of Dry Distillation Products from Wood

Tree Species		Pines	Spruce	Birch-trees	Beech-trees
Charcoal		37.83 (%)	37.81 (%)	31.80 (%)	34.97 (%)
Pyroligneous Acid		34.87	37.82	44.85	40.81
Wood Tar		11.79	8.08	7.03	8.11
Wood Gas		14.69	14.88	14.01	15.59
Loss		0.62	1.41	1.41	0.32
The Contents of Pyroligneous Acid and Wood Gas					
Pyroligneous Acid	Acetic Acid	3.50	3.19	7.08	6.04
	Methanol	0.88	0.96	1.60	2.07
	Other Volatile Oil Substances	8.22	7.97	8.36	6.12
Wood Gas Contents (Volume %)	Carbon Dioxide	56.37	56.50	58.67	56.97
	Carbon Monoxide	32.64	32.55	30.77	34.68
	Methane	8.99	9.23	8.81	6.72
	Ethane	2.00	1.72	1.75	1.63

Note: Max. Temperature 400°C

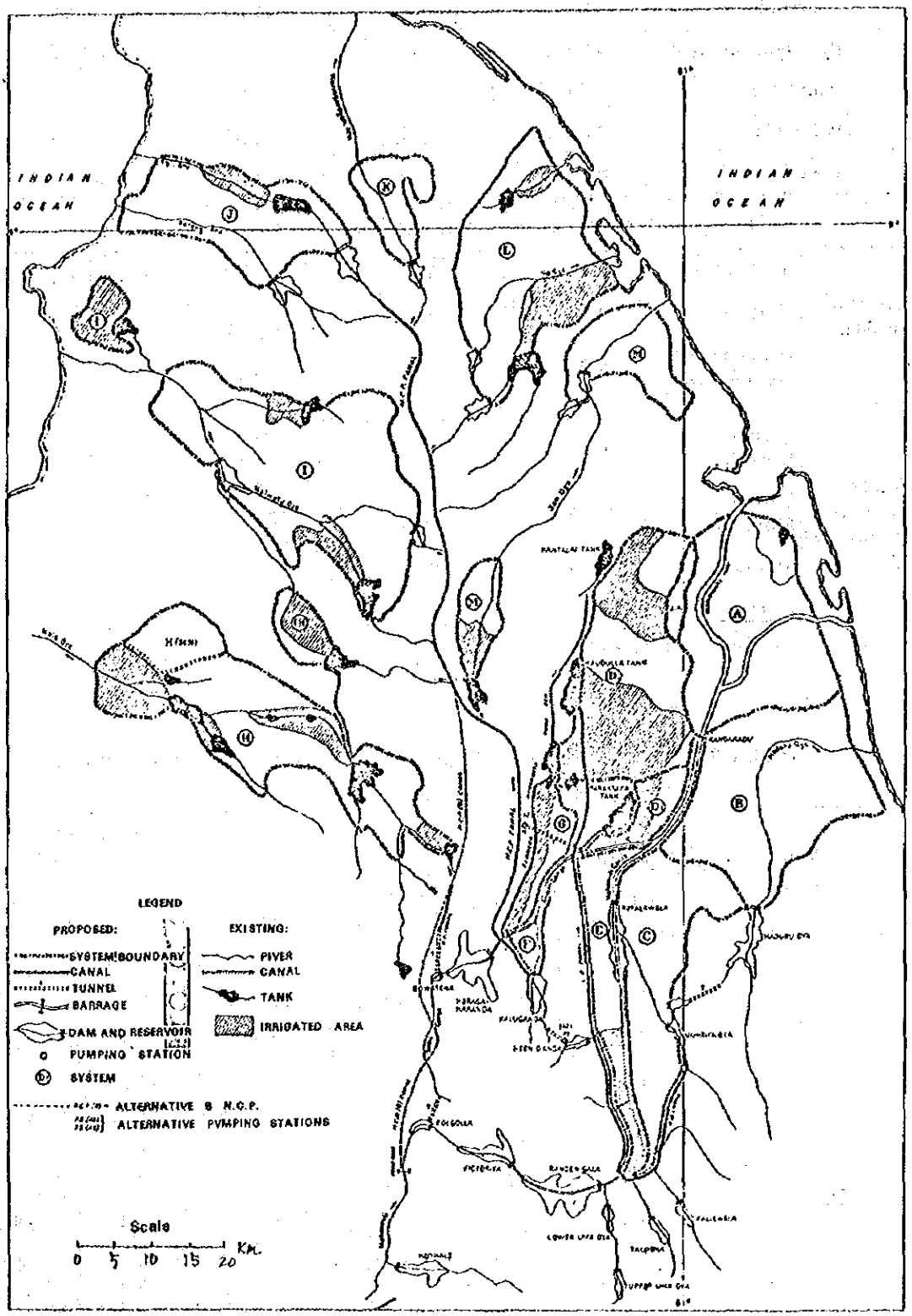
Source: As above

Attached Table VII-7 Wood Dry Distillation Temperature and Yield of Products

Wood Species	Max. Temperature	Yield of Products			Contraction Rate (%)	
	(°C)	Charcoal	Distilled Liquid	Wood Gas (lg/100)	Length	Diameter
Cedar	180	100.5	0	0.01	0	0.7
	260	83.2	11.7	1.88	0.6	1.9
	310	50.0	35.5	7.27	4.3	11.3
	400	39.2	44.3	9.73	11.3	17.1
Small Oaks	180	94.7	4.6	0	0	1.8
	260	72.8	20.1	2.91	0	—
	310	41.5	43.7	8.41	4.1	18.7
	400	33.5	46.6	10.65	11.2	21.6

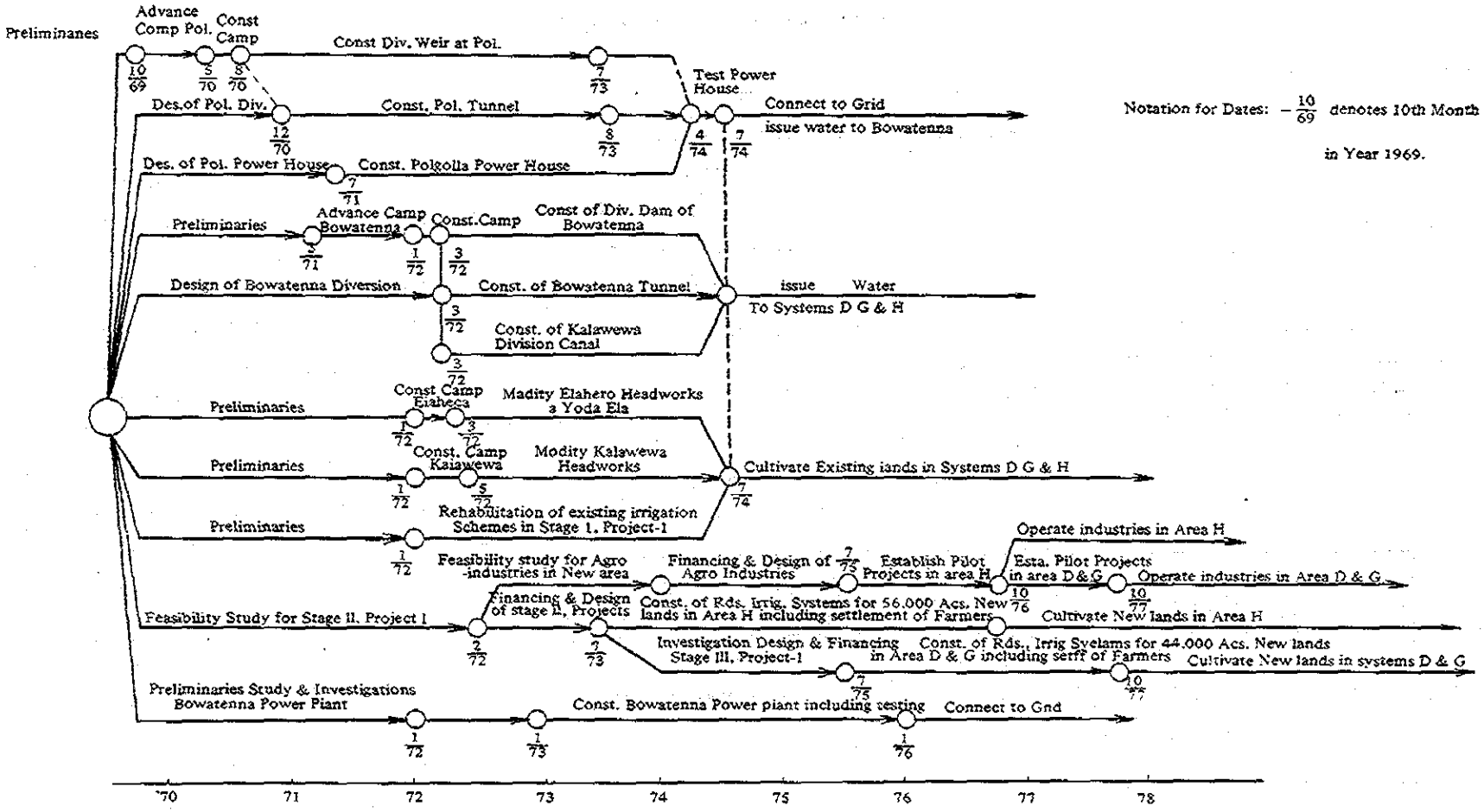
Source: Forestry Experiment Station, Ministry of Agriculture and Forestry

Attached Fig. IV-1 Irrigation Systems of Mahaweli Ganga Project



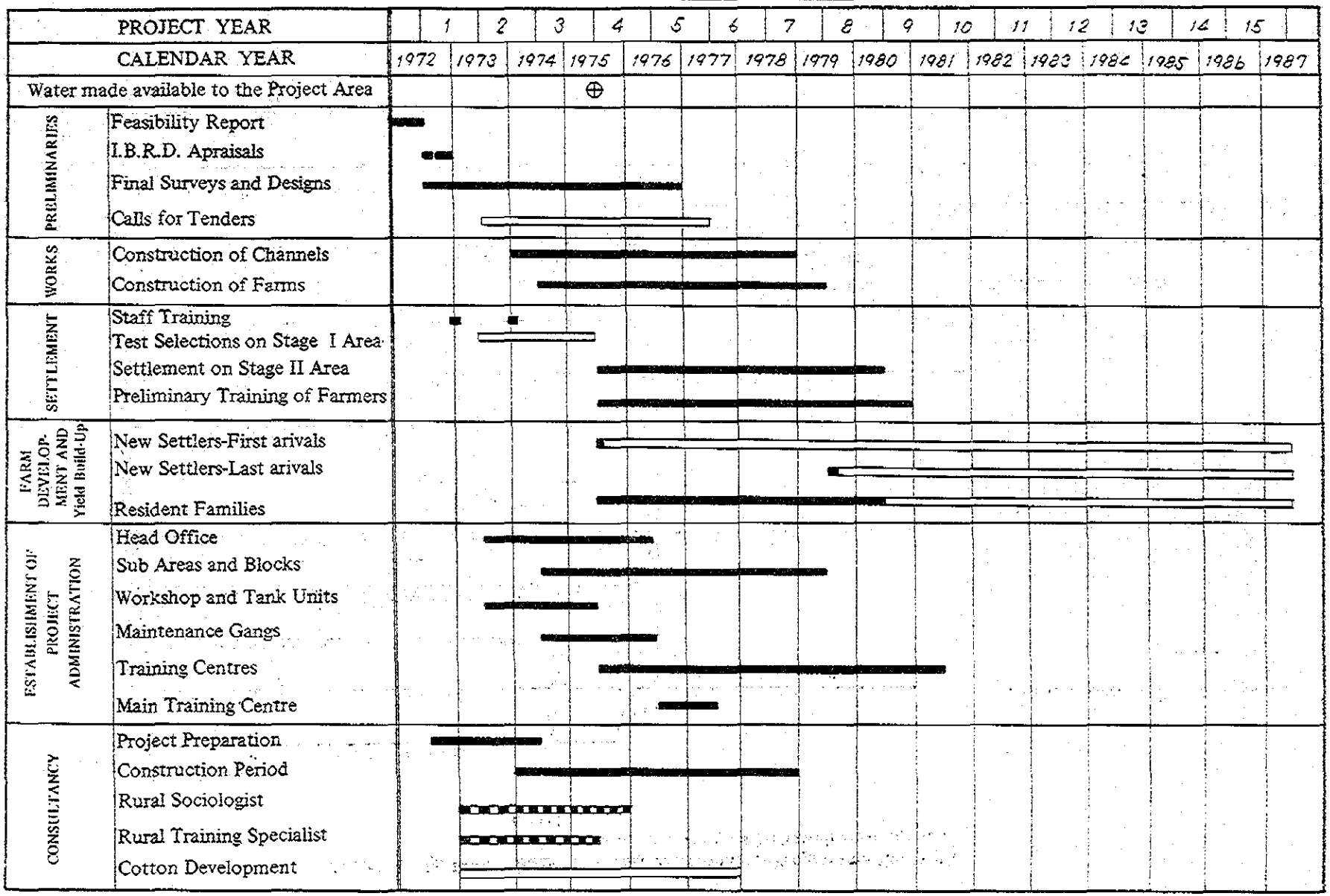
Source: FAO Report (FAO/SF: 55/CEY-7)

Attached Fig. IV-2 Mahaweli Ganga Development Programme Net Work within Area of Authority of Mahaweli Development Board



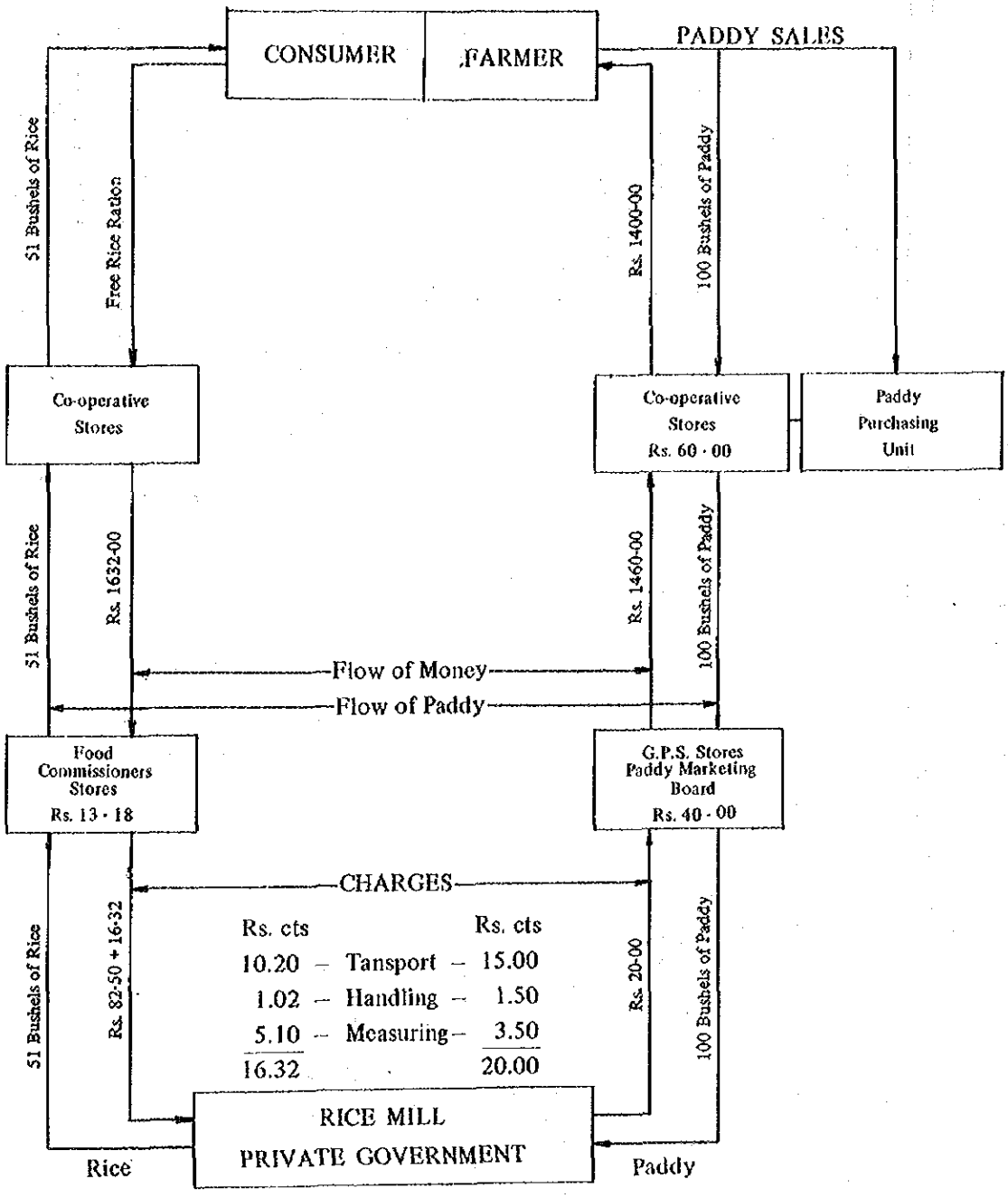
Notation for Dates: $-\frac{10}{69}$ denotes 10th Month in Year 1969.

Attached Fig. IV-3 Development Schedule



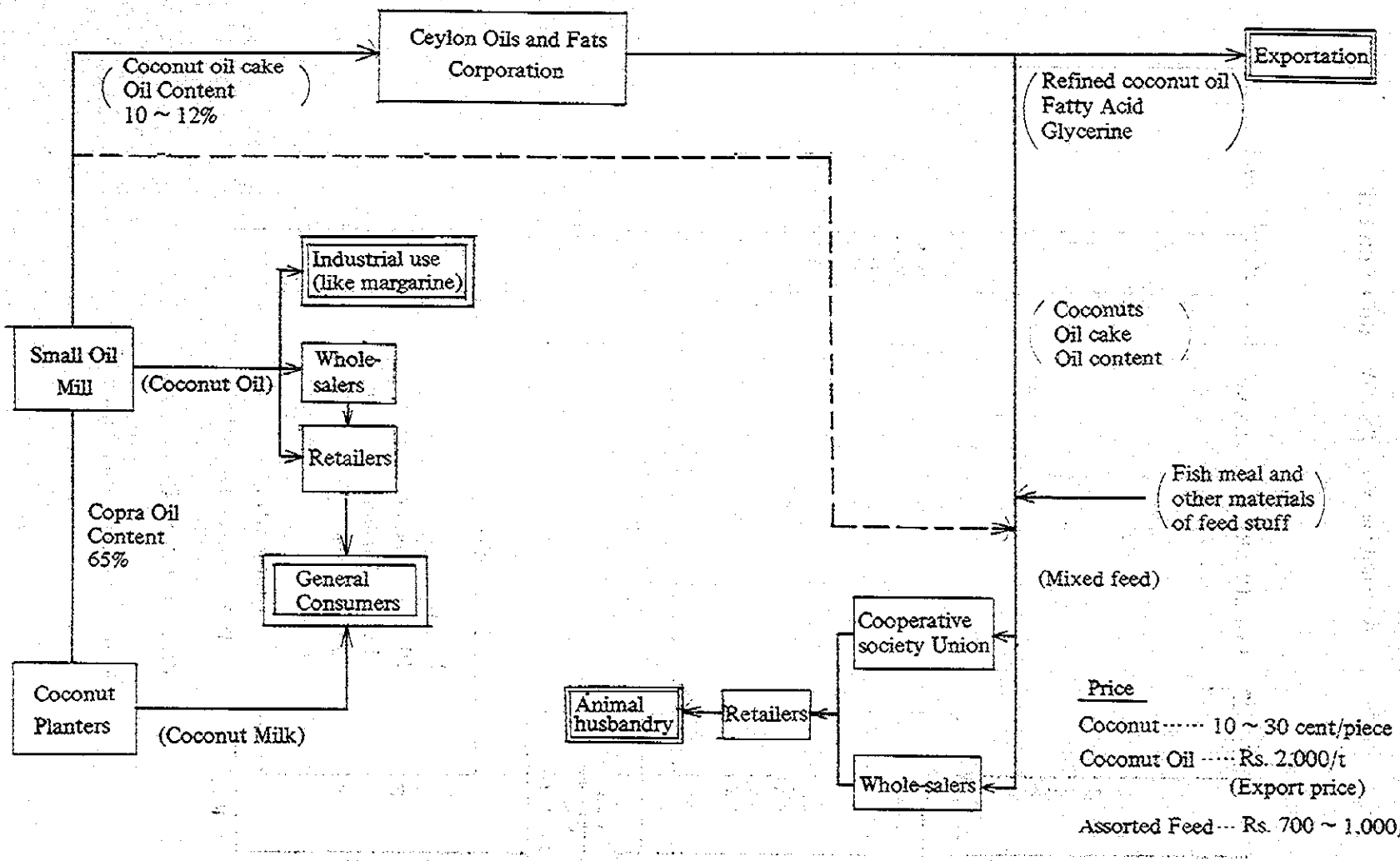
Source: Feasibility Study Stage II

Attached Fig. V-1 PADDY – RICE CIRCUIT

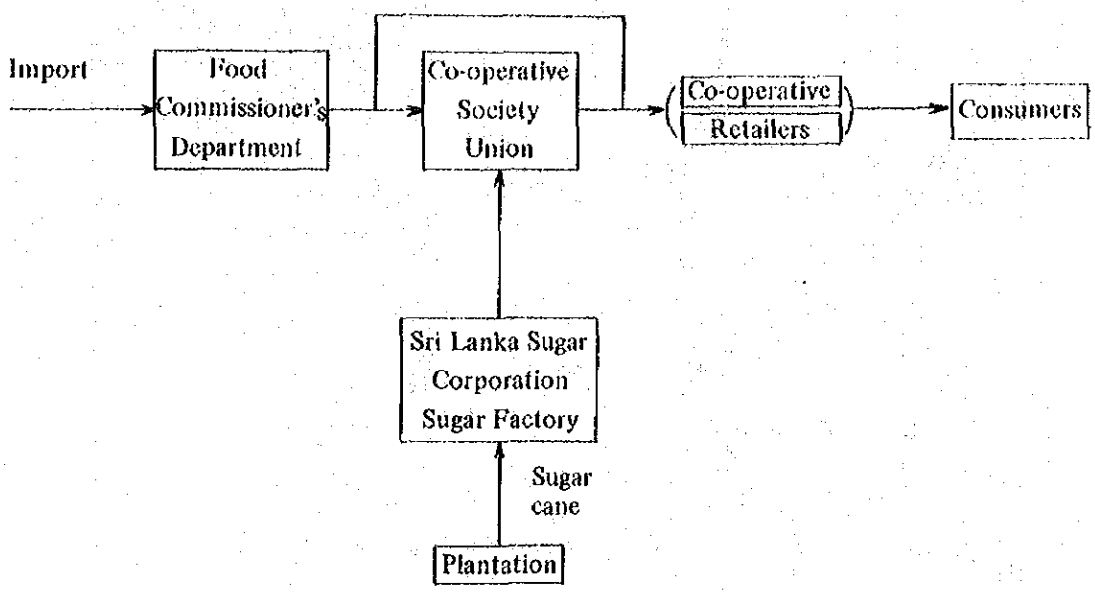


Source: Feasibility Study Stage II

Attached Fig. V-2 Distribution of Oils and Fats and Feed Stuff



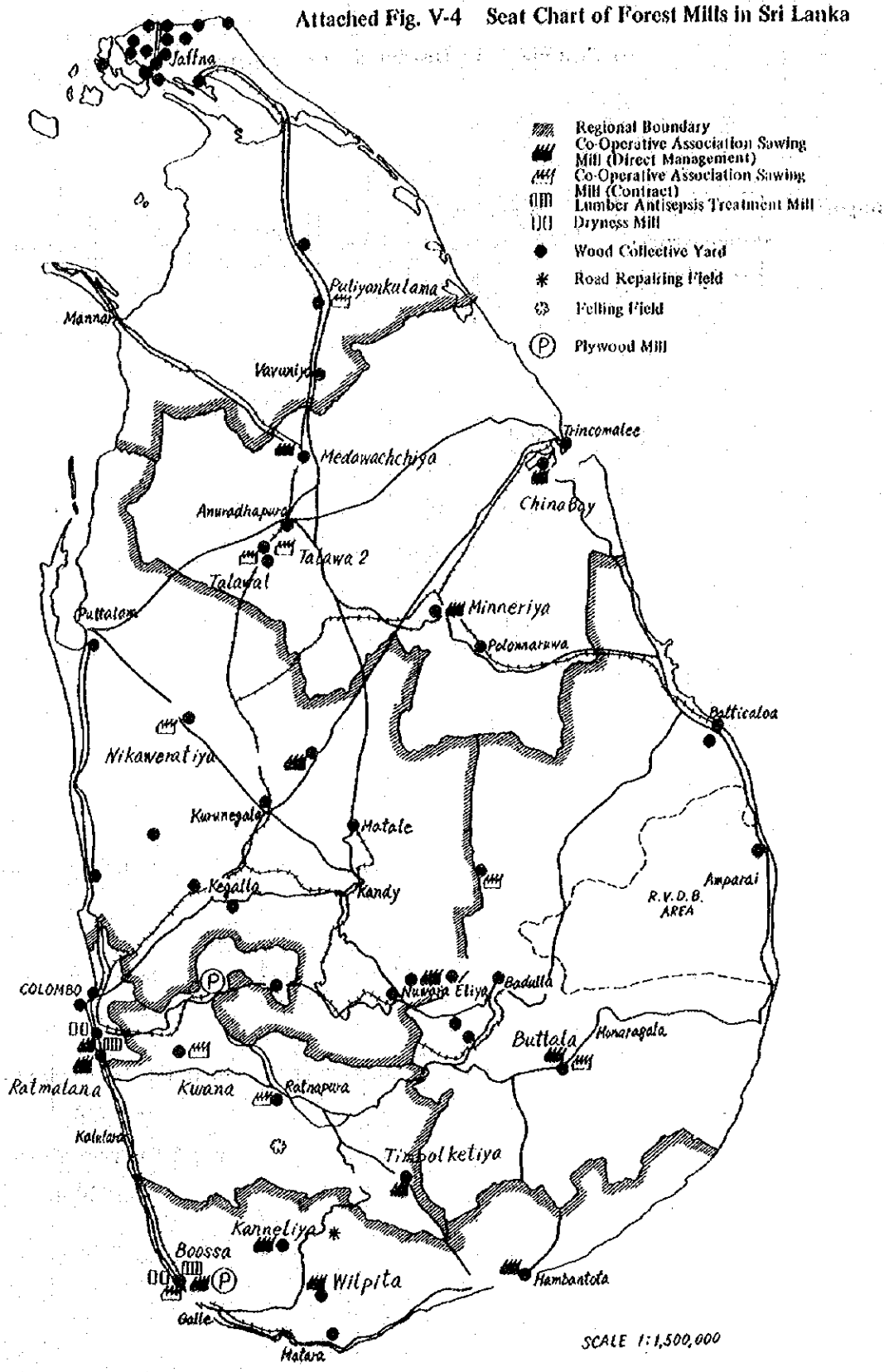
Attached Fig. V-3 Distribution Route of Sugar



Price

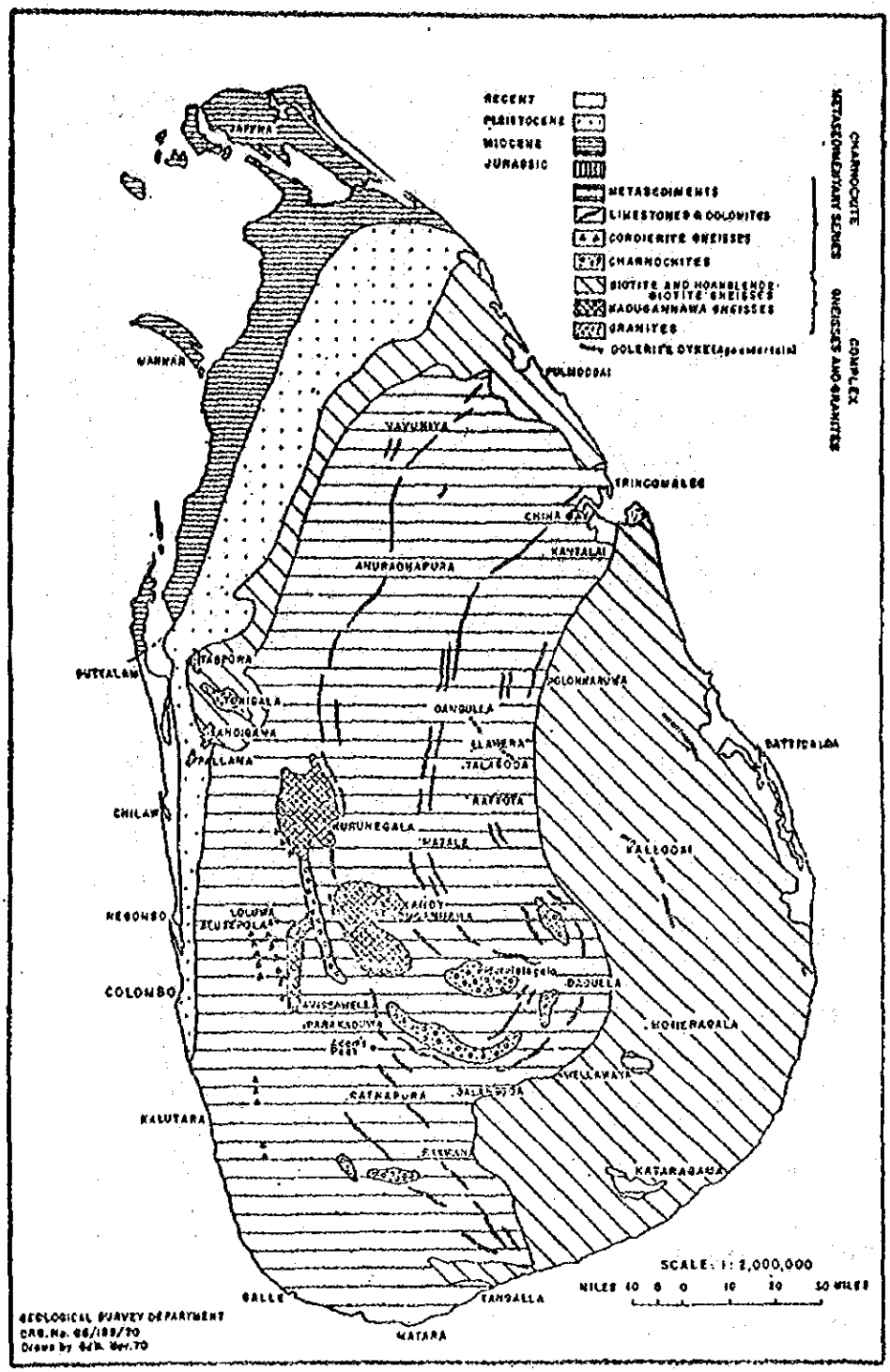
Import Price	cent 66 ~ 44/kg
Sale Price from Public Corporation to Government	cent 25/lb
Retail Price	up to 0.5 lb/person/week
	cent 72/lb
	over 0.5 lb/person/week
	cent 150/lb

Attached Fig. V-4 Seat Chart of Forest Mills in Sri Lanka



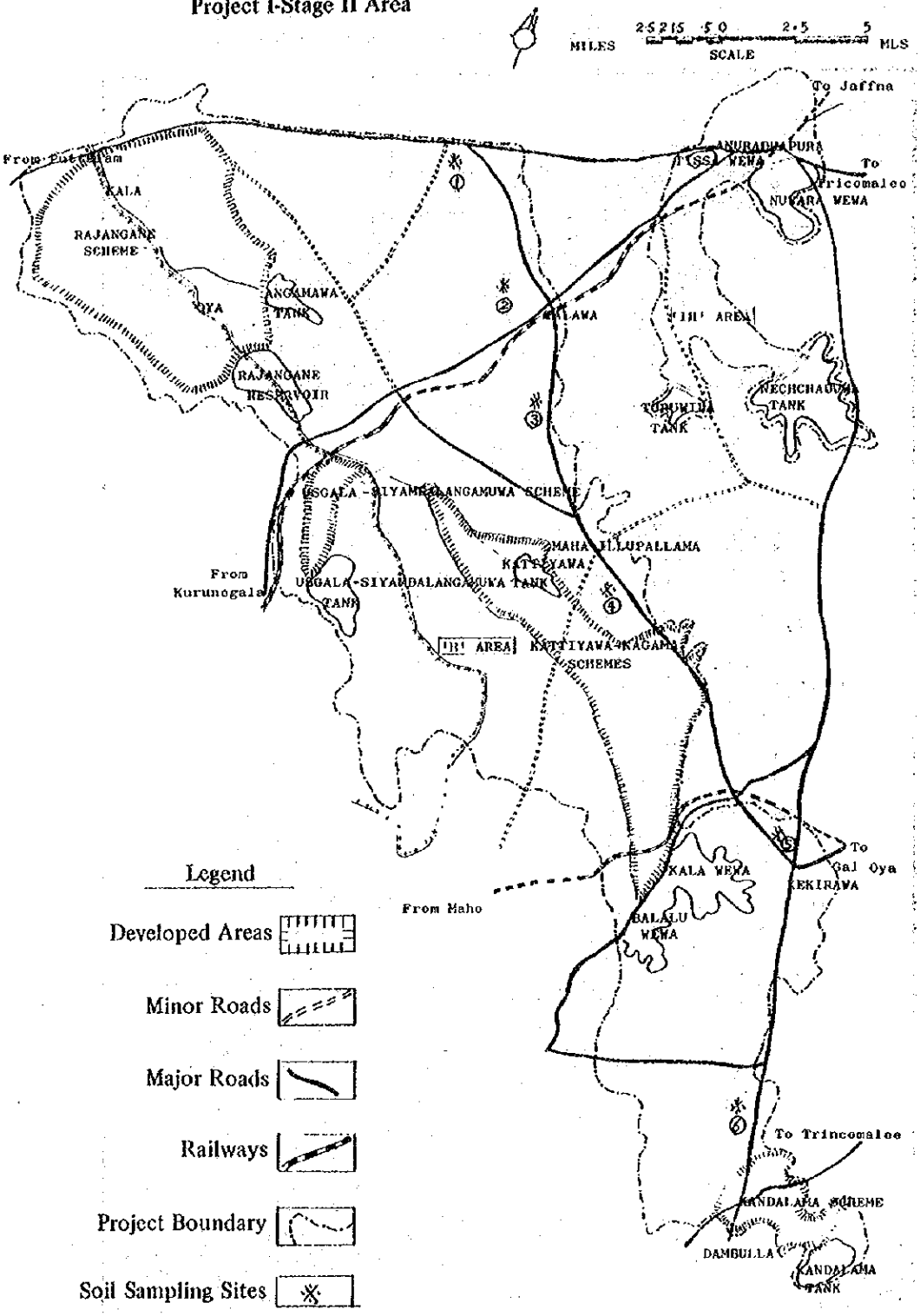
Source: State Timber Corporation

Attached Fig. V-5 Geological Map in Sri Lanka

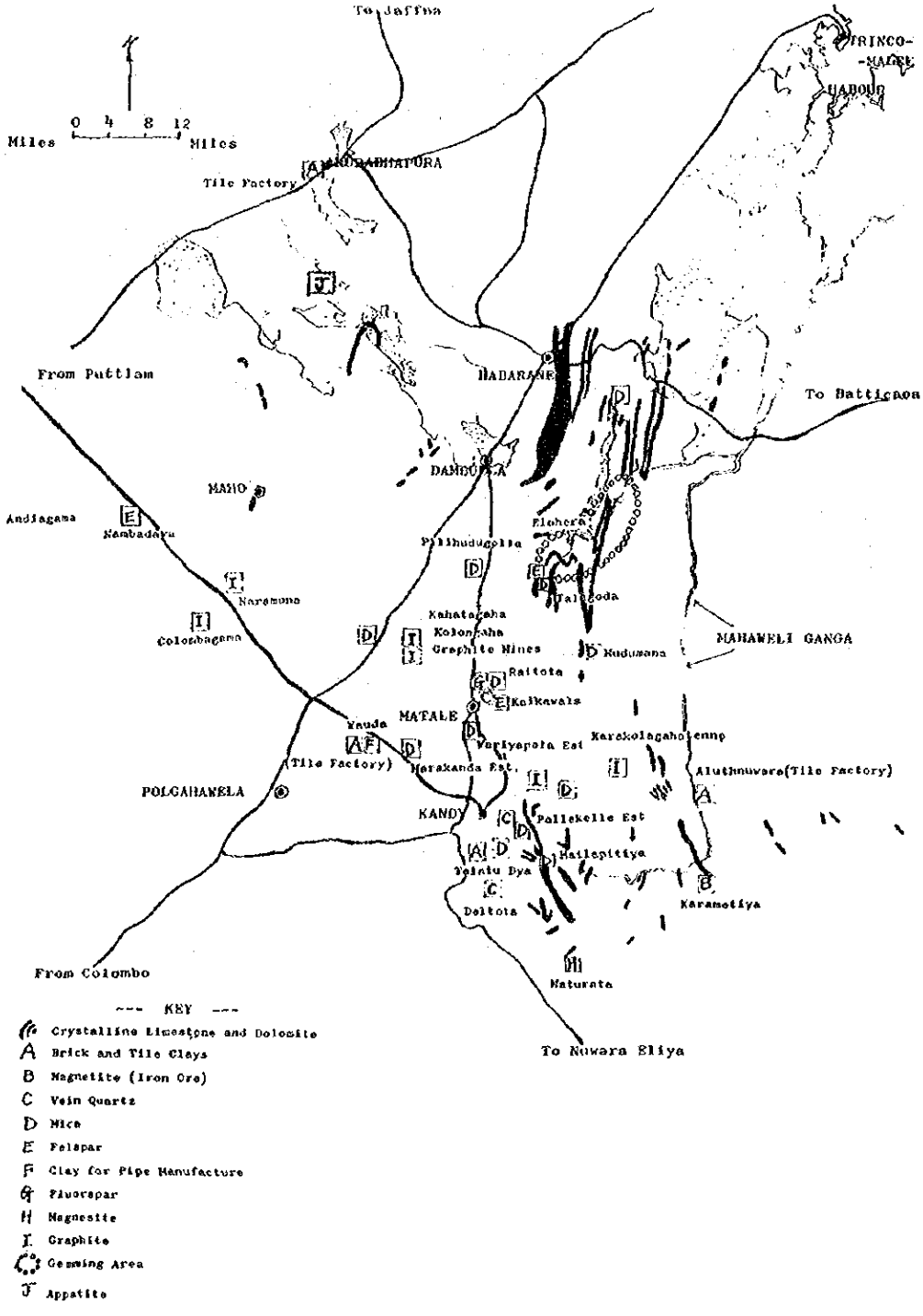


Source: Geological Survey Department

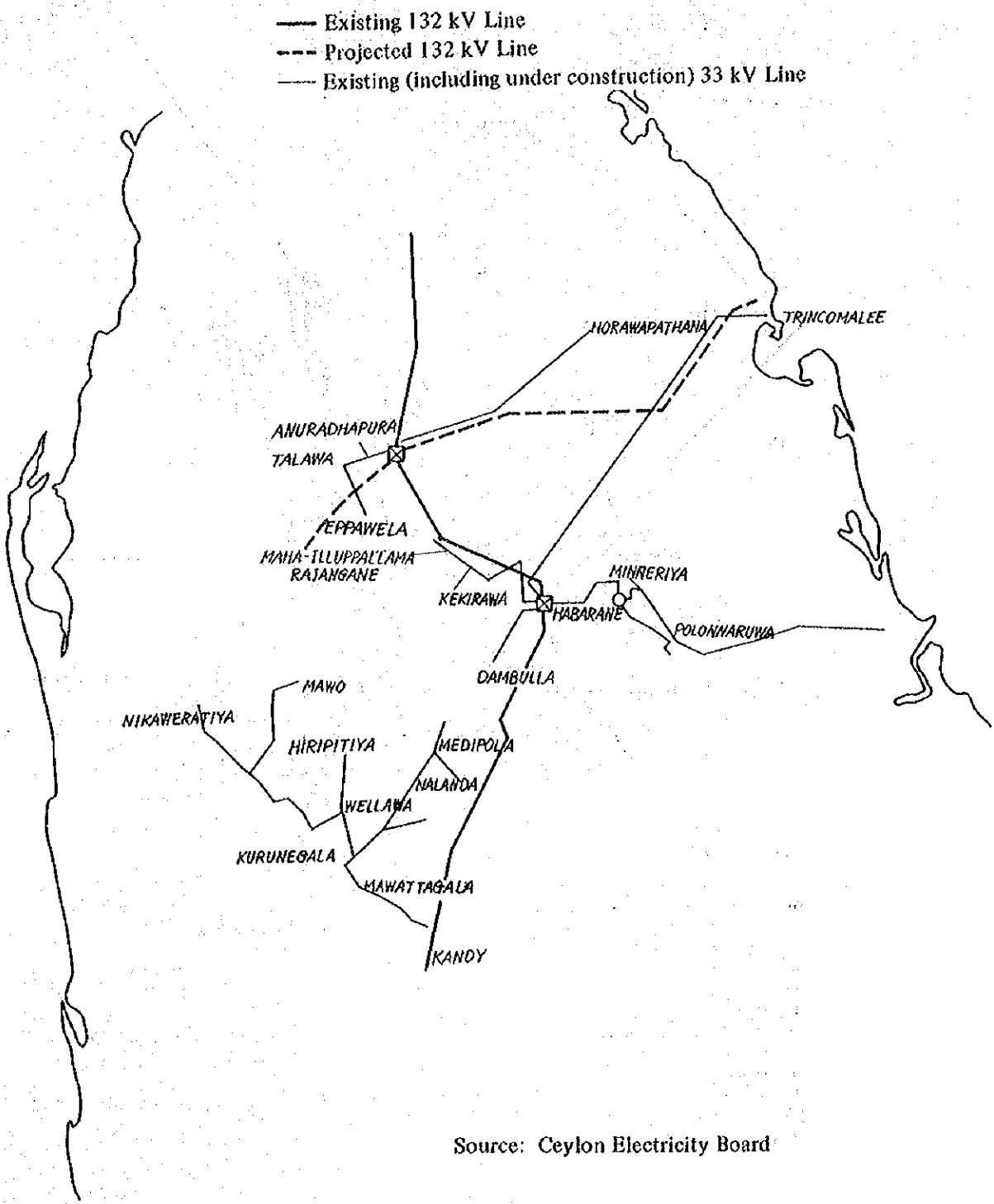
Attached Fig. VI-1 Mahaweli Development Programme
Project I-Stage II Area



Attached Fig. VI-2 Distribution Chart of Minerals in Mahaweli District

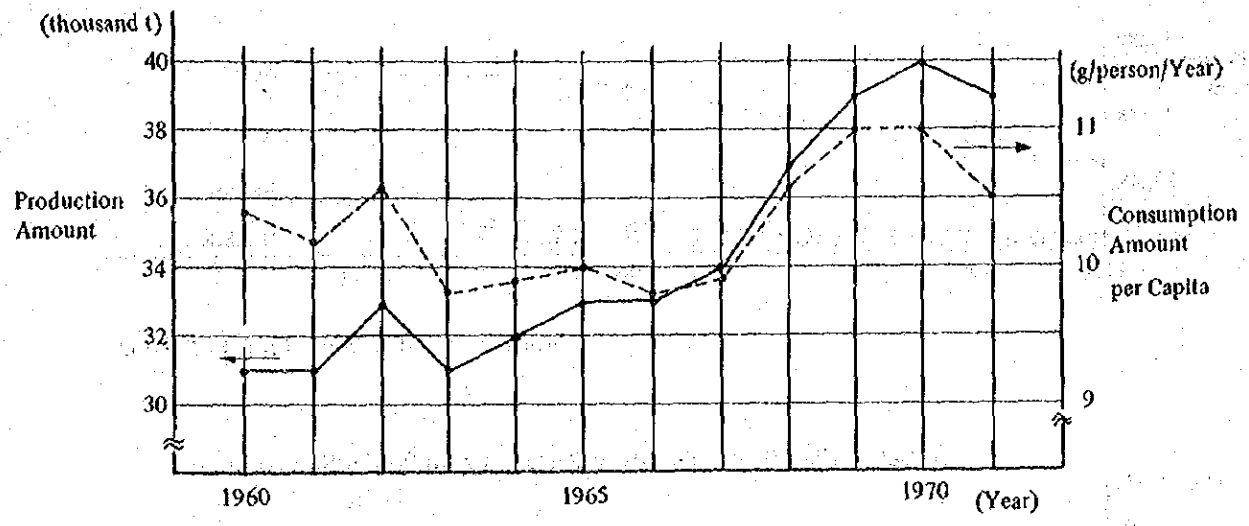


Attached Fig. VI-3 The Electric Condition in The Mahawell Project Area



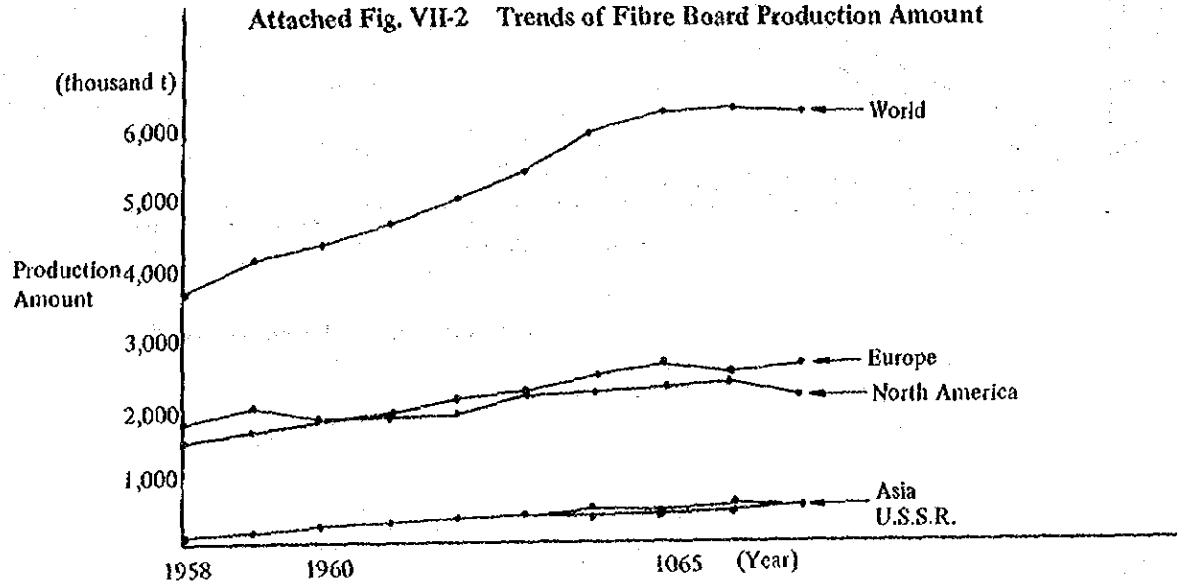
Source: Ceylon Electricity Board

Attached Fig. VII-1 Trends of Raw Silk Production and per Capita Consumption Amount in the world



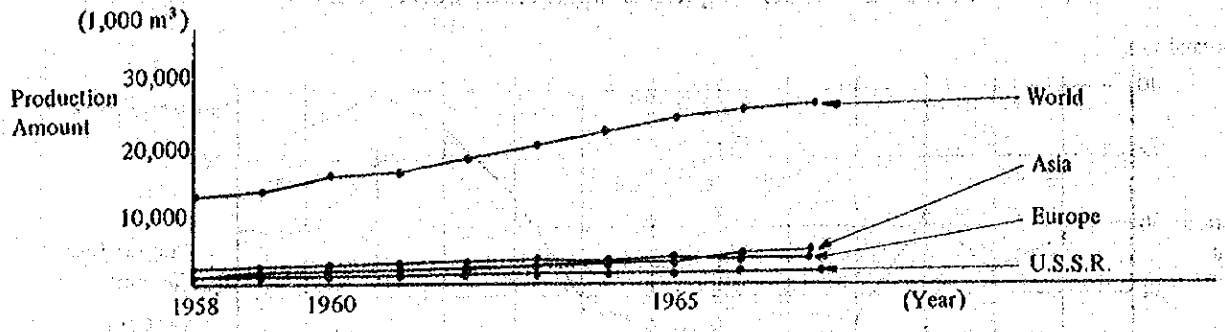
Source: Chemical Fibre Handbook

Attached Fig. VII-2 Trends of Fibre Board Production Amount



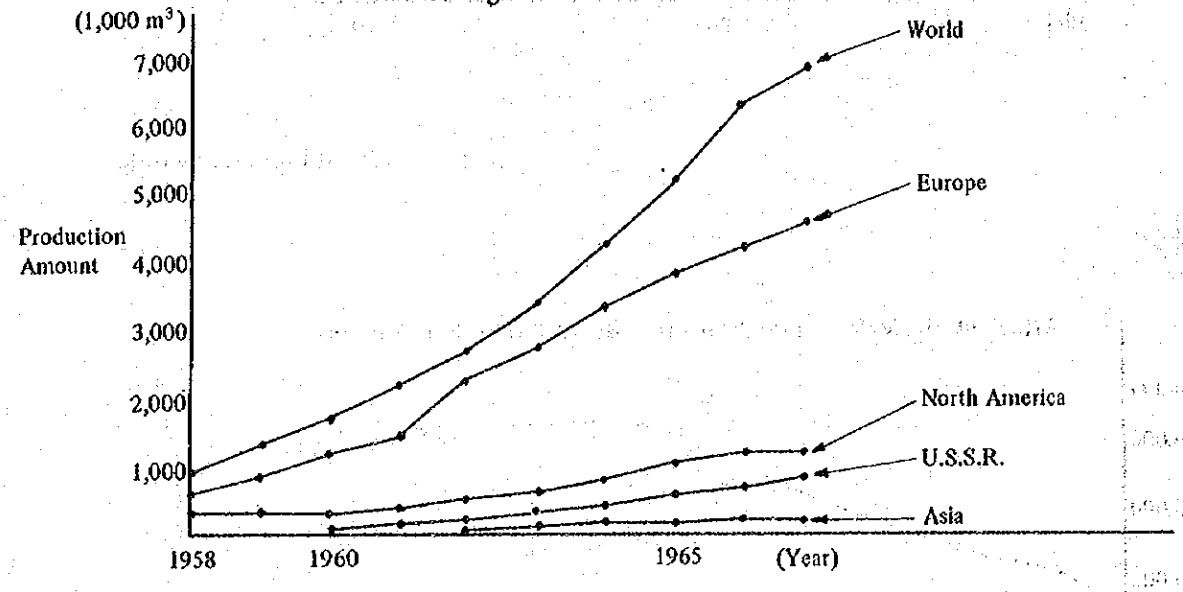
Source: World Annual Report of Wood

Attached Fig. VII-3 Trends of Plywood Production Amount



Source: World Annual Report of Wood

Attached Fig. VII-4 Trends of Particle Board Production Amount



Source: World Annual Report of Wood