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AGRO-INDUSTRY DEVELOPMENT

IN MAHAWELI SYSTEM "H"

FINAL REPORT

SUBMITTED TO UNIDO

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT: SI/SRL/[illegible]

UNDER CONTRACT [illegible]/32

Industries Development Corporation
(International Services) CO. LTD.

[illegible]

חברה לפיתוח תעשיות (שרותים בינלאומיים) בע"מ
INDUSTRIES DEVELOPMENT CORPORATION (INTERNATIONAL SERVICES) CO. LTD.

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HAIFA, APRIL 1986

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ABSTRACTS

This report discusses the main issues of potential agro-industrial development opportunities existing in Mahaweli System "H", Sri Lanka. This area was resettled by 25,000 agricultural farming families producing today mainly rice and chilli.

An agro-industrial development plan is proposed based on crop diversification and the producing of crops and varieties suitable for industrial processing.

Seven agro-industrial projects are presented in an integrated program, each covering the approach for its development, the basic facilities required and its program of implementation.

General recommendations are presented for priority of implementation, location of projects, manpower and training, R&D requirements entrepreneurship, estimate of investment required and technical assistance.

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In this study all references to prices are to United States Dollars (average rate of exchange for 1983 was US$ 1.00 = Rs. 23.5, and US$ 1.00 = Rs. 26.65 for June 1985).

All tons in this study are metric tons.

Maha Season - Wet Season

Yala Season - Dry Season, low rainfall, April to August.

The following abbreviations are used in this study:

Abbreviation		Meaning
CCC	-	Central Canning Center
CC System	-	Canning Center System
CTC	-	Ceylon Tobacco Company
CISIR	-	Ceylon Institute of Science and Industrial Research
FFSF	-	Full Fat Soybean Flour
ha	-	hectare
HCC	-	Home Canning Center
L.G.H.S.	-	Low Humic Gley Soils
NEDECO	-	Netherlands Engineering Consultants
R.B.E.	-	Reddish Brown Earths
Rs.	-	Rupees

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INDUSTRIES DEVELOPMENT CORPORATION (INTERNATIONAL SERVICES) CO. LTD.

Haifa, April 1986

UNIDO - United Nations Industrial
Development Organization
Vienna
AUSTRIA

Dear Sirs,

This final report contains the text of a study presenting a program for agro-industry development in Mahaweli, System "H", Sri Lanka.

The report aims to give a general outline of policy and a basic plan regarding future activities in System "H".

The implementation of the above-mentioned program will generate new job opportunities for the second generation of the region and will increase the income of the farmers. Further, it will lead to the farmers' self-sufficiency in a wide range of food supply, and in the long-term will result in improving the balance of payment in Sri Lanka.

The IDC experts who participated in the field work in Sri Lanka were:

Dr. Eliahu Fridman - Agro-industries, Team Leader
Mr. Aharon Levi - Food technologist

The team who stayed in Sri Lanka during June-July 1985, met with officials of the Mahaweli Authority, local and regional financial institutions, representatives of national organizations, agricultural stations, food research institutes, private entrepreneurs, food processing plants, etc. Available data was collected in Colombo, Kandy and System "H" and a serious attempt was made to verify the figures with field information.

The data gathered by the team was thereafter elaborated in Israel using the services of the interdisciplinary staff of IDC.

Our gratitude is extended to all individuals and organizations in Sri Lanka, especially the Mahaweli Authority, for their cooperation and understanding, as well as to the UNIDO/Vienna and Colombo staff for their valuable guidance which enabled us to formulate this project.

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SUMMARY

1. This report discusses the possibilities of agro-industry development in System "H" of the Mahaweli area. System "H" is already settled by about 23,000 families, each possessing one hectare of irrigable land. Almost all agricultural land in System "H" is already occupied.

2. At present, production in System "H" is mainly agricultural. Agro-industrial activity is only in the very initial stages, and there is no agro-industrial development program.

3. This report gives the reader a general outline of a policy as regards future activities for agro-industrialization. It also details the stages involved in the execution of the policy and recommends which activities should be organized and financed by public funds.

4. The diagnosis of agricultural production is as follows:
Farmers grow paddy, almost solely, during the wet season, and paddy and chilli during the dry season. Few other crops are grown in the area although some gave good yields.

5. Industrial production is limited to chilli and soybean processing and to paddy milling.

6. An agro-industrial development plan is proposed, based on crop diversification and the production of crops and varieties suitable for industrial processing.

7. Seven potential agro-industrial projects are suggested for processing of Chilli, Soybean, Milk, Fruits and Vegetables, Peanut and Sesame, Spices and Animal Feed. These projects are presented in an integrated program, each covering the approach for its development, the basic facilities required and its program of implementation.

8. General recommendations are presented for priority of implementation, location of the agro-industrial projects, manpower and training, R & D requirements and entrepreneurship.

9. The need for technical assistance by international organizations is undoubtedly obvious. For each of the seven projects evaluated the nature of this aid is presented, including a schedule of implementation.

10. The required investment budget for equipment and production facilities is estimated to be about US$ 5 million during the first five years of agro-industrial development of System "H". About US$ 1.2 million of this sum is to be invested in the first two years by public and private sources.

CHAPTER 1

INTRODUCTION

1. Introduction

This report discusses the issue of potential agro-industrial development for the System "H" of Mahaweli area in Sri Lanka. The report describes and analyses the present situation of the agricultural production of System "H", highlighting the crops currently produced, mainly paddy and chilli, compared to vegetables and other crops productions.

Reviewing existing studies, crops evaluated for Mahaweli area in general and for System "H" in particular, are presented with special emphasis regarding data for yields, cost of cultivation and net return per hectare.

Vegetables are an important raw material for canning, pickling, freezing and dehydration. Unfortunately no figures are available for vegetable production for System "H". The data presented for vegetable cultivation in dry zones in Sri Lanka may be indicative for System "H".

Agro-industrial activities in System "H" are reviewed, covering studies and existing projects.

The diagnosis of the agricultural production and the necessity to place emphasis on efforts for agroindustrialization of the region, are behind the program presented. A general integrated program and individual presentation for seven projects are developed.

The purpose of this report is to give the reader a general outline of the policy considering future activities of each project. It is also meant to provide the decision makers with a general plan of operation, as well as an indication of the responsibilities for its implementation.

In summary, the preparation of this study embraces the stages of: an overall view of the agricultural situation and agro-industrial activities; an analysis of the main issues; elaboration of a basic plan including a proposed program of execution.

CHAPTER 2

AGRICULTURAL PRODUCTION

2. Agricultural Production

It is virtually superfluous to explain the primary importance of determining the agricultural production in System "H" which constitutes the basis for all agro-industries to be established in the area. This chapter summarizes the available data regarding agricultural production in the Mahaweli region in general and in System "H" in particular, covering studies prepared and compared with the actual situation in System "H". Based on the current agricultural production and on the existing potential, recommendations regarding agro-industrialization are presented.

2.1 Review of Existing Studies

2.1.1 Forward

The development of the Mahaweli region was accompanied with previous preparation of numerous studies. These studies dealt with various aspects of regional development, including agricultural factors such as soil, water, climate and, of course, the agricultural crops. Comprehensive studies and master programs were prepared for the various systems in the Mahaweli by several groups from Canada, The Netherlands, Japan and others, in collaboration with Sri Lankan governmental offices and authorities responsible for the development of the Mahaweli area.
It should be noted that the principal efforts of these studies were aimed at presenting data and analysing future plans regarding soil, infrastructure, water, energy, health, education, etc.

Little emphasis was placed on the issue of how and why to grow crops, not to mention that the problem of whether or not to grow certain agricultural crops, was not analysed.

Based on experimental evaluation by the Maha Illuppallama Research Station with a wide range of irrigated crops under actual soil and climatic conditions encountered in the project area studied for several years, recommendations for different crops were made in Master Plans, most of which were recommended also later (1,2,3,4,5,6,7 etc.) and most are actually applied.

2,1.2 Crops Evaluated for Mahaweli Area

Although the cultivation of a wide range of crops can be considered, it was advisable to encourage the farmers to grow a small number of different crops in the first stage. Each crop requires specific knowledge and experience. A limited number of crops which had been given high priority, had been considered.

The available information from various sources is controversial, especially concerning the level of produce and other numerical data. In some cases, the data given for quantities in the same area is inconsistant even though it was obtained from the same source. We are not in a position to evaluate and judge the inconsistancy of the data, therefore they are presented as such.

In addition, we wish to stress that we did not find any relevant qualitative data on the agricultural crops. Even indicative minimal data, which is of major importance in any analysis of industrial processing of crops, was not found.

The importance of the data and figures presented hereafter regarding cultivation is indicative of the potential that lies in cultivation of the region and underlines the necessity of studying the subject in an orderly and correct manner, keeping in mind that this cultivation is intended for agro-industrial processing.

The following crops were evaluated in a master plan (1), most of which were also recommended later (2)(3)(4)(5)(6)(7)(8)(9)(10).

2.1.2.1 Paddy (Oriza sativa)

The main crop due to objective evaluation and traditional use (main food) for poorly drained lands. Mudland paddy is the normal practice during Maha and Yala seasons. Cultivation of paddy with supplementary irrigation under upland conditions is a suitable technique during the Maha season. Better crops were obtained in Low Humic Gley Soils (L.H.G.S.) under upland and midland conditions, and poor crops in both seasons in well drained and imperfectly drained Reddish Brown Earths (R.B.E.). (See Yields below.)

Yields: 1800 - 5400 kg/ha. (10).

.1.2.2 Chillies (Capsicum annum)

Can be grown on well drained land during all seasons, but the same land should not be used for successive crops and a dry period during harvest is necessary in order to permit sun drying of the ripe pods. Planting of chilli in L.H.G.S. is not recommended for any season.

Yields: 1360 - 1700 kg/ha (10), 2121 kg/ha (15), or 1500 - 1800 kg/ha (11) of dried chillies.

The following data is for Yala season 1983 in System "H":

a. According to NEDECO Study (11):

Costs of cultivation:

- including farmer family labor - US$ 996/ha (23403 Rs/ha)
- excluding " " " - US$ 606/ha (14252 Rs/ha)

Net return per hectare when sold for US$ 900/ton (21 Rs/kg):

- including farmer family labor - US$ 549/ha (12900 Rs/ha)
- excluding " " " - US$ 938/ha (22057 Rs/ha)

b. According to Agr. Economics & Projects Study (15):

Costs of cultivation:

- including farmer family labor - US$ 750/ha (17639 Rs/ha)
- excluding " " " - US$ 463/ha (10883 Rs/ha)

Net return per hectare when sold for US$ 1130/ton (26.61 Rs/kg) and yield 2121 kg/ha

- including farmer family labor - US$ 1651/ha (38798 Rs/ha)
- excluding " " " - US$ 1938/ha (45554 Rs/ha)

2.1.2.3 Pulses

A. Green gram (Phaseolus aureus)

Must be planted after the heavy Maha season rains because the harvesting should be dry, in order to prevent germination of seeds in pods.

Intercropped with chillies.

Yields: No reliable data available - from 500 - 600 kg/ha (after severe insect attack) to 1200 kg/ha (11).

B. Cowpea (Vignus sinensis)

Well adapted for well drained soils for both seasons, and also for imperfectly drained soils in Yala. Not recommended for L.H.G.S. in either season.

Yields :In system "H", 910 - 1350 kg/ha (10) or up to 3000 kg/ha (11).

The following data is for Yala season 1983 (11):

Costs of cultivation:

- including farmer family labor - US$ 235/ha (5514 Rs/ha)

Net return per hectare when sold for US$ 340/ton (8000 Rs/ton)
- including farmer family labor - US$ 800 (18800 Rs/ha)

2.1.2.4 Soybean (Glycina hispida)

Well adapted crop for well drained and imperfectly drained soils, not suitable for L.H.G.S.

Yields: Up to 2830 kg/ha (10), 1545 kg/ha (15), or 1800 kg/ha and 3000 kg/ha on farm water management project in Yala season 1982 (11).

The following data is for Yala season 1983:

a. According to NEDECO Study (11):

Costs of cultivation:

- including farmer family labor - US$ 374/ha (8790 Rs/ha)
- excluding " " " - US$ 247/ha (5800 Rs/ha)

Net return per hectare when sold for US$ 277/ton (6500 Rs/ton)

- including farmer family labor - US$ 138/ha (3250 Rs/ha)
- excluding " " " - US$ 264/ha (6214 Rs/ha)

b. According to Agr. Economic & Projects Study (15):

Costs of cultivation:

- including farmer family labor - US$ 331/ha (7785 Rs/ha)
- excluding " " " - US$ 192/ha (4502 Rs/ha)

Net return per hectare when sold for US$ 267/ton (6290 Rs/ton) and yields 1545 kg/ha

- including farmer family labor - US$ 82/ha (1933 Rs/ha)
- excluding " " " - US$ 222/ha (5216 Rs/ha)

2.1.2.5 Maize (Zea mays)

Can be cultivated during Yala season. Well adapted to well drained and imperfectly drained soils; not suitable for L.H.G.S. in any season.

Yields: 2265 - 3740 kg/ha (10).

Sorghum is similar in its requirements to maize and may be considered interchangeable with the latter crop.

1.2.6 Groundnuts (Arachis hypogea)

Can be grown in both seasons, but give better results during Yala. Performs very well in well drained soils, but not satisfactory in other soils.

Yields: 2270 kg/ha (10).

2.1.2.7 Onions (Alium spp)

Can be cultivated successfully only in well drained soils. Both Red and Bombay onions perform well in well drained soils in the Yala season. From our personal experience, onions grown in tropical countries (short days), usually contain low, dry matter content and are not suitable for dehydration.

A. Red Onion

Yields: (only for intercropped) - 13250 kg/ha (11) and 12680 kg/ha (15).

The following data is for Yala season 1983:

a. According to NEDECO Study (11):

Costs of cultivation:

- US$ 564/ha (13248 Rs/ha)

Net return per hectare when sold for US$ 74.5/ton (1750 Rs/ton) and yields 13250 kg/ha was US$ 350/ha (9340 Rs/ha).

b. According to Agr. Economic & Projects Study (15):

Costs of cultivation:

- including farmer family labor - US$ 1867/ha (43871 Rs/ha)
- excluding " " " - US$ 1483/ha (34844 Rs/ha)

Net return per hectare when sold for US$ 183/ton (4.30 Rs/kg) and yields 12680 kg/ha.

- including farmer family labor - US$ 453/ha (10653 Rs/ha)
- excluding " " " - US$ 837/ha (19680 Rs/ha)

B. Bombay Onion

Yields: 10000 kg/ha(11) and 2535 kg/ha (15).

The following data is for Yala season 1983:

a. According to NEDECO Study (11):

Costs of cultivation:

- including farmer family labor - US$ 362 (8500 Rs/ha)
- excluding " " " - US$ 253 (5950 Rs/ha)

Net return per hectare when sold for US$ 298/ton (7000 Rs/ton).

- including farmer family labor - US$ 830/ha (19500 Rs/ha)
- excluding " " " - US$ 957/ha (22500 Rs/ha)

b. According to Agr. Economic & Projects Study (15):

Cost of cultivation:

- including farmer family labor - US$ 995/ha (22436 Rs/ha)
- excluding " " " - US$ 428/ha (10061 Rs/ha)

Net return per hectare when sold for US$ 379/ton (8.90 Rs/kg) and yields 2535 kg/ha

- including farmer family labor - US$ 4.8/ha* (113 Rs/ha)
- excluding " " " - US$ 531/ha (12483 Rs/ha)

(*) This published figure seems to be very low, however we could not verify it. This is an extreme case which presents the difficulties in compiling reliable data.

2.1.2.8 Fruits and Vegetables

Fruit growing is recommended only in backyards and includes: paw-paw (papaya), mango, passion fruit (grown previously in this region), bananas, etc. Vegetables are grown on a very small scale. No detailed information is available regarding quality, yields, etc. with the exception of tomatoes grown in Yala season 1983 in System "H" (Kalawewa) (15), as presented below:

Cost of cultivation:
- including farmer family labor - US$1123/ha (26380 Rs/ha)
- excluding " " " - US$ 914/ha (21490 Rs/ha)

Net return per hectare when sold for US$ 103/ton (2.41 Rs/kg) and yields 14670 kg/ha

- including farmer family labor- US$ 382/ha (8975 Rs/ha)
- excluding " " " - US$ 646/ha (15185 Rs/ha)

2.1.2.9 Cotton (Gossypium spp.)

Only some modest production. Although scare information is available, the assistance of a specialized organization for this crop was recommended previously in 1975 and 1979 (1, 8). A mission (9) recommended a careful study of cotton growing for several years. Performs well in well-drained soils but has an excessive vegetative growth in imperfectly and poorly drained soils. (10)

2.1.2.10 Sugar Cane

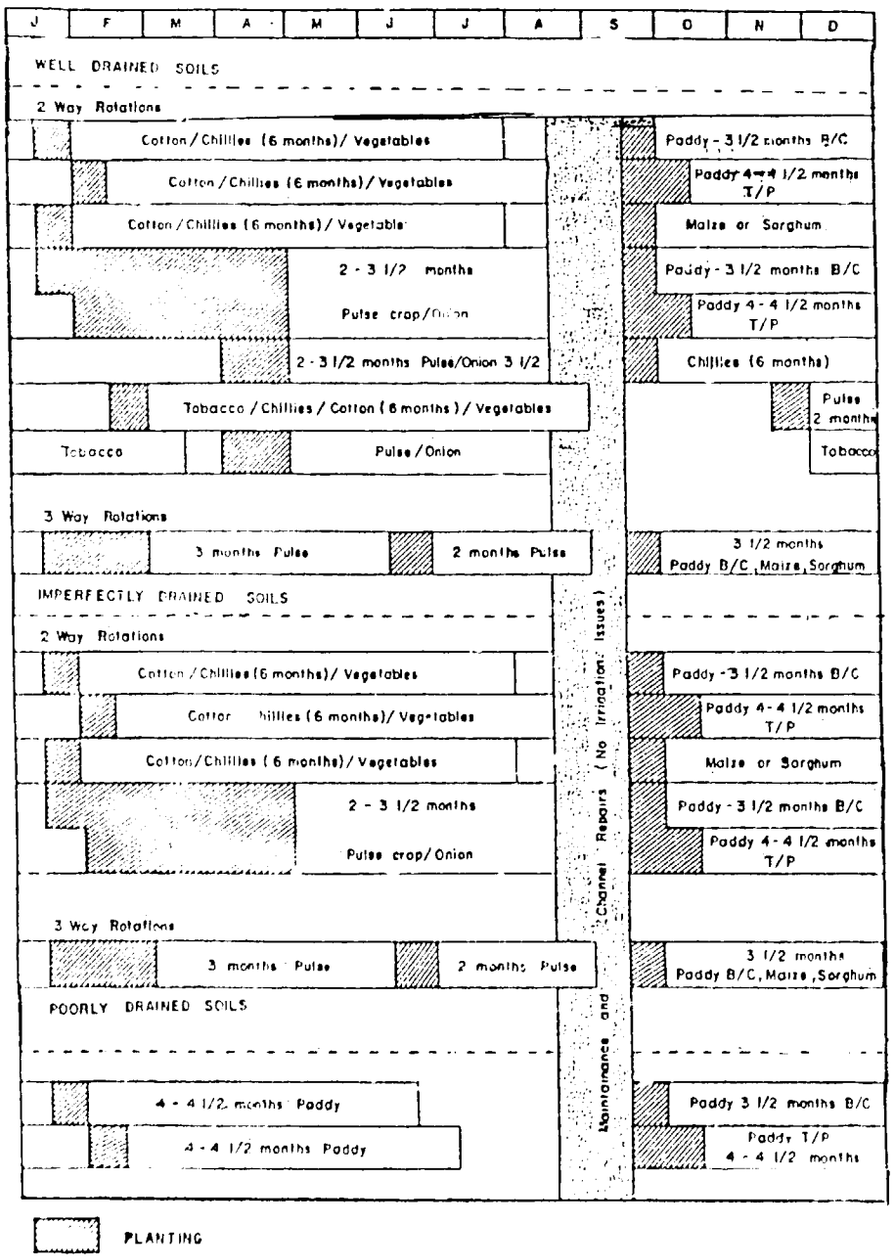
Production and processing of sugar cane on small family farms is not advisable for the time being. This crop, usually grown on large farms, is capital intensive and does not provide sufficient employment opportunities.

2.1.2.11 Crop Calendar and Cropping Patterns

The following figure presents a suggestion for a crop calendar and cropping patterns for different types of soils (10).

a. Well Drained Soils
b. Imperfectly Drained Soils
c. Poorly Drained Soils

These cropping patterns are for land under irrigation system and would require repairs and maintenance work as is the case in system "H". As can be observed the main, if not the only, crop suggested for poorly drained soils is paddy.



2.1.3 Quality Aspects

One of the most important and primary factors for evaluation of the possibilities to process agricultural produce is the quality of available raw material.

Various parameters of the agricultural material which finally determine the economic feasibility or non-feasibility of industrial processing are essential. Relying on such quality characteristics of the raw material it is possible to specify the size of the facilities required, the technical possibilities in general, and whether or not the agricultural produce is suitable for processing.

In all the studies and reports dealing with the Mahaweli region, we found no data whatsoever regarding these parameters. Although we repeatedly searched for information on this subject through the extension services and agricultural R & D station in System "H", no data was found. It is not surprising that information of this type has never been determined. In the absence to date of any plan or aim to test the possibilities of processing agricultural produce in industrial form and wider scope, this data was not required.

During our visit at the Food Technology Division of the Agricultural Dept. of Peradenia, Kandy, we found some data of this type concerning fruits, mainly fruit grown in the Kandy area (with different climatic conditions than in System "H"). In order to show the wide range of data, we present it in Table 1, but in no case should this data be used for feasibility evaluation.

TABLE NO. 1

QUALITY CHARACTERISTICS OF FRUITS AND OTHERS IN SRI LANKA (27)

Crop	Area of Cultivation	Acidity (% as citric)	pH	^{o}Bx	Moisture (%)	Pulp/Fruit Ratio
Banana	Mahaweli "H"	0.17-0.23	-	23-30	-	0.75-0.86/1
Passionfruit	Kandy - Mid-country and Wet zone	-	2.6-3.1	8-16	-	-
Jac fruit	"	-	-	27	-	0.40/1
Mango	"	0.17-0.43	-	9-24	77-88	0.66-0.81/1
Pawpaw (Papaya)	"	-	-	11-15	78-89	0.78-0.86/1
Tomato	"	0.50-0.81	3.8-4.7	3.2-7.1	-	-
Cowpea	"	-	-	-	10	(19.8-22.5% protein on DM basis)
Okra	"				85-88	(0.54-0.84 % fibre)

2.2 Actual Situation in System "H"

Whilst the earlier plans for agricultural activity in System "H" present production possibilities for many crops, however actually during the Maha season the farmers grow practically only paddy, and during the Yala season this crop is also dominant. This situation is due to various reasons. The following is a review of this situation, taking the prevailing causes into consideration:

2.2.1 Prevailing Conditions and Situation

The Mahaweli region has been resettled, mainly by a population with an agricultural background; some of these settlers come from the Mahaweli area itself.

At present, all areas suitable for agricultural cultivation have been divided between 23,000 families, in plots of 1 hectare per family, and the experimental agricultural research station at Maha Illuppallama. No other vacant land is available in System "H" for growing agricultural produce within the frame of a government or private farm.

This structure of small field plots worked by the farming families creates a situation in which it is necessary to collect the agricultural raw material in varying qualities from thousands of farmers.

The soils of System "H" can be broadly classified as L.H.G.S. (ill-drained), and R.B.E (well-drained). The crops are cultivated at least twice a year; in the Yala season of low rainfall, and in the Maha season of heavy rains. The L.H.G.S. land in Maha season are definitely intended for paddy growing, but in principal can be used for other crops growing during the Yala season. The R.B.E. land can be used during Maha and Yala seasons for various crops, other than paddy, but in practice other crops are grown only during Yala season.

The earlier concept of irrigated agriculture in the dry zone was the supply of water for the cultivation of paddy under puddled conditions. Irrigation of other field crops was not employed and only during the last 10-15 years irrigated agriculture including other crops became a more acceptable pattern of land use. Through this change of emphasis it became apparent that the farmers lacked the experience in managing other field crops under irrigation.

The basic approach of most farmers in the area is to give priority to growing agricultural produce for individual consumption, while the cultivation of crops for sale is secondary. In addition, from the variety of agricultural produce intended for sale, there is a definite preference to grow agricultural produce which is not perishable, and which may be stored. As a result, the variety of produce not intended for individual consumption is very limited, and includes paddy, chilli, and some types of pulses.

This situation is a result of the present methods of marketing the agricultural produce. There are no effective organized marketing procedures for the agricultural produce. The farmer, who begins to work his plot, has nc guarantee at all that his produce will be purchased, and at what price. Marketing is performed by middlemen who buy the produce whenever it is convenient to them. Under these circumstances, the farmers are at the mercy of the middlemen, and thus have to protect themselves. The farmers grow crops which can be stored for long periods, such as paddy and chilli (dried).

Such a marketing structure evolves fluctuations in the agricultural production. During one year there may be a lack of a certain crop,while in the following year many farmers begin to cultivate this crop. As a result there is a surplus, the price drops, and in the next year the farmer may not grow this crop at all.

Thus, there is no specialization for some farmers, or a certain area, for cultivation of a specific crop. This is the case today in system "H" (apart from paddy and chilli).

One of the possibilities to break out of this vicious circle is to guarantee the purchase of produce in quantities and prices.
This situation may be attained by local requirement for agricultural produce, by establishing plants for the processing of the produce, and by mutual dependence between the farmers and the plants.

2.2.2 Breakdown of Crop Cultivation and Production

Although the presentation of statistical data concerning areas being cultivated and the quantities of agricultural production produced appears to be relatively simple, actually the data presented hereafter constitutes a puzzle of data received from various sources.

During our visits to the Mahaweli Authorities in Colombo and in System "H" we concluded that these difficulties may be attributed to the subject of production in the absence of a central marketing system for the agricultural produce and principally the fact that a large portion of the agricultural produce is intended for individual consumption by the farmer's family.

The inconsistency of the figures presented hereafter is obvious, but it gives a general perspective of agricultural production in System "H" in the years 1980 to 1985.

2.2.2.1 Land Cultivation in System "H"

Table 2 presents the differentiation of land cultivated in System "H" during the years 1980 to 1985, according to seasons. It can be seen that over this period nearly all fertile land was cultivated during Maha season and more and more land was cultivated during Yala season (however many plots were not cultivated, probably due to lack of water). The differentiation in cultivation of crops and seasons clearly shows that paddy practically the only crop grown during the Maha season, and that during the Yala seasonpaddy is still the dominant crop. However the range of other crops is increasing. At any rate, from the point of view of scope of cultivation, other crops are marginal.

TABLE No. 2

CULTIVATED LAND IN SYSTEM "H"

(in % of total land*)

1 Year	2 Season	3 Paddy	4 Chilli	5 Other Crops	6 Total Cultivated Land
1980/81	Maha	54.5	3.5	-	57.5
1981	Yala	27.9	4.0	9.8	41.7
1981/82	Maha	69.6	1.7	-	71.3
1982	Yala	8.6	4.7	8.4	21.7
1982/83	Maha	80.0	1.6	-	81
1983	Yala	17.2	6.7	3.3	27.2
1983/84	Maha	80.3	3.3	-	83.6
1984	Yala	49.1	16.9	2.5	68.5
1984/85	Maha	97.3	-	-	97.3
1985**	Yala	18.2	21.1	1.7	41.0

* Based on total irrigated land of the project - 29,820 hectares (20)

** Figures presented are for cultivation program - estimation

2.2.2.2 Main Crops' (Paddy and Chilli) Cultivation and Production in System "H"

Tables 3 and 4 present areas under paddy cultivation and estimate paddy production data collected from various sources on site or from publications.

Tables 5 and 6 present the area under chilli cultivation and estimate chilli production.

The difficulties concerning data collected and its consistency are quite clear.

We have already stated a number of times that there is no correlation between the numerical data published by different sources. In many instances the numerical data are not related, in a clear manner, to a certain area; thus it is very difficult to summarize data from different sources. In some cases we have had to present these different data alongside each other.

It can clearly be seen that the scope of chilli production is increasing from year to year, and it is estimated that in 1985 the quantity will be close to 10,000 tons. These quantities may be increased and many areas are still vacant during the Yala for chilli cultivation. This season produces at least a 100% higher yield than during the Maha.

TABLE No. 3

PADDY CULTIVATION IN SYSTEM "H"

(in hectares)

1 Year	2 Season	3 H 1 +2+ 7 (24)	4 H 1 (25)	5 H 2 (25)	6 H 7 (25)	7 H 4 (24)	8 H 5 (24)	9 H 6 +8 (26)	10 H 9 (26)	11 Total Cultivation in H* area
1980/81	Maha	8176	3674	1918	2583	3716	1785	1120	1730	16526
1981	Yala	3748	2306	1494	1139	1637	540	316	891	8323
1981/82	Maha	8583	3867	1602	2988	6550	3210	363	2062	20642
1982	Yala	1834	1636	290	-	452	184	-	-	2562
1982/83	Maha	8580	3825	2043	2729	6912	4264	1442	2037	23252
1983	Yala	2940	1356	776	798	962	-	446	795	5133
1983/84	Maha	8946	3747	2021	2676	7276	4730	1446	2056	23952
1984	Yala	5752	-	-	-	5619	3272	-	-	14643 **
1984/85	Maha	11740	-	-	-	12188	5130	-	-	29000 **

- General Remark: Differences of data presented in the various information sources.

* Sum of columns 4,5,6,7,8,9 and 10.

** Sum of columns 3,7, and 8 (not including H 6, H 8 and H 9).

TABLE No. 4

PADDY ESTIMATED PRODUCTION FOR SYSTEM "H"

(in metric tons)

1	2	3	4	5	6	7	8	9
Year	Season	Yield (24) (ton/ha)	H 1 + 2 + 7 (24)	H 4 (24)	H 5 (24)	Total for H 1+2+4+5+7	Yield (13) (ton/ha)	Total Production in H Area (13)
1980/81	Maha	422	34130	15510	7750	57085	4.929	110125
1981	Yala	417	15640	6832	2250	24730	2.688	-
1981/82	Maha	414	35285	27345	13400	76030	3.696	93980
1982	Yala	415	7620	1888	768	10276	2.689	-
1982/83	Maha	469	40280	32455	20024	96760	5.265	142870
1983	Yala	313	9204	3013	-	12217	4.179	-
1983/84	Maha	548	49000	39860	25908	114770	-	-
1984	Yala	392	22520	22000	12812	57330	-	-
1984/85	Maha	425	49854	51500	22000	123350	-	-

- General Remark: No consistency when comparing yields presented in reference 24 (column 3), with yields presented in reference 13 (column 8).

TABLE No. 5

CHILLI CULTIVATION IN SYSTEM "H"

(in hectares)

1 Year	2 Season	3 H 1 + 2 + 7(24)	4 H 4 (24)	5 H 5 (24)	6 H 1+2+6+7+8(25)	7 Total for H 1+2+4+5+6+7+8
1980/81	Maha	71	292	151	-	513 *
1981	Yala	896	143	2	1038	1183
1981/82	Maha	70	173	266	-	509*
1982	Yala	735	335	10	1058	1403
1982/83	Maha	95	305	80	-	480 *
1983	Yala	817	1011	-	984	1995
1983/84	Maha	125	270	575	-	970 *
1984	Yala	2076	910	402	-	3388 *

* Excluding H-6.

TABLE NO. 6

CHILLI ESTIMATED PRODUCTION FOR SYSTEM "H"

(in metric tons)

Year	Season	Yield (24) (ton/ha)	H 1+2+7 (24)	H 4 (24)	H 5 (24)	Total for H 1+2+4+5+7	Yield (26) (ton/ha)	Total Production in H Area (26)
1980	Yala	-	-	-	-	-	1.08	516
1980/81	Maha	0.625	45	182	93	320	-	-
1981	Yala	1.250	1119	178	2.5	1300	1.45	1523
1981/82	Maha	0.625	43	108	166	317	-	-
1982	Yala	1.250	918	419	112	1449	1.54	2316
1982/83	Maha	0.604	59	181	50	290	-	543
1983	Yala	1.648	1225	1534	-	2759	1.54	3817
1983/84	Maha	0.605	75	163	348	586	-	567
1984	Yala	1.648	3421	1499	663	5583	1.54	7745
1984/85*	Maha	1.000	39	72	69	180	-	299
1985*	Yala	1.648	4260	2876	2560	9696	1.50	9460

* Figures presented are for cultivation program - estimation.

2.2.2.3 Cultivation of Other Crops

As already presented in Table 2, the areas cultivated for other crops (excluding paddy and chilli) comprise a small percentage of all the land , also only in the Yala season. Most of these crops belong to oilseeds or pulses.

Because of its vital importance, the subject of vegetables as a raw material for the canning industry will be discussed separately in the next sub-paragraph.

Table 7 presents specific data regarding the years 1980-1984, as cited in two sources.

TABLE NO. 7

OTHER CROP CULTIVATION IN SYSTEM "H"

YALA SEASON

(in hectares)

Year	1 Soybean		2 Sesame		3 Cowpea		4 Green Gram		5 Black Gram		6 Onions		7 Other Vegetables		8 Total for "H" Area	
	(24)	(26)	(24)	(26)	(24)	(26)	(24)	(26)	(24)	(26)	(24)	(26)	(24)	(26)	(24)	(26)
1980	-	40	-	-	-	382	-	76	-	-	-	31	-	82	-	625
1981	162	170	2234	-	374	380	72	71	-	-	20	29	53	134	2918	798
1982	447	457	888	-	1110	1112	41	48	6	-	15	20	-	66	2507	1803
1983	112	394	146	-	228	283	9	51	5	-	25	49	-	198	525	975
1984	32	58	298	-	251	168	62	83	19	-	13	38	85	206	760	616

* Includes also others such as maize, ground nuts, etc. grown on very small areas.

2.2.2.4 The Potential for Vegetable Production in System "H"

Vegetable cultivation is practically negligible in System "H". Table 8 specifies the total of different vegetables grown in System "H" for five years. Notwithstanding that vegetable cultivation in the area is considered unimportant, tests of the existing potential in System "H" for vegetable cultivation indicate its supreme importance since vegetables are the principal raw material for the canning industry. Vegetable cultivation may be an intensive crop and a main source of income, this in addition to supplying many work days to the farmer's family.

Very little information exists in system "H" concerning vegetable cultivation, yields,or any characteristics of various vegetables.

In order to obtain some information on this subject in System "H" we gathered data concerning other areas in Sri Lanka determined as dry zones and which are geographically close to System "H" and regarding vegetables mentioned here and there which can be cultivated or which have undergone cultivation experimentation in Sri Lanka. This data collected for nine vegetables grown in Sri Lanka during the years 1980-1982 is presented in Table 9.

Table 10 presents yields for vegetables grown in Anuradhapura in comparison with those obtained in other locations in Sri Lanka. These figures may be indicative for certain areas in System "H" bordering the Anuradhapura region.

TABLE No. 8

VEGETABLE CULTIVATION IN SYSTEM "H" (2+)

(in hectares)

1 Year	2 Season	3 H 1 + 2 + 7	4 H 4	5 H 5	6 Total for H 1+2+4+5+7
1980/81	Maha	33	20	63	116
1981	Yala	-	14	40	54
1981/82	Maha	46	-	68	114
1982	Yala	-	-	-	-
1982/83	Maha	59	27	21	107
1984	Yala	33	31	20	84
1984/85*	Maha	40	77	25	142
1985*	Yala	316	176	128	620

* Figures presented are for cultivation program - estimation

TABLE NO. 9

EXTENT AND PRODUCTION OF SOME VEGETABLES IN SRI LANKA (16)

Year	Season	T O M A T O			C A P S I C U M (Pepper)		
		Extent (in ha)	Production (in tons)	Yield (in tons/ha)	Extent (in ha)	Production (in tons)	Yield (in ton/ha)
1980	Maha	1850	11395	6.160	1040	6476	6.230
1980	Yala	948	7103	7.495	835	2596	3.110
1981	Maha	1115	13144	11.790	989	5908	5.975
1981	Yala	1164	11498	9.880	872	2532	2.905
1982	Maha	867	6346	7.320	951	2745	2.885
1982	Yala	570	5801	10.180	668	2320	3.475
		O K R A			E G G P L A N T		
1980	Maha	2003	10296	5.140	3292	44310	13.460
1980	Yala	1942	7157	3.685	1928	16728	8.675
1981	Maha	2174	26070	11.990	3298	32973	10.000
1981	Yala	1687	6715	3.980	1826	16745	9.170
1982	Maha	2053	7349	3.580	2816	24073	8.550
1982	Yala	1660	7444	4.485	1924	20915	10.870

TABLE No. 9 (Cont.)

EXTENT AND PRODUCTION OF SOME VEGETABLES IN SRI LANKA (16)

Year	Season	BEANS			CARROT		
		Extent (in ha)	Production (in tons)	Yield (in tons/ha)	Extent (in ha)	Production (in tons)	Yield (in ton/ha)
1980	Maha	1732	11219	6.48	413	5672	13.73
1980	Yala	3041	14584	4.80	275	3464	12.60
1981	Maha	2983	16391	5.50	776	7915	10.20
1981	Yala	3053	15221	4.99	326	3352	10.28
1982	Maha	2191	8321	3.80	668	7581	11.35
1982	Yala	1957	8246	4.21	210	3130	14.90
		RADISH			CABBAGE		
1980	Maha	875	7746	8.85	803	22156	27.60
1980	Yala	1448	7477	5.16	782	11585	14.81
1981	Maha	934	8687	9.30	992	24787	25.00
1981	Yala	1018	7954	7.81	795	10717	13.50
1982	Maha	1025	7656	7.47	724	12396	17.12
1982	Yala	1100	7554	6.87	581	10415	17.93

TABLE No. 9 (cont.)

EXTENT AND PRODUCTION OF SOME VEGETABLES IN SRI LANKA (16)

Year	Season	B E E T R O O T		
		Extent (in ha)	Production (in tons)	Yield (in tons/ha)
1980	Maha	456	7802	17.110
1980	Yala	544	7778	14.300
1981	Maha	551	2335	4.275
1981	Yala	477	4149	8.700
1982	Maha	339	3405	10.045
1982	Yala	957	3880	4.055

TABLE No. 10

YIELDS OF VEGETABLE PRODUCTION IN ANURADHAPURA REGION IN COMPARISON WITH AVERAGE YIELDS(*) FOR SRI LANKA (16)

(in metric ton/ hectares)

Crop	Anuradhapura	Other Locations in Sri Lanka
Cabbage (Standard)	17.08	27.39 (4 locations)
Cabbage (Hybrid)	28.22	48.35 (4 ")
Cauliflower	13.31	19.60 (4 ")
Beetroot (red)	21.18**	20.97 (4 ")
Cucumber	30.48	38.20 (2 ")
Onion (large)	11.33	7.34 (3 ")
Tomato	8.68	21.32 (3 ")
Capsicum	11.70	10.96 (3 ")
Carrot	8.33	25.66 (4 ")
Beans	7.65	21.61 (3 ")

(*) Yields average of 4 seasons

(**) Average in Sri Lanka: (16) 15.4 ton/ha (1980); 6.3 ton/ha (1981) and 5.6 ton/ha (1982).

CHAPTER 3

PROCESSING OF AGRICULTURAL CROPS

3. Processing of Agricultural Crops

The necessity to process agricultural produce arises usually after agricultural production has reached certain levels. In a pre-planned system the subject of processing is dealt with at an early stage and is used as a target for agricultural production.

It seems that in System "H" there was a strong desire to quickly resettle on the land as many settlers as possible who would begin to cultivate for their subsistance. Subsequently, it is not surprising that the farmers chose to grow as much paddy as possible, as this is their basic food. The need to establish agro-industries arose at a later stage, but not as part of the activity planned in advance.

3.1 Review of Studies for System "H"

Many studies were prepared for resettlement of the system of the Mahaweli area. All the studies discuss at length various data concerning the area as well as its agricultural potential. The subject of agro-industrialization of the area was not dealt with at all. It is really amazing that master plans were prepared for Mahaweli's systems which related to roads, towns, water sources, health, education, agriculture and training services, but in the maps drawn up no areas, which were defined in advance as industrial areas, were allotted. This situation applies to the new systems in the Mahaweli area and certainly applies to System "H" which is the first area to be resettled.

If studies were performed, then they were prepared regarding various agro-industrial subjects and the necessity of applying them in Sri Lanka in general or, at best, for the region of Mahaweli in general. Some of the subjects discussed and recommended could however be suitable for System "H" although they are not specific to this area. Two of these subjects are presented hereafter:

a. Under a program of UNDP/FAO assistance, a series of studies were carried out which related to Sri Lanka in general, in order to develop a viable and well balanced soybean industry. This program was carried out in three phases. Phase I covered the agronomic as well as the utilization and marketing aspects. Phase II (32) covered the development of processing techniques, product development and feasibility of production of full fat soy flour (34) and soymilk powder (35). In phase III (33) the instalation of a pilot plant was carried out, enabling the development of technologies and the production of some products such as full fat soy flour, liquid soymilk, dried soymilk (36), etc., all based on locally grown soybean.

b. The subject of the Feed Industry was examined regarding Sri Lanka in general (38). With this background it is possible to present the recommendation (40) as submitted regarding System "H", for the exploitation of rice straw to feed animals by pre-treatment with urea. This procedure raises the straw digestability and, at the same time, enriches the end-product with urea.

In summary, it may be clearly stated that the report submitted herewith contains a precedent on the subject of agro-industries in System "H" or Mahaweli in general. The feeling that we are discussing a subject not previously dealt with is reinforced by the fact that within the various existing frameworks of the Mahaweli Authority there is not one department which specifically deals with industry.

3.2 Existing Agro-industrial Plants

Despite that the Terms of Reference of this study refer to the existing situation and possible plans for agro-industrialization in System "H" only, in order to present the correct analytical perspective, we note the necessity to do this while observing the background situation in Sri Lanka in general. Although we encountered difficulties obtaining information considered confidential, an effort was made to meet with authorities other than those belonging to the Mahaweli Authority. We also met with local people involved in agro-industry and, where permission was given, visited some food plants in the Colombo area.

3.2.1 General Introduction for Sri Lanka

The current situation which typifies the agro-industry in Sri Lanka is the scarce supply of agricultural raw material (fruit, vegetables). As a result the processing capacity of facilities and production lines are only partially exploited. The raw material is produced by individual farmers working small plots, and has to be collected in small quantities from long distances, and transported to the Colombo area. As a consequence the raw material is of inferior quality, not uniform, and the supply is sporadic. Considering that the purchase of raw material and its transport to plants in the Colombo area requires

the involvement of middlemen and expensive transportation, on the one hand the price paid to the farmer for his agricultural produce is very low, while on the other hand the industrialist pays a high price. The consequences of this situation are unavoidable and they do occur today - it is not worthwhile for the farmer to cultivate and collect his produce, whilst the industrialist cannot pay the high prices and works only at limited capacity.

The following is an actual example of the above situation, as explained by an industrialist whom we met:

Fruit juice processing plants are willing to pay Rs.6-7 per kg. passionfruit. Considering that the yield for this fruit in Sri Lanka is 8-10 tons per acre, an income of Rs.50,000-70,000 per acre would be expected, an extremely high income compared with the average for almost all crops in Sri Lanka.

However, in reality, the situation is entirely different: the price received by the farmer for the fruit is about one-quarter of the final price, while the remainder is divided between the middlemen. Thus today, even when the industrialist applies directly to the farmer and is willing to pay all or most of the price, the farmer has meanwhile lost confidence in this crop and is no longer willing to grow other fruits or vegetables intended only for industry. The System "H" region, which was once a source of passionfruit, no longer produces this fruit at all!

Hereafter we will consider the situation of a few agro-industries in Sri Lanka (recommended in Chapter 5) as suitable for System "H". These are intended to be based upon agricultural raw material which will be cultivated in the area.

a. A few fruit processing plants exist in Sri Lanka, mostly located in the Colombo area. We visited some of these plants and talked with the people in charge. These plants are typically multi-disciplinary, process various types of fruit, and generally produce a variety of products. These plants are not sophisticated and are based on manual labour. Because of the small quantities of fruit processed, and the small quantity of the specific final product, the product is not sophisticated at all. (For example, juice is produced but they do not continue and process it to a concentrate.)

For instance, one of the plants, Lanka Fruit Canneries Ltd., processes pineapple and produces pineapple rinds, pineapple pieces in syrup, jams, juice (straight) of 13-15^{o} Bx. Here again, not enough pineapple is available for industry and prices increased well above any estimation (

Other raw materials are: Passionfruit, which is processed to sweetened and unsweetened juices,
markets. Passionfruit syrup is produced for the local market. Mango is processed to pieces of fruit in syrup, jam and mango syrup.

b. The basic food basket of a Sri Lankan resident includes a wide variety of spices. Spices cultivated in Sri Lanka or imported (mainly from India), are sold either dried in their natural form or ground. Spice grinding is carried out at spice mills, which are small size family enterprises, where the spices are ground, weighed and packed.

Most of the spices are sold unmixed, and each family prepares its own mixtures. Alongside the grinding and sale of spices, these family enterprises also process and sell various types of medicinal plants.

We visited one of the spice mills near Colombo - the variety of spices is very wide but there is no quality control of the raw material compounds which are ground, nor of the quality of the ground material. The level of profits in this branch, such as chilli, are hundreds of percent.

We were informed that near Colombo there exists a facility for production of essential oil from spice plants. This is a steam distillation unit operated by a subsidiary of CTC (Ceylon Tobacco Co.).

c. The dairy industry is not sufficiently developed in Sri Lanka, however it is planned to expand this branch in the coming years. This aim has been reinforced by the local authorities and by international groups. The World Bank has presented a broad plan(39) to develop the dairy industry, including expansion of a number of existing dairies and the establishment of new dairies. The World Bank publication on this subject describes in detail the situation of the existing plants, and plans for their development. We wish to mention that certain agricultural areas such as the coconut triangle have organized the collection and processing of milk. This could well be taken as an example of what we recommend to apply in System "H".

According to information received from the Agricultural Development Authority of Sri Lanka (Ministry of Agriculture), a factory near Colombo produces basic food composed of 32% soybean + 33% wheat + 32% corn. This plant, of 2500 ton/year capacity, produces for the Ministry of Health of Sri Lanka.

3.2.2 Plants/Projects in System "H"

Little agricultural raw material is cultivated and processed in System "H". In fact, today there are only two modern plants in the area, and also some other activities which are listed as follows:

a. As mentioned, the main agricultural cultivation in System "H" is paddy,which is actually entirely processed in the area. The common method for paddy processing in Sri Lanka is by parboiling, i.e. the paddy undergoes partial boiling, fermentation, and drying, all this before being transferred for milling, and afterwards for polishing. There are about 18 private medium rice mills in System "H", each with an average milling capacity of 1 ton/hour, and about another 90 small rice mills. The work is carried out by very simple procedures, mainly manually. In addition, in System "H" there is a modern rice mill with near-maximum mechanization producing 35 tons/day. In principle its process method is similar to that of the medium stations except that the fermentation stage is replaced by a steam process (instead of boiling). This plant is located at Bulnewa and belongs to the Mahaweli Authorities.

The rice is marketed to the Colombo area in large sacks and only a small quantity is packed in polyethelene bags for retail trade.

b. In Maha Illuppallama a plant has been erected for the processing of soybean seeds to soybean milk powder, with a potential production capacity of 3 tons of raw soybean per 12 hour shift, and operates on a process based on drum drying and includes soybean seeds cleaning, magnetic separation, dehulling, wet cooking, crushing, grinding and packing in 125 and 250 gr. packs. This plant, called the Rajarata Food Grain Processing Co. Ltd., sells its products to the retail market. The product is used as a coconut milk substitute. During the last year (1984), the coconut price decreased and the soybean milk powder became relatively expensive. Therefore difficulties in selling the entire production were encountered. As a result the plant operates at only half of its capacity.

c. At Dambewatane, there is a simple plant for grinding dry chilli. This plant, which belongs to Ceylon Tobacco Company (CTC), purchases dried chilli from the farmers of the area, stores the raw material all year round, grinds and packs it in bags of 250 gr. Grinding is performed by a line including one chopper and three grinders. Two kinds of products are sold - chilli powder, and pieces of chilli. The chilli, which is sun-dried by the farmers, does not undergo any other drying procedure within the plant. The raw material is stored in jute bags and then ground in quantities as required by the market. There is no standardization in the product during the year, and the longer the chilli is stores, the colour of the product becomes darker.
The plant has been in operation since September 1984 and is well maintained. Considering the significant expansion in System "H" of the chilli cultivation branch, and also the rapid control of the production and organizational capabilities of CTC, the company may be interested in expanding production to other products and markets.

d. Initial milk processing activity exists within the frame of the Niraviya Livestock Farm. In September 1984 in System "H" there were 22,300 head of cattle and buffalo belonging to about 3,000 settlers. Feed grass area in System "H" is not available, but it is envisaged that two cows per settler's farm will be raised. At present, at least 3,000 litres of milk can be collected from the existing local cattle. Milk collection started only recently but only 200-300 litres are collected from five collection points along 15 miles on the main road of H-3. Milk is not chilled before collection, and is later cold stored at the dairy farm. Milk is processed by very primitive means to three main products: yoghurt, buffalo milk curd, and ghee, which are all sold in the region.

Cream is separated from collected cow milk (4% fat) and is used as ghee, and skim milk (2% fat) is processed to plain or sweetened yoghurt. Skim milk is boiled in a double-jacket kettle, heated directly by wood fire. If better equipment would be available, dairy products from 1000-2000 litres of milk could be sold immediately. However, at present this cannot be achieved.

During many conversations with local information sources we were informed of a number of futile experiments to establish agro-industrial projects. However we did not receive figures or written information regarding this subject and thus cannot offer details concerning where and why these projects failed. The following two cases were mentioned:

With the entry of a large Swiss purchaser of passionfruit, an impetus was given to its cultivation. Individual growers and even a cooperative center was set up. Unfortunately this project failed and the plant was not erected.

Another project mentioned was the growing of cucumbers for pickling. Pickled vegetables in semi-finished or fully packed products have a high potential for export. It seems that failure was due to the raw material being uncompetitive to products' quality requirements.

Chapter 4

A Diagnosis of Agricultural Production and Agro-Industrial Processing

4. A Diagnosis of Agricultural Production and Agro-Industrial Processing

This chapter analyses the findings regarding agricultural production in System "H" and the possibilities of changes in this area. With regard to agro-industrial production, we principally discuss the future and the potential.

4.1 Analysis of Agricultural Production in System "H":

The following points summarize this situation:

- The entire area is already resettled from the agricultural point of view and no agricultural land is vacant to establish a large agricultural frame.
- At present paddy is the dominant crop in the area, nearly the only crop during the Maha season, and about 50% during the Yala period.
- Chilli is the second crop.
- Only a few farmers cultivate crops other than paddy or chilli during the Yala season. Sometimes, when conditions are not suitable for paddy cultivation in the Yala season, the fields are not worked at all.
- In System "H" fruit is grown only in backyards for individual consumption. In future, fruit growing will be restricted to the free area of one-half an acre, on which the farmer's house stands.
- Difficult problems of marketing the agricultural produce exist since there are no guarantees for marketing or adequate prices for the produce.

- Only part of the paddy crop is sold to the Mahaweli Authority. The remainder of the crop is sold to private dealers or to local rice mills.

- Part of the chilli yield is sold to CTC. The rest is bought by middlemen who transfer the produce to the Colombo area.

- All the rest of the agricultural produce is purchased by middlemen.

- As a result of the uncertain situation in which the farmer exists, and the control which the middlemen exercise, a situation has occurred where some farmers work their lands as hired labourers for all purposes, and their produce is wholly owned by the middlemen. This should serve as a warning that the marketing system needs reorganization.

4.2 Recommendations Concerning Agricultural Production:

- Efforts should be made for diversification of agricultural cultivation of crops other than paddy, especially during Yala, and partially on high lands during Maha.

- In order to ensure a demand for the farmer's produce and also that he will receive a fair price for it, a minimum guaranteed price for the agricultural produce, profitable to the farmer, has to be assured.

- The establishment of supply contracts between the farmer and the plants which purchase and process the produce. In order to supply additional reinforcement to this cooperation, we recommend that the plants should provide seeds, fertilizers and agricultural training as a loan which will eventually become a grant if the farmer finally markets his produce to the plant.

- The transfer to additional crops must, from the very beginning, receive public assistance in order to guide the farmer what is worthwhile cultivating, and also to encourage various entrepreneurs by guaranteeing a frame of agricultural development which can advise farmers what should be grown, what are the required qualities of agricultural produce, current agricultural training services, etc.

4.3 Analysis of Agro-Industrial Processing in System "H"

- Most of the paddy yield is processed at rice mills located within the boundaries of System "H". This agro-industrial activity provides work for a considerable number of settlers in the area.
- The existing soy processing plant in the area actually operated this year at partial capacity because of difficulties in marketing the end-product. Efforts should be made to expand the produce by finding other uses for soybean milk powder, or by producing other products which are not produced today.
- The CTC chilli processing plant operates well and its products are marketed countrywide. The plant aims to expand the variety of its products and also to improve the quality of the present products.
- Milk collection and processing is only in its first steps of organization. It seems to us that the Niraviya Dairy Farm is the natural place for development of this branch. In order to provide momentum to this branch, public assistance is urgently required for the purchase and installation of a small scale production unit in order to encourage the farmers to raise cattle and milk production, and for the potential entrepreneur to establish a dairy.

- Apart from the abovementioned subjects, we did not find other industrial activity.

4.4 Recommendations for Agro-Industrial Processing

Agro-industrial activity in this area today is not sufficient and does not provide an appropriate impact for the desired activity.

- The present agricultural production situation in System "H" cannot justify immediate involvement of private groups, except for the subject of chilli processing. In order to encourage the involvement of private groups, steps must be taken by public institutions to assure organizational support and appropriate financial backing.
- Introduction of other agro-industries to the area will result in:
  a. Higher income to the farmer per unit of land.
  b. Creating additional work opportunities, especially for the second generation.
  c. Creating an outlet for the agricultural products.
  d. A more balanced food supply during the entire year for the settlers of the area.
- Expansion of the agro-industries on a national level will eliminate imports, enable export possibilities, and activate existing unutilized production resources.
- Chapter 5 presents general recommendations as to the nature of the plan as well as the specific subjects recommended for development of the area.

Chapter 5

The Basic Plan for Agro-Industry Development in System "H"

5. The Basic Plan for Agro-Industry Development in System "H"

This section sets forth the basic plan for agro-industrial development in System "H" based on findings in the region, and in Sri Lanka in general.

5.1 The Nature of the Plan

The basic plan for development of agro-industries in System "H" is based on recommendations regarding the present socio-economic, agricultural and industrial development of the region. This development should rely on the following objectives:

a. Diversification of agricultural crops to be grown in the region, especially in the Yala season.

b. To ensure that maximum processing operations will take place in System "H" itself, thereby avoiding a situation in which its designation will be limited only to agricultural raw material supply.

c. Agro-industrialization in System "H" should be effected in phases and adapted especially for each project to the point that conditions justify the implementation of the project in full scale capacity.

d. In the intermediate phase, semi-processed agricultural raw material could be produced in System "H" and supplied to existing plants in the Colombo area. At a later stage all the processing activities would be transferred to System "H". The intermediate period (until processing activities take place) can be used for data collecting, skilled manpower training, imparting to farmers the advantages of growing new agricultural crops and helping them to meet quality standards of produce and a specific supply schedule to the plants.

The nature of the plan for System "H" recommended in this report is based on establishing a series of projects/plants which will be partially connected to each other. In many instances one plant will supply part of a raw material or ingredient to another plant. Obviously, it is not feasible to attempt simultaneous development of all projects. Therefore, in certain cases, until a local plant can produce the required ingredients then the raw material and ingredients should be supplied from sources outside System "H" during the initial period.

5.2 Crops for Agro-industrialization

The program suggested for implementation is based on processing the agricultural produce already being grown today in commercial quantities, whether large or small, and on a regular basis (over and above the individual consumption of the farmer). We have also taken into account potential agricultural crops whose growth have been tested, or those grown in small quantities for general individual consumption.

However, the economic feasibility of cultivating the following agricultural crops should be verified, whether they are intended for direct consumption or as raw material for processing.

A tentative list of crops and their possible processing to products is presented below:

5.2.1 Existing Crops

a. Chilli

Ever increasing quantities are being grown for drying. We recommend chilli should be grown for production of dried chilli powder and pieces, sauces, chutneys and oleoresins.

b. Soybean

Quantities which enable the existing plant to operate are being grown at present. We recommend expanding the present production for use as flavoured soybean milk powder,and for a new product, full-fat soybean flour, to be used for fortification of rice and wheat flours.

c. Milk

About 300 liters per day are collected; however, this could be increased to 3,000 liters. Future development programs estimate that 60,000 liters per day could be produced. Manufacture of different flavoured yoghurts, ghee, curd, icecream, butter and chocolate milk is recommended.

d. Agricultural By-Products

Rice Bran - Can be obtained in medium quantities from rice mills.

Rice Straw - Can be obtained in medium quantities from the farmers.

Soy Hulls - Can be obtained today from the existing soya processing plant.

All these products are potential raw material for the feed mill.

5.2.2 Potential Crops

a. Fruits

Limited quantities of fruit reach the market at present. However, it is feasible to collect ever increasing quantities of papaya, passion fruit, mango, banana, jacfruit, pineapple, for the production of pulp (as a semi-processed raw material) for jams, dried fruits, juices and fruit powders.

b. Vegetables

Small quantities are grown by a few farmers in the area. The cultivation of the following vegetables for industrial purposes should be taken into account:

- Okra - to be semi-processed and preserved in brine, sun-dried, or canned in tomato juice.
- Red onion - to be used as raw material for various sauces.
- Baby onions - for pickling.
- Baby corn - to be semi-processed and preserved in brine, pickled and packed as such or with other pickled vegetables.
- Sweet corn - to be canned as kernels, or on the cob.
- Ghurkins - to be pickled.
- Tomatoes - to be processed into juice or comminuted, used as raw materials for sauces or canned products. Small green tomatoes can be pickled.
- Eggplant - Pieces or small eggplant to be semi-processed and preserved in brine or pickled.

c. Peanuts

Only small quantities are grown. If production increases, peanuts could be processed to: shelled peanuts, roasted and salted peanuts, peanut bars, sugar-coated peanuts, peanut butter, ingredients for sweets.

d. Sesame

Small quantities are grown; if grown in larger quantities the white variety should be used for the production of tehina, sesame bars, halva, and as an ingredient for sweets.

e. Spices

Only small, domestic quantities are grown in backyards at present. This produce is intended mainly for drying and grinding. When this branch develops and enough quantities of suitable varieties are cultivated, manufacture of essential oils and oleoresins could be considered.

f. By-Products

Sesame and peanut hulls: By-products obtained from processing to be used as an ingredient in feed preparations.

Vegetables and fruits: By-products obtained from processing agricultural produce, such as peels, seeds, kernels, corn cobs to be silaged for animal feed.

Oilseed meals: Can be produced in the far future if oil extraction of oil seeds (soybean,peanut, sesame) will take place in the region and will be used as the main raw material of a feed mill.

5.3 Proposed Agro-Industrial Projects

We consider that the recommended projects for System "H" will be potentially feasible if a framework is established which will enable controlled implementation, as well as encouragement and support of this development by governmental authorities. These projects can be divided into two distinct categories.

a. Existing projects requiring expansion of production and of the variety of products.

b. Potential projects whose establishment require a good deal of preparatory work, collection of data, and public and governmental support.

It is recommended that these projects be developed in stages, and that progress from stage to stage be accompanied by a revision of the situation and its prospects.

The following is a list of suggested projects, defined in general, and include a general approach as to how they should be developed, the basic facilities required therefor, and a program and schedule for their implementation.

5.3.1 Expansion of Existing Projects

5.3.1.1 Chilli Processing Plant

A. Forward

As presented in Chapter 2, Chilli is one of the most successful crops already bringing high profits to the farmers in system "H". Chilli is mainly grown for marketing in raw (green) or "sun dried" form. As already mentioned, the Ceylon Tobacco Company (CTC) has erected a small chilli grinding facility (mill) which grinds, packs and markets dried chilli powder and pieces. The existing chilli mill is of a limited capacity only and the end-products are of poor quality, and probably not suitable for export. Considering the high retail price of the chilli powder, sold for about 95 Rs/kg. in cottage mills in Colombo, compared to the 21 Rs/kg. paid to the farmers, there is a first priority to encourage the development of new projects using dried chilli and to erect new plants in system "H".

B. Approach for Project Development

We suggest that the approach for exploiting this raw material (chilli) for agro-industrialization be integrate in character and should include the following stages:

a. Continuing the present course of processing dried products, gradually increasing the capacity and variety of products, while improving the quality.

b. Processing chilli to sauces and products which are not yet produced in System "H", and probably have a high potential for Sri Lanka.

c. Entering the subject of chilli sauce production will later lead to the next stage of sauce preparation of other types, based on agricultural produce of the area.

This integration will be achieved by the use of products and intermediate fractions obtained in chilli grinding plants as ingredients for chilli sauces. In addition, sauce plants could utilize semi-processed products obtained from the CC system (see para. 5.3.2.1) such as tomatoes, eggplant, pepper and some spices (probably grown on a very limited scale) in the area.

In view of the above we propose and envisage the following:

a. Expansion of the existing CTC plant capacity.

b. The expansion of the CTC plant with a unit for preparation of liquid bottled sauces for sale in the neighborhood; Anuradhapura and other towns including Colombo.

c. To attract other private enterprises for more small regional plants for chilli powder and sauces manufacture.

d. The CCC (see para. 5.3.2.1) itself could also elaborate bases of sauces in a semi-processed form, packed in large containers, utilizing vegetable ingredients for such sauces, e.g. tomato juice. These sauce bases (preserved also by preservatives such as benzoates or sorbates) can be delivered to the sauce plants (CTC and others) as a raw material for the final formulation and bottling.

e. The sauce plants will probably provide a nuclei for further development of fruit and vegetable products, such as plants for liquiform and other preserves, which would absorb the local production.

C. Basic Facilities Required

The equipment and facilities required for the implementation of a chilli powder mill are similar to those existing in the CTC plant in System "H". These may be improved by adding better storage facilities as well as packing and quality control systems. CTC do not analyse the dry matter content of the raw dried chilli or its powder. The relatively high moisture content could be the main reason for discoloration of their end products, as observed during our visit to the plant. In order to initially expand the existing CTC plant to chilli sauce production, the following basic facilities are needed:

- A hygienic room suitable for preserved food processing.
- Small pulper-finisher for disintegration and fiber removal of the chilli and other fruits and vegetables.
- Suitable kettles for formulation and mixing of ingredients (stainless steel).
- A small pasteurizer (tubular or plates heat exchanger) system of stainless steel.
- A "hot filling" tank of a limited capacity - 50 to 100 liters - with suitable stainless steel table for filling, caps, etc.
- A semi-automatic bottle and jar sealing device.
- Packing material - bottles, jars, caps, cartons, etc.
- Suitable storage space for storing empty packages and the ready products (bottled sauces) at ambient temperature.

D. Program and Schedule of Implementation

Since private and profitable industrial activity already exists in the region, further initiative for development should be in the hands of private entrepreneurs with little government intervention. However, a number of stages and order of preferences for implementation of chilli processing are recommended and should be taken into account, as following:

a. Chilli Powder

1. Technical assistance to CTC plant, by the governmental institutes, in quality control and analysis of raw material and end products.
2. The introduction of forced drying facilities to ensure an adequate level of moisture of the dried chilli for grinding.
   This is recommended for the existing CTC plant and for any new plant to be erected.
3. Expansion of production capacity accompanied by the introduction of cleaning, grading and sifting equipment which will enable the production of high quality products as well as the separation of fractions to be used as ingredients in the sauce production.
4. Expansion of milling activities to other spices already available (or to be grown) in System "H".

b. Sauces

We envisage three stages involved in the development of this line of products.

1. The erection of chilli sauces production lines.
2. The expansion of these sauces' production lines to the manufacture of sauces other than chillies.

3. After gaining experience in sauce manufacture for the local market, high quality raw material supply will enable the expansion of sauce production for the export markets.

Stages 1 and 2 can be implemented by private entrepreneurs without public investment. Technical assistance by local institutes is advisable. In order to encourage the companies to export their products (Stage 3), financial and technical government involvement is required for the preparation of a market study. This study, prepared by a team of experts, will examine the specific market demand in the target countries including marketing organization, quality standards, packing, labelling requirements, etc.

5.3.1.2 Soybean Processing Plant

A. Forward

World prices for soybean are low, therefore the prices which may be obtained for soybean grown in System "H" are not high enough to make soybean an attractive crop (see para. 2.1.2.4). Thus it is recommended that soybean should be grown only in areas where no other alternative exists for growing crops during Yala, such as chilli or vegetables, which are more attractive from the economic point of view.

In 1982 soybean was grown on approximately 450 hectares in System "H"; but in 1984 only 10% of this land was allocated for soybean growing. The reasons given for the reduction in the scope of soybean growing are contradictory. The farmers claim that the prices paid are not high enough, and the lack of demand for soybean led to a decrease of its cultivation.

On the other hand, the existing soybean processing plant in the area claims that the supply of soybean is irregular, despite the fact that they continue to pay current world prices. It would seem the truth lies in the fact that the present product (soybean milk powder) is used as a substitute for coconut milk in certain curry preparations; when coconut prices are high there is a demand for soybean milk powder which is cheaper - whilst the reverse also applies; when the price of coconut is low, then there is no demand for the soybean milk powder.

Considering that the potential to grow soybean in System "H" exists and that the processed products are an important factor in the daily nutritional requirements of the population, it is recommended that soybean be grown and processed into various products.

The soya processing plant possesses the capacity for diversification of its present products, to additional products which will permit a wider range of applications, thereby improving the local diet.

B. Approach for Project Development

In view of the low economic attraction of growing soybean in system "H" compared to growing other crops, the processing of soybean rests mainly on the concept of the necessity to improve the nutrition of the major part of the nation.

On the other hand, the existing plant for soybean milk powder production should be the nucleus for any other soybean processing project.

We estimate that the total processing activities in the field of soybean processing in system "H" will not exceed the limit of 2000 tons/year of raw material (if soybean supply is limited exclusively to system "H").

The immediate step which could lead to an increase in the sale of soybean milk powder and a rise of its basic price, is the development of products based on this basic material.

Products such as flavoured soybean milk powders can be developed. These are ready mixed powders in various flavours such as chocolate or fruits, with the addition of sugar. Ingredients for these products can be purchased from sources outside the area of system "H", and at a later stage fruit powders can be supplied by fruit processing industries which may be established in the area.

It is recommended that an extensive marketing study be prepared as soon as possible in order to assess acceptance of new products by consumers and the economic feasibility for the potential commercial production of full fat soybean flour (FFSF).

FFSF is used for fortifying foods by blending it with wheat or rice flour, such as for fortified noodles, bread, biscuits. FFSF can also be used in home cooking and added to patties, curry, weaning food, etc.

However, production of extruded products such as meat extenders should not be considered. These products are based on soybean defatted flour, a material which cannot be produced in System "H" since it involves previous extraction of oil. It is not feasible to grow sufficient quantities of oilseeds to justify an oil extraction plant within the given limitations of small, individual plots in System "H".

C. Basic Technology and Equipment Required

The process for full fat soy flour production involves the operation of two main sections - raw material handling, and processing.
Raw material handling consists of the following unit operations: receiving, debagging, scalping, bagging and bags storage. Processing consists of the following steps: cleaning/destoning, heat treatment, grinding, bagging, flour storage.

Assuming that the existing soybean milk powder plant will be expanded to produce full fat soy flour, then only the following new units are required to be installed: heat treatment, grinding. In principle, all other units can be used if their capacities are sufficient for the production of both end products at the same time. Considering the actual situation that the soy milk powder plant operates only on a partial basis, the immediate major investment will be a heat treatment unit and a grinding unit (the existing grinder should be checked to determine whether it can be used).

D. Program and Schedule of Implementation

Since the existing plant for soybean milk powder possesses all facilities for this end product production and is not operating at full capacity, the following schedule of implementation is recommended:

a. Flavoured Soybean Milk Powder

1. Development of chocolate flavoured soybean milk powder sweetened or unsweetened, ready to use as instant milk drink, including the instalment of a small mixer for the preparation of this product.
2. Development of fruit flavoured soybean milk powder based on low acid fruits.
3. Distribution of the said products in small packages (100 to 250 gm.) for home preparation and in 5 to 10 kg. packages for institutional feeding, or in 50 kg. bags for the soft drink factories or dairy plants which will reconstitute the powder and sterilize or pasteurize the liquid flavoured soybean milk and market it ready to drink.

b. Full Fat Soybean Flour (FFSF)

1. Preparation of an extensive marketing study, checking the acceptance of new products by potential consumers.
2. Receiving the help of the government to introduce the FFSF in subsidized products and services (school lunch, army, hospitals, universities, etc.)
3. Know-how transfer for the production (in para. C we mentioned dry heating technology which is not the sole alternative).
4. Investment in complementary processing equipment, industrial utilities and storage facilities, mainly for end products.

Soybean milk powder is produced by Rajarata Food Grain Processing Co. Ltd. The initiative for further development of soybean processing should be in the hands of this same company or in some type of joint venture with them. Government involvement is envisaged only regarding the introduction of the end products of soybean origin into the national diet. The government should sponsor school lunch programs, or alternatively oblige by law the fortification of bread with 5 to 10 percent of soybean flour.

5.3.1.3 Dairy Products Plant

A. Forward

Priority was given to milk production in System "H" only in 1983. Today there are about 22,000 head of cattle in the area, 12,000 of which are buffalo. At present 3,000 liters per day of milk could be collected (after deducting individual consumption). Within the next 6 to 8 years, it is envisaged that every family in the area will own one or two cows, which will supply a total of about 60,000 liters of milk per day.

At the Niraviya Farm there exists preliminary activity of milk collection and its processing. 200-300 liters per day are now being collected, of the possible 1,000 liters per day which could be collected in the H-3 area. Yoghurt, fermented milk, gee and curd from buffalo milk are produced. The means of production are primitive and very small.

Considering the price of Rs.3.2 actually paid to farmers per liter of milk, and the high profitability in Sri Lanka for dairy products (100% for yoghurt, 75% for fermented milk and 300% for icecream), the establishment of a milk processing plant in the region seems highly feasible.

B. Approach for Project Development

Development of the dairy industry in System "H" is a function of the intensity of livestock development. However, in the absence of cold storage facilities, manufacture of end products is limited to snacks or to fermented products (possessing a self-preservation capacity), to be consumed in a day or two.

In any case all milk produced in the System "H" area should be entirely processed at the local processing facilities and end products delivered for the consumption of local residents, providing a high nutritive food source which is not available to them today.

The development of a dairy industry in the region should be carried out in a long-term program and which we recommend should comprise of the following steps:

a. The establishment of a collection system of raw milk from the farmers. The collection system will cover more and more farmers according to milk production and processing facilities.

b. Installation of a pasteurizing system (plate heat exchanger type) and cool storage system.

c. Production of unfermented milk products (flavoured milk).

d. Installation of facilities for processing of approximately 2000 liters of fermented milk products (yoghurt, plain and flavoured and curd).

e. Production of icecream products.

f. Expansion of the milk collecting system to the entire System "H" area (introduction of chilling system).

g. Expansion of production of the fermented milk products capacity in volume and in range of products.

h. Expansion of the plant processing capacity to 60,000 liters of raw milk per day, a target to be achieved when the livestock program (one cow per family) will be accomplished.

C. Basic Facilities Required

The following is an indicative list of equipment and facilities required:

a. Milk collection system equipment: stainless steel buckets, milk cans, mobile bulk tanker of 400-600 liter capacity.

b. Milk reception facilities including: milk scale, balance tanks, milk filter, bactofuge, pumps, cleaning facilities for cans and tankers, quality control facilities.

c. Milk storage facilities including: plate cooler and insulated storage tank, pumps.

d. Milk pasteurizing facilities including: plate heat exchanger, cream separator, storage tank.

e. Flavoured milk product production facilities: homogenizer, storage tank, filling-sealing machine, cooling room.

f. Fermented milk products facilities: culture preparation vessel, mixing tank with agitation/mixing devices, filling-sealing machine, incubation room.

g. Icecream production facilities including: mix processing (mixing, pasteurization, homogenization, cooling, aging) and icrcream processing (mixing, agitation and freezing, packing, final freezing - hardening.)

h. Laboratory installation and equipment.

i. General industrial infrastructure required: electricity, steam boiler, cooling rooms, incubation rooms, freezing rooms.

D. Program and Schedule of Implementation

This project will be implemented by the following steps:

a. Preparation of a detailed program evaluating the next 5-7 years of livestock development in System "H".

b. Preparation of a detailed study to evaluate and determine collecting system, production programs, and future expansion possibilities.

c. Allocation of budgets from national and international funds, required for the investments involved in implementing the following steps d. and e.

d. The establishment of a collection system for about 5,000 liter milk per day.

e. The establishment of processing facilities for the milk collected - to be carried out in steps (yoghurt, flavoured milk, icecream).

f. Revision of the programs regarding production, collection and processing of milk in System "H".

g. Allocation of the budgets from private sources, required for the investment involving the implementation of recommendation of step f.

h. Expansion of the milk collection system to the entire area of System "H".

i. The setting up of a new line for fermented products.

j. The setting up of a new line for pasteurized plain milk and flavoured milk.

k. Implementation of other recommendations of the revised master plan (step f).

This project should operate on commercial profitability and at the same time open additional sources of income to farmers. In order to initiate the development of the project we recommend that the preliminary stages (a. to e. inclusive) should be implemented by public organizations. The investments involved will be from public sources but the daily operation should be commercially sound. When livestock in the region will be relatively developed and organized, the private sector will take over all activities regarding investments, operation, marketing, etc.

5.3.2 New Projects

5.3.2.1 Fruits and Vegetables Processing Plants (Canning Centers System)

A. Forward

No precise information is available on most of the crops grown in the System "H" area (except for paddy and chilli). In addition, some of the available information regarding area and yields (including paddy and chilli) is controversial or does not exist, specifically for all fruits and most vegetables grown in the "H" area, mostly in backyards. Precise information could not be found on varieties, extent of growth and types of fruits and vegetables, pulses, etc., grown in System "H". In addition, no free land is available for promotion of agroindustrial crops on a reasonable scale.

Based on the above, it is clear that private (and even government) enterprises considering possibilities for agro-industrialization of System "H", cannot estimate what kind of agro-industries (nor what size), can be planned for the time being or the near future.

In order to overcome the above constraints (lack of information, land, etc.) and to promote the utilization of these unknown crops, we propose to initiate and later expand certain units organized in a "Canning Centers System".

The Canning Centers System will assess the basic quality characteristics of the agricultural raw materials such as: total soluble solids, dry matter, fiber content, ascorbic acid, juiciness, fiberness, acidity, pH, ash, as well as flavor, color and other important characteristics. A qualified laboratory technician(s) will analyse and collect the necessary information for future feasibility evaluation and later on, for quality control of the prepared semi-(or fully) processed food material.

In our opinion, the Canning Centers System should be initiated and supported by government (or other public and international) institutions. We recommend that the Mahaweli Authority, CISIR, and the Food Technology Department in Peradenia cooperate in organizing, supervising and operation the system.

When all data will be available, private enterprises should be ready to either establish a number of plants around the CCC facilities, or from scratch.

The CC system will continue its function by evaluation and introduction of new potential agro-industrial crops.

B. Organization and Function

In general, the Canning Center System will be organized as a network of units which will operate as follows:

- Small units (Home Canning Centers - HCC) equipped with basic equipment for preparation of simple food preserves such as jams, vegetables in brine, etc., will be situated in a central village (or townlet). The HCC will serve the farmers living in villages within walking, bicycle or "draught animal carts" distance. Each of these units will be operated by a well-trained food technician.

- A central unit (Central Canning Center - CCC), situated in a regional town and possessing suitable infrastructure will serve, instruct and coordinate several HCC's in the region. Each CCC will be equipped with bigger scale and more sophisticated equipment (including a laboratory) for elaboration, evaluation and collection of information on various and relatively major crops of fruits and vegetables. A qualified experienced food technologist (or home economist) will head the CCC and will coordinate the HCC's activities.

  The CCC's would be expanded in the future to small food plants for semi-processed or processed food products.

- All the CCC's operations will be coordinated by an administrative head office located in System "H" area in the senior CCC unit (probably the first unit implemented).

An example of how a CC System could be developed and function is described hereafter.

a. First Stage: The local agricultural instructors will advertise and organize groups of members (mostly females probably) to come to the local HCC bringing with them one or more types of fruits and vegetables available at a certain season. These organized small groups will be instructed by the HCC how to prepare jam, (for example) the formulation of the jam (sugar and fruit); the method of its preparation, the cooking (probably on a direct wood fire), the hot-filling of the still liquid jam, with or without preservatives added (supplied by the HCC and depending on the quantity of jam), and the immediate sealing, in hot condition. The farmers will bring with them the basic ingredients such as sugar, fruits, vegetables, salt, spices, etc., but will pay for the containers and services a basic price or with surplus raw material.

The local HCC staff will collect, analyze and store (for up to 48-72 hours, depending on conditions) the raw material collected, asking also for information on quantities available for the present or past season and the expected quantities for the future. Once every two to three days a small truck will deliver to the CCC the raw material collected. Data received from the HCC will be sent periodically to the CCC.

The CCC will coordinate the activities of each HCC and will transform the raw material in "semi-processed" food ingredients, which could be marketed to existing food plants in Colombo. Due to a scarce and expensive supply of raw material in Sri Lanka, the market potential for semi-processed fruits and vegetables exists (the plants visited by the writers of this report operate mainly between one-half and one-third of their full capacity).

b. Second Stage: Depending on the availability of basic information concerning varieties, quantities, characteristics, quality and availability of a certain crop, private enterprises could be attracted to invest in System "H" for the expansion of the activities of the existing HCC and CCC, or for new feasible ventures.

c. Third Stage: This stage consists of the erection of one or more private agro-industries of small, versatile plants, e.g. for sauces, ketchup, fruit preserves, jams, juices, nectars, etc. This is expected within three to five years, provided that raw material of suitable quality will be available.

If enough quantities of some crops will be available around the HCC or the CCC, a controlled atmosphere storage facility could also evolve - "small packing houses". Thus, the raw crops will be selected for fresh consumption or agro-industrialization and directed accordingly (or stored), in order to obtain better prices and avoid the services of middlemen.

C. Basic Facilities for the Project

Hereafter is an indicative list of equipment and facilities proposed for each HCC and CCC.

. Facilities for HCC:

Running water and electricity; available area for several direct fires (tripods); a place for direct sun drying; a building with basic hygienic facilities; storage (shade at least); balances(up to 100 kg.); several sizes of kettles; several sizes of stainless steel containers for jam preparation on a direct fire; small sealing machine; portable field pH-meter; hand refractometer; jars, bottles, etc.

b. Facilities for CCC:

A building divided into some rooms and processing area with hygienic facilities and suitable infrastructure (water, electricity, etc.) and storage area, equipped with -
a small steam generator; steam or hot water jacketted kettles of different sizes; small pulper-finisher; big (kitchen size) food processor; blender, mixer, meat grinder (for vegetables) etc.; autoclave (for vegetable products' sterilization); water baths (on a direct fire); small cabinet dryer, etc.; storage tanks (for semi-processed raw material); packaging, drums, barrels; suitable laboratory equipment such as; pH meter, refractometer, glass equipment for volumetric or gravimetric analysis, vacuum oven for dry matter evaluation, etc.

D. Program and Schedule of Implementation:

We recommend this project be implemented by the following steps.

a. The preparation of a detailed program for the organization of the Canning Centers System in the Mahaweli System "H". This program will be prepared by a team of experts (at least two) that will determine all the details of the CC system (HCC and CCC) concerning:

- Structure and organization of a body to be in charge of the implementation (erection and operation) of this project.
- Terms of reference for the above mentioned body.
- Detailed plan of work, by stages, for the HCC's and CCC's.
- Size, number of units and location for the HCC's and CCC's.
- Facilities required for the HCC's and the CCC's, such as:
  - infrastructure (building, area, roads, etc.)
  - equipment (type, number of units)
  - utilities (electricity, water, etc.)
  - manpower (skilled and non-skilled)

b. The establishment of an executive body for the implementation of the program prepared by the team as described in a. which will be in charge of the following steps.

c. The allocation of the budget required for the project (probably from international funds, national and private sources).

d. The implementation of the first stage of the program (beginning with a number of units).

e. The preparation of the expansion program for the second stage, based on conclusions at the end of the first stage.

f. The implementation of the second stage. This stage will be characterized by involvement of private enterprises in the operation of the CCC's.

g. The implementation of the third stage, in which one or more fruits and vegetables processing plants will probably begin to operate.

5.3.2.2 Peanut and Sesame Processing Plant

A. Forward

As mentioned before, although sesame (gingelli) and peanuts are grown in system "H", no information is available regarding exact areas, quantities, yields, quality characteristics, etc. of these two crops. On the other hand, according to the information given to us (verbally) at the Maha Illuppallama Experimental Station, good yields of peanuts were obtained in experimental plots at the agricultural research station located in system "H".

We propose the involvement of the private sector in this area, operating in several stages, beginning with the installation of a packaging-marketing facility which will eventually evolve later on into a factory manufacturing candy and confectionary and other typical products based on peanuts and sesame. This will assure a market and better prices for these crops, as well as encourage the growing of these crops by many other farmers.

B. Approach for Project Development

In view of the small volume of actual agricultural production in system "H" of peanuts and sesame, a preliminary stage is required before the introduction of this agro-industrial venture.

The preliminary stage will be devoted to the preparation of a survey in which information will be collected. Farmers ready to grow these two crops in system "H" will be identified and seeds of promising varieties will be introduced to the farmers by the Mahaweli Authorities.

The following stages of development of this agro-industry are envisaged:

a. First Stage:

Organization of a packaging-marketing plant. Probably at the start of this stage a small collecting plant will be erected by a private entrepreneur who will buy and process the available crops.

A suitable building will be offered by the Mahaweli Authority to be rented by the private enterprise which will invest in simple machinery, equipment, and provide capital to process the sesame and peanuts (with possibility of extension to also process some pulses growing in the area).

This stage will consist of the following basic operations:

1. Organization of transport of the collected (purchased) peanuts, sesame seeds, or pulses, to the plant.
2. Cleaning and washing facility to remove earth, stones, stalks, by dry and wet methods.

3. Solar drying in order to dry the unshelled peanuts or the sesame plant before seed separation.
4. Shelling of peanuts and shelled peanuts separation, mainly manually.
5. Cleaning once more and removal of stalks, shells, etc. by simple manual or pneumatic device,
6. Grading, according to local market demands.
7. Packaging of products in small polyethylene or airtight hot-sealed bags.
8. Storage and marketing to the local town centers.

Samples of the collected raw material will be assessed by governmental institutions (Peradeniya, CISIR), as to the desirable quality characteristics which will help the private enterprise in the selection of the varieties possessing the best yield and quality characteristics, to be grown in the next stages.

b. Second Stage:

The expansion to candy-confection production.

During this stage the plant will enter into the production of sesame and peanut bars, brittles, crisps and crunches, as well as sugar-covered "mani" type peanuts, salted peanuts, etc.

Most of the above products will be marketed on the local markets, while marketing possibilities to Middle-Eastern countries, traditional users of both sesame and peanut (salted and sweets), are a probable market.

The basic ingredients for these products will be: peeled sesame seeds, whole, halves, broken and ground pieces of peeled peanuts, refined white sugar, corn syrup, molasses, aromas, essential oils, packaging materials.

c. Third Stage:

After the second stage, enough information and raw material supply could be provided for other products such as peanut butter and the sesame-based "tehina".

Both products are wet-milled to a fine paste product, usually sold in plastic or glass containers and therefore will require the supply of suitable packaging materials. The above products could be sold locally, improving the basic nutrition of the local population. Tehina can be exported to Middle-Eastern countries whose population is a traditional consumer of this product.

C. Basic Facilities for the Project

An indicative list of equipment and facilities required for this project is hereafter presented.

a. Grading-Packing Unit

Cleaning of unshelled peanuts will be done in a suitable shed. An open area for solar drying before shelling has to be allocated. All other operations have to be performed in a hygienic room in order to assure clean and dry packing of the end products. A well-aired, dry shed is required for storage of packaging material and packed products.

The equipment will consist of the following:

- Working tables for manual shelling and removal of shells (peanuts) or stalks, etc. (sesame), and grading of sesame according to color, or peanuts according to size.
- Dry roaster (direct fire) - for peanuts.
- Tables for filling (in packages), weighing and sealing of full packs.
- Balances.
- Manual hot-sealing device, attached to the above tables.

During the second and third stages, according to quantities and production of the more sophisticated products (dehulled seeds, tehina, candies, etc.), simple but necessary equipment such as for testa removal, dehuller for sesame, should be envisaged.

b. Candy-Confectionary Plant

A building divided into processing area, rooms, and storage area for packing material and end products equipped with the following basic equipment (in addition to the existing from the first stage):

- Suitable containers for corn syrup and molasses, needed for the preparation of peanut and sesame brittles, crisps, crunches, etc.
- Suitable balances for formulation.
- Direct fire stainless steel cookers (with agitating device) for preparing the recipe and cooking the mixture in batches.
- Cooling slabs, on which the boiled mixture will be spread, elaborated and cut or formed.
- Table for manual packaging of individual pieces.
- Small sesame seeds peeling device.
- Mill or grinder.
- Oven for peanut dry roasting.

c. Peanut Butter and Tehina

The additional production equipment required for the manufacture of these type of products are:

- Wet milling unit
- Mixing devices
- Filling devices for fine paste into plastic and glass containers or cans (mainly for export market, in this case a can or jar seaming device is required).

This equipment will be installed in a hygienic processing area with suitable infrastructure (water, electricity, etc). Storage area for empty containers and end products is required.

D. Program and Schedule of Implementation

The project will be implemented by the following steps:

a. The preparation of a preliminary agricultural survey to select suitable areas in system "H" for growing peanuts and sesame of high quality and good yields.

b. Introduction of selected varieties and supplying technical assistance for the growing of the above crops, and in situ economic evaluation of the crops.

c. Organization of farmers capable of growing the crops on a commercial scale. This will be done during step d.

d. Erection of a simple, labor-intensive grading and packing facility (cottage type).

e. Expansion of the grading and packing facilities to a capacity which will be accompanied with the introduction of mechanization. (Simple industry type.)

f. Upgrading of the production plant by the introduction of a candy-confectionary unit.

g. Preparation of a Middle-Eastern market study for tehina and other sesame and peanut products.

h. Further production development for other peanut and sesame products such as peanut butter and tehina.

It is recommended that the preliminary stage (including a. to c.) should be implemented by governmental organizations. The first, second and third stages (including d., e. and h.) will be implemented by the private sector. This project could be attractive to entrepreneurs possessing technological capability and commercial experience in the confectionary field. Step g. (market study) should be conducted by a team of experts, organized and financed by a governmental authority.

5.3.2.3 SPICE GROWING AND PROCESSING PROJECT

A. Forward

Spices are mainly cultivated in tropical countries. Their production on a commercial scale is mainly confined to a few regions, mostly in countries in south and southeast Asia which are the biggest consumers and exporters of most of the spices. India is the major spice producing country (17).

Sri Lanka was one of the principal producers of pepper (black), ginger, cardamom, cloves, chillies, cinnamon, cassia and nutmeg and mace (18)(19). On the other hand Sri Lanka imported in 1975 spices, mostly capsicums and chillies, for approx. US$ 12,000,000. More than 90% of India's total export of hot chillies during the "seventies" were to Sri Lanka, which was about 60% of the world market for hot chillies. (17)

Spices are still an important item imported in Sri Lanka as well as having good export possibilities. Considering the high potential of spice cultivation existing in Sri Lanka and the labor intensive activities which are required, the growing and processing of spices should be evaluated.

Based on the above, and encouraged by the experience already accumulated in growing chillies in system "H", we propose to study and implement a strategy of cultivation and processing of other spices during Yala seasons in Mahaweli in general and in system "H" in particular, which could be applied in several stages.

B. Approach for Project Development

Only a few spices (other than chilli) are actually grown in system "H", mainly in backyards and in small quantities, limited for self-consumption. Therefore we propose that the implementation of this project will start by a preliminary agricultural phase. Only after obtaining all figures and data, it is advised that activities be expanded to the processing phase, in which the private sector will play the main role.

The following stages of development of this project are envisaged:

a. First Stage

This stage is for immediate execution in which agricultural parameters will be defined during the selection of the spices with potential to be grown and processed. This stage will include :

- The gathering of information on spices already grown in System "H" for self-consumption.
- Concurrently with the cultivation, a quality characteristics evaluation of the existing raw spices is required.
- The introduction of suitable spices to be grown by the farmers, based on the above collected information.

b. Second Stage

After obtaining the information on the existing spice cultivation and, at a later stage, of the "potential for cultivation-evaluation", private enterprises must be encouraged to organize the cultivation and to erect a drying-grading-grinding-packaging plant.

The private entrepreneurs settled in system "H" will supply the seeds and seedlings, the agricultural assistance (with the help of the Mahaweli Authority), and will sign contracts with farmers after defining varieties, quantities, and quality of the raw (or partially sun-dried) spices to be supplied to the plant.

A plant for spice drying, grinding and packaging may also be considered as a part of the chilli processing plant, provided that the plant will be equipped with specific lines such as for curing of the particular spice available.

c. Third Stage

The main approach supporting the commercial growing of spices in system "H" is to enable high income from the small plot of land cultivated by the farmer's family. Therefore, it is advisable at this stage to determine which spices require intensive labor during their growing and harvesting operations, using agricultural methods adapted for small plots. The cultivation of these types of spices should be introduced despite the fact that their growth is unfamiliar to the farmers.

The policy of introducing new spices will require the expansion of the processing facilities built during the implementation of the second stage.

A market study will determine which products should be manufactured, taking the local and export markets into consideration.

A plant for essential oils, oleoresins, etc. in system "H" should be considered when enough raw spices of adequate quality will be available. This possibility should be evaluated notwithstanding that such plants have to be highly sophisticated, based on well-established "knowhow" specific for each spice, and are not labor-intensive.

C. Basic Technologies and Equipment Required

Most spices are exported dry, in "whole" form, and later ground in the consuming country, in order to avoid deterioration, off-flavor and oxidation.

The technology involved in spice processing should ensure proper conservation of the basic qualities for which the spices are valued, such as aroma, flavor, pungency or bite, color, etc.

So long as which types of spices to be grown in system "H" are not determined, it is not possible to prepare an indicative list of equipment required.

In order to give an indication of the type of technology and equipment required, the following is a description of the various stages involved in the processing of spices. Production lines of this type will probably have to be installed in the spice processing plant to be erected in system "H". In addition, grinding and packaging lines for spices intended for local production will be implemented. These lines will be of a similar nature to those described in Para. 5.3.1.1. (Chilli Processing Plant).

During processing the spices are subjected to various types of unit operations such as: washing, peeling, curing, drying, cleaning, grading and packaging.

The following basic technology steps are generally applied for processing most of the spices, with specific details for some:

a. Cleaning and Washing: dry (pneumatic) or wet. Root and Rhizome spices (such as ginger and turmeric) which are dug out of the soil, require thorough washing, which is done with pressurized water.

b. Peeling: almost all spices are dried whole (without peeling) except for ginger. The skin of the ginger rhizomes is a barrier to evaporation. If peeling of ginger is applied, it is peeled manually or by abrasive peelers. Another method applied to overcome this barrier is the slicing of the ginger.

c. Pricking: applied also in order to facilitate the moisture evaporation. Chillies for example, are pricked longitudinally to reduce the drying time.

d. Blanching: Not always applied because in some spices it destroys the enzymes involved in the enhancement of their respective flavours.

e. Chemical treatments: Brief dipping in sodium carbonate solution is used in Sri Lanka in order to enhance and help preserve the green colour of cardamoms (28). On the other hand, if bleached cardamoms are desired (USA for example), they are treated by exposure to sulphur fumes. Alkali treatment facilitates drying of chilli. Lime treatment is used for bleaching of ginger, etc.

f. Several treatments are applied for the development of the specific flavor or color, for example: "Sweating" (holding in still air for 3 hours at around 54°C) of cardamoms in order to preserve the green color. Wrapping in mats of cinnamon and holding it overnight, for flavor development. Boiling of turmeric in alkaline water, before drying, for development of the yellow color, etc.

g. Drying: In order to reduce the moisture content to 8-12%, drying is necessary to enable the storage and marketing of the spices. The spices are stabilized only at low moisture content, preventing deterioration through bacterial and fungal attack. There are two methods or a combination of both: sundrying, and hot air drying (dehydration).

- Sundrying - is still used for cardamom, but it bleaches the green color. Partial sun-drying is applied for many other spices: chillies, black and white pepper, ginger, etc.

- Dehydration - is applied by itself or after partial sun-drying. It consists of applying hot air flow at temperatures specific for each spice. For example, black pepper can be sun-dried (up to 2 weeks) to a moisture of 25% and then dehydrated in an oven down to 10%.

h. Fumigations: Some dry spices are fumigated with insecticides (methyl bromide and similar) in order to avoid its infestation during their storage.

i. Antioxidants: Treatment with antioxidants, such as SO_2, prevent discoloration, loss of flavor and also bacterial spoilage during processing and mainly during storage.

j. Packaging: Almost all spices are hygroscopic and generally marketed in dry form, and therefore need protection against the ingress of moisture. The essential oil components, naturally present in most of the spices, are subjected to oxidation by atmospheric oxygen, resulting in development of off-flavors. Ground spices, because of the greater surface area exposed, lose flavor and absorb moisture very fast. Therefore packaging for spices has to prevent its deterioration by high moisture and atmospheric oxygen, as well as to prevent insect infestation.

Usually a combination of packaging films will give the best protection.

k. Storage: In order to prevent deterioration during storage, the dry spices are stored in air-tight containers (if possible), or at least in a cool, dry place.

The installation of an essential oils (EO) and oleoresins (OR) plant is suggested to be implemented in the third stage.

The technology for EO and OR production has to be adapted to local raw materials and conditions. CISIR has developed some pilot processes for distillation and extraction of EO, OR and similar, and some information is available in CISIR publications (28) (29)(30)(31) and others (17).

D. Program and Schedule of Implementation

The project will be implemented by the following steps:

a. The gathering of information on spices already grown in system "H" for self-consumption (types, varieties, qualities, quantities, location, etc.)

b. The expansion of spice growing on a commercial basis (even in backyard plots).

c. The establishing of spice collecting-drying-grinding units which will deliver the spices in bulk to spice mills in Colombo.

d. The growing of new varieties of spices for local consumption.

e. Supply of good seeds and planting materials as well as agricultural assistance.

f. Expansion of the collecting units to processing, grinding and packing operations.

g. Preparation of an export market research for selected spices and spice products appropriate to the regions of system "H", in accordance with the overall spice development strategy for Sri Lanka.

h. Diversification of spice growing to the spices selected in the market research. This has to be accompanied by agricultural assistance (subsidized plant material, assistance with fertilizers and pesticides, agricultural instruction, etc.).

i. Signing contracts with farmers before the growing season (if the farmer cultivates the plants according to instructions, then the supplies of the plant material, fertilizers and pesticides which were delivered as a loan, will be converted to a grant).

j. The expansion of the processing facilities for the specific spices grown, and in accordance with the new capacities.

k. Erection of an essential oils and oleoresins plant to process mainly the low-grade spices (which face tight import regulations when sold in raw form), if found feasible.

The second and third stages have to be implemented on a commercial base by private entrepreneurs. This project could be attractive to entrepreneurs possessing commercial experience in the spice field and/or possessing technological capability in essential oils production (e.g. Ceylon Tobacco Company).

In order to encourage private companies to invest in the area, the public sector's involvement is required as follows:

The first stage (steps a. and b.) will be initiated by a governmental body including the cooperation of the Mahaweli Authorities with the Agricultural Department in general, and Peradeniya (Maha Illuppallama) in particular, as well as CISIR, and can be organized in the framework of Home Canning Centers (HCC). The involvement of the public sector should also be considered regarding export market aspects and organization of the agro-industrialization of spices (step g.). It is recommended that a "spice expert" should be invited, with the help of national and international organizations; this as an intermediate phase between the second stage and the third stage.

5.3.2.4 Animal Feed Plant

A. Forward

Priority was given in 1983 to development of livestock in System "H", which lacks natural pasture land. Therefore, cattle raising by families must be based on grazing near the homestead and supplementing the feeding with prepared animal feed. In System "H" very few agricultural by-products can be used for animal feed. Agro-industrial activity is limited, thus there are practically no by-products suitable for animal feed. At any rate, these materials are not currently used for feeding animals.

The operation of agro-industrial projects will create a situation whereby the supply of by-products will form the basis for establishing a feed plant in the area. It will be possible to collect quantities of by-products (peanut and sesame hulls, rice bran, rice straw, soybean hulls) and also, at a later date, to purchase oilseeds meals from the nearby vicinity.

Part of the by-products have a low animal digestibility, therefore it will be necessary to improve its nutritional value by chemical or enzymatic processing.

While preparing dry mixtures, it will be possible to take advantage of the by-products (peels, pulp, seeds, etc.) from the fruit and vegetable processing industries, for the preparation of silage. At any rate, industrial activity in the field of animal feed will be possible at later stages of agro-industrial development in the area.

B. Approach for Project Development

Our recommended approaches for promoting this subject are on three levels of operation:

a. Preparation of balanced animal feed which will be prepared from raw materials supplied from outside of System "H" (corn, grains, oil meals, feed additives), in addition to by-products from local industries, which will be allocated for this purpose.

b. Digestibility improvement of by-products by chemical or enzymatic treatment.

c. Silage preparation from leftovers received from industries in the area.

It should be noted that little ready balanced feed is produced in Sri Lanka, and most is consumed at the government farms where herds are raised for breeding. However, cattle raising in System "H" is intended as auxiliary farming and not as a branch in itself, therefore the farmers should endeavour to supply as little bought feed as possible, and should seek temporary alternatives.

Thus, it may be assumed that the main demands for ready balanced feed will be provided by the government farm in the area. This, perhaps, will be the factor which will provide the base for the establishment of this project and its operation.

At this early stage it is difficult to indicate more details which would define the project and a detailed plan of action. At any rate, it is advisable to carry out a detailed study (perhaps as part of the study which was recommended concerning the milk production plant) which would define specifically as to System "H" the demand for animal feed, other feed alternatives, raw material availability, prices, quantities, etc.

Based on such a report, it will be possible to outline a plan of execution for this project and to receive a better defined basis as to the nature and scope of this future project.

5.4 Integration of the Agro-Industry System

The previous section describes seven fields of potential activity which are recommended for agro-industrial projects. The interrelationships between the various agro-industries recommended, throughout all stages of development, are presented hereafter.

5.4.1 General Chart of the Agro-Industrial Projects

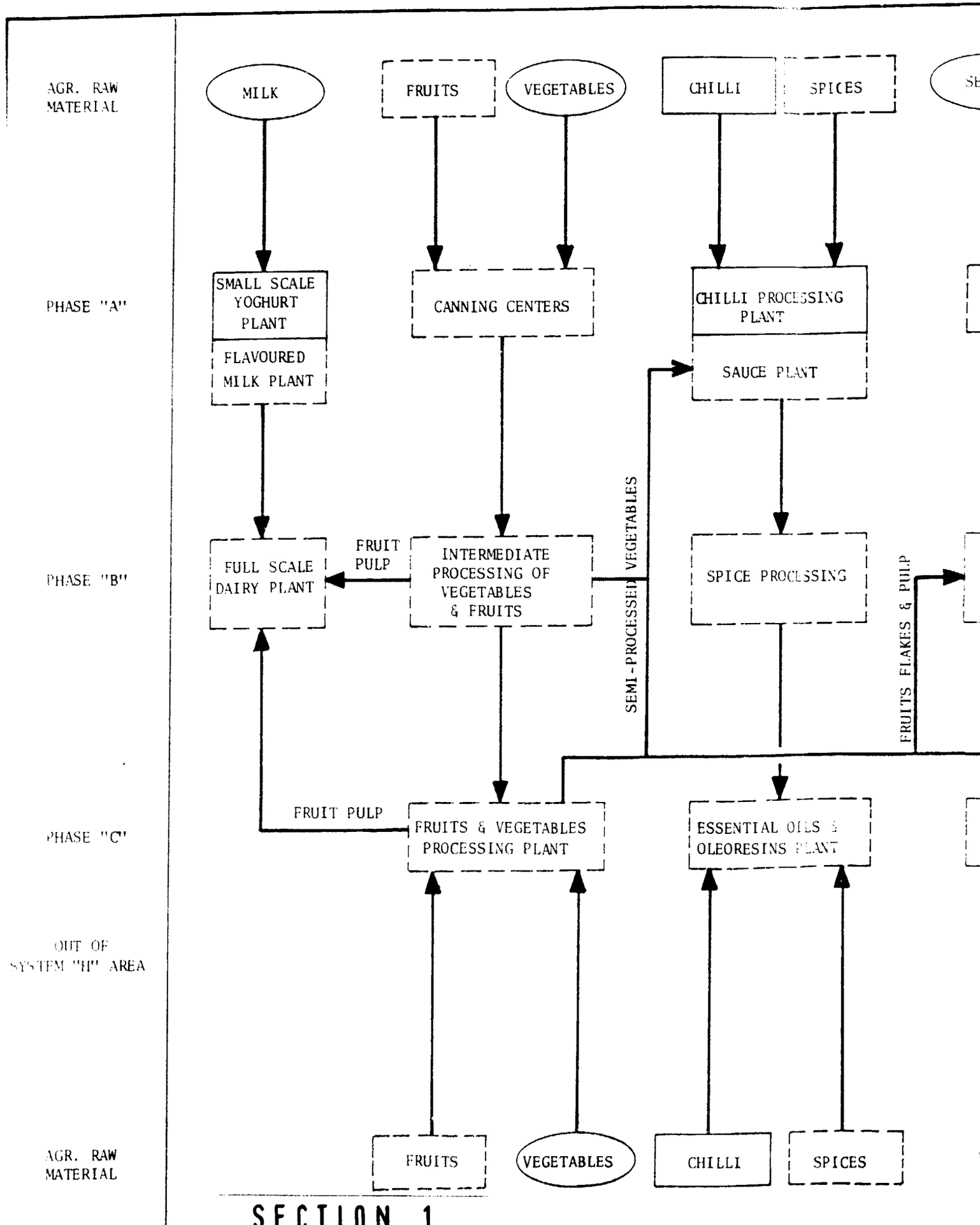
The chart of agro-industrial processing operations for System "H" indicates the basic links between the proposed projects, presented according to priority of implementation, in three phases (A, B & C). Mutual relations exist between the agro-industrial processing activities recommended in the program at various stages, from their first step to their final stage of development. The chart also presents the basic raw agricultural material supply requirements, indicating whether crops are actually produced.

5.4.2 Priority of Projects Implementation

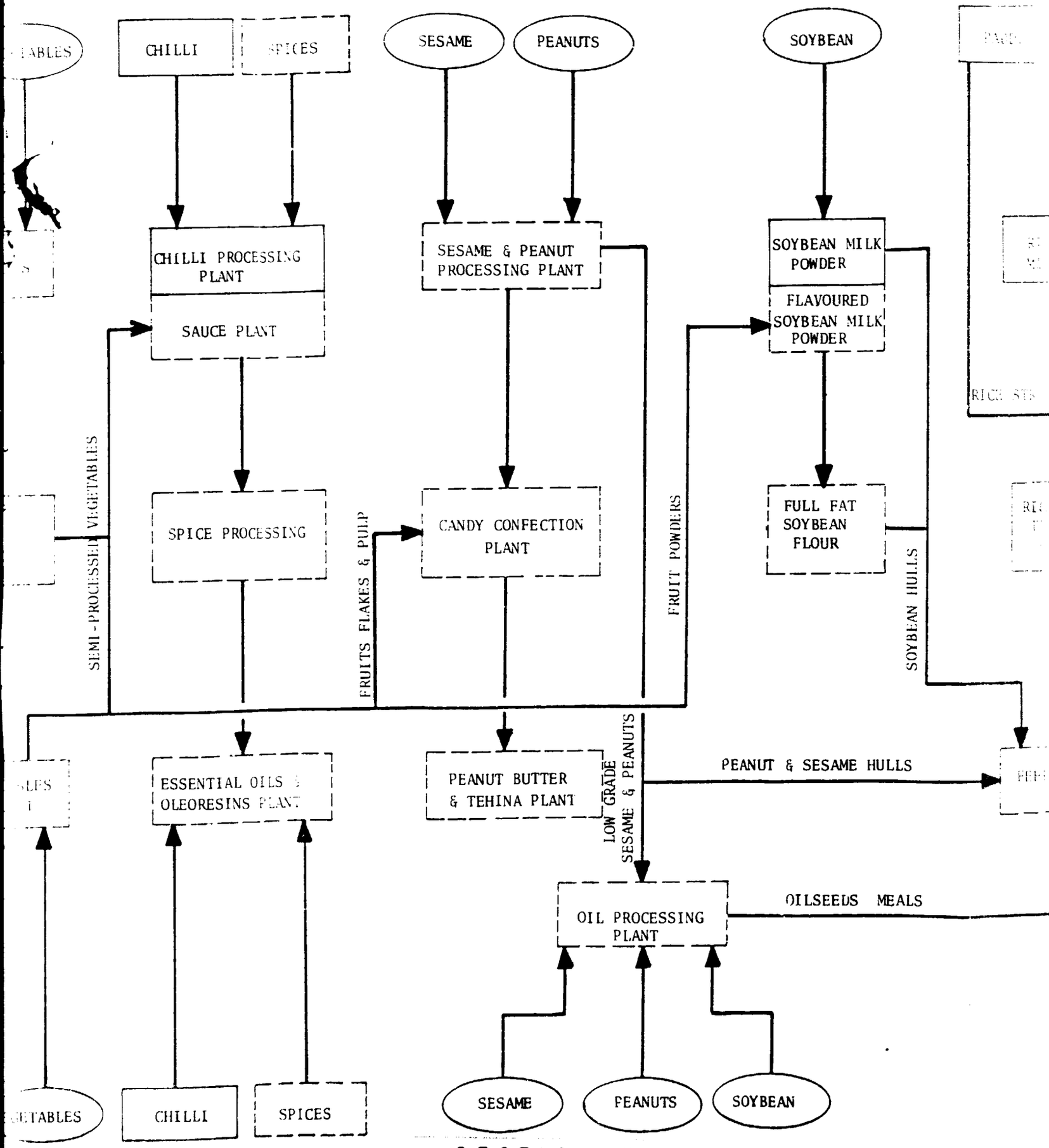
As stated, seven agro-industrial projects have been recommended as suitable for development in System "H". Of these projects, two (chilli and soybean) already engage in industrial and commercial activity to a significant extent. One project (dairy) is undergoing initial and limited experimental activity. As mentioned in para. 5.3, for each of these seven projects described the approach for project development was generally presented in some stages. The program and schedule of implementation for each project was also established.

Generally, it may be stated that it is possible to immediately begin activity in each of the subjects listed in phase A, as outlined regarding each and every project in para. 5.3. Some of the projects, such as processing of chilli, milk, soybean, are of industrial-commercial nature. Other projects (fruits and vegetables, peanuts and sesame, or spices) possess activities of a preliminary nature which will incur a period of at least two years before activity of industrial-commercial nature, can begin.

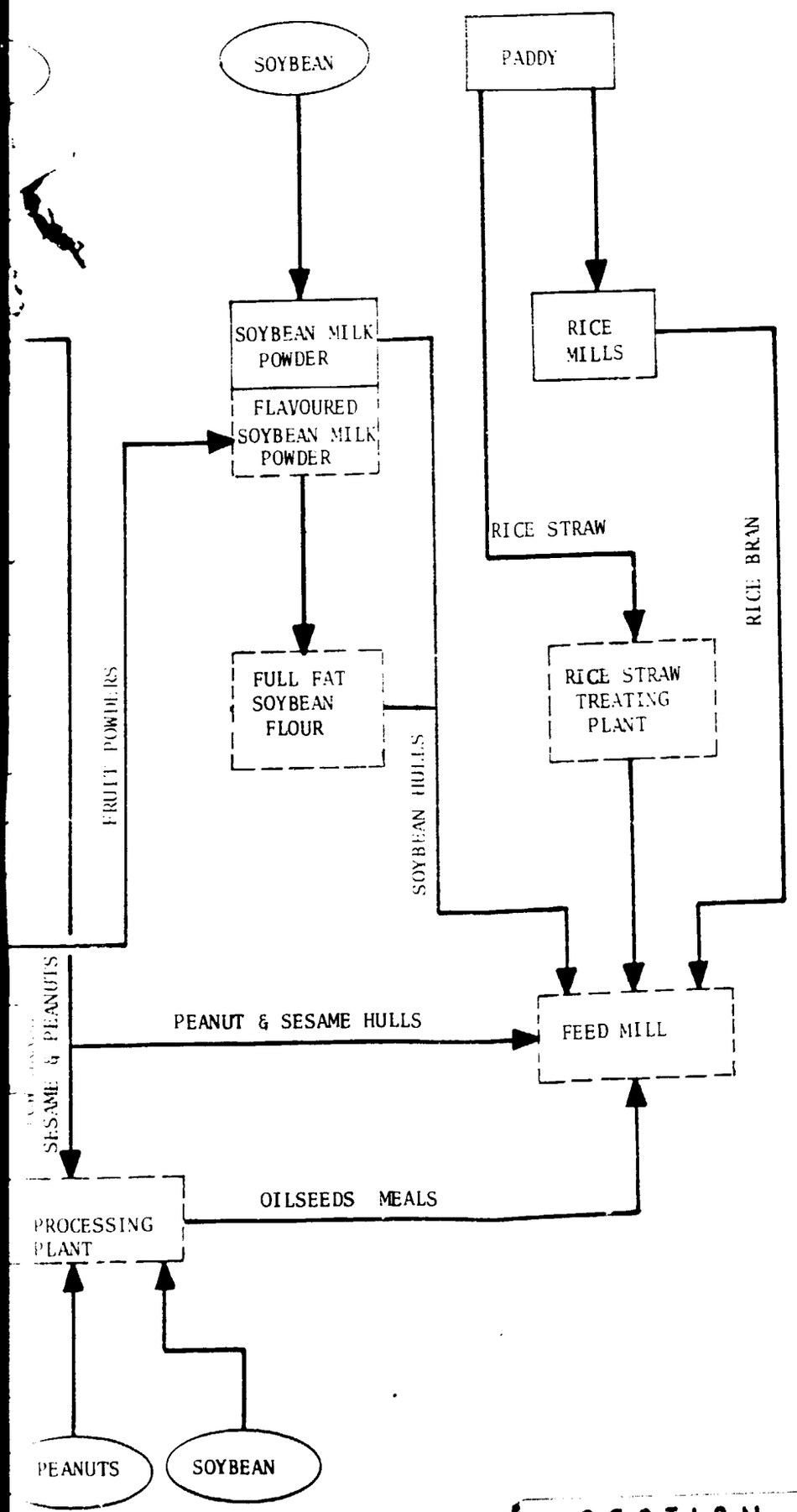
The rate at which each project progresses from phase to phase, as presented in the chart, will in time be determined as a function of promotion, financing, government backing, and encouraging the farmer to changes, etc.


AGR. RAW MATERIAL
MILK
FRUITS
VEGETABLES
CHILLI
SPICES
PHASE "A"
SMALL SCALE YOGHURT PLANT
FLAVOURED MILK PLANT
CANNING CENTERS
CHILLI PROCESSING PLANT
SAUCE PLANT
PHASE "B"
FULL SCALE DAIRY PLANT
FRUIT PULP
INTERMEDIATE PROCESSING OF VEGETABLES & FRUITS
SEMI-PROCESSED VEGETABLES
SPICE PROCESSING
FRUITS FLAKES & PULP
FRUIT PULP
PHASE "C"
FRUITS & VEGETABLES PROCESSING PLANT
ESSENTIAL OILS & OLEORESINS PLANT
OUT OF SYSTEM "H" AREA
AGR. RAW MATERIAL
FRUITS
VEGETABLES
CHILLI
SPICES

SECTION 1


CHILLI
SPICES
SESAME
PEANUTS
SOYBEAN
CHILLI PROCESSING PLANT
SAUCE PLANT
SESAME & PEANUT PROCESSING PLANT
SOYBEAN MILK POWDER
FLAVOURED SOYBEAN MILK POWDER
SPICE PROCESSING
CANDY CONFECTION PLANT
FULL FAT SOYBEAN FLOUR
SEMI-PROCESSED VEGETABLES
FRUITS FLAKES & PULP
FRUIT POWDERS
SOYBEAN HULLS
ESSENTIAL OILS & OLEORESINS PLANT
PEANUT BUTTER & TEHINA PLANT
PEANUT & SESAME HULLS
LOW GRADE SESAME & PEANUTS
OIL PROCESSING PLANT
OILSEEDS MEALS
CHILLI
SPICES
SESAME
PEANUTS
SOYBEAN

SECTION 2



LEGEND

AGR. RAW MATERIAL ACTUALLY AVAILABLE IN SMALL QUANTITIES

AGR. RAW MATERIAL ACTUALLY PRODUCED IN LARGE QUANTITIES OR PROCESSING PLANT ACTUALLY OPERATING

AGR. RAW MATERIAL TO BE GROWN OR PROCESSING PLANT TO BE INSTALLED

CHART OF AGRO-INDUSTRIAL PROCESSING OPERATIONS FOR MAHAWELI SYSTEM "H"

SECTION 3

5.5 Location of the Projects

System "H" is principally an agricultural region with a few commercial, training and administrative centers of the Mahaweli Authority which diverge from agricultural activity.

Apart from one soybean processing plant in the Maha Illuppallama area, a chilli processing plant in the Dambewatane area, and a rice mill in the Bulnewa area, no industrial activity exists in the region.

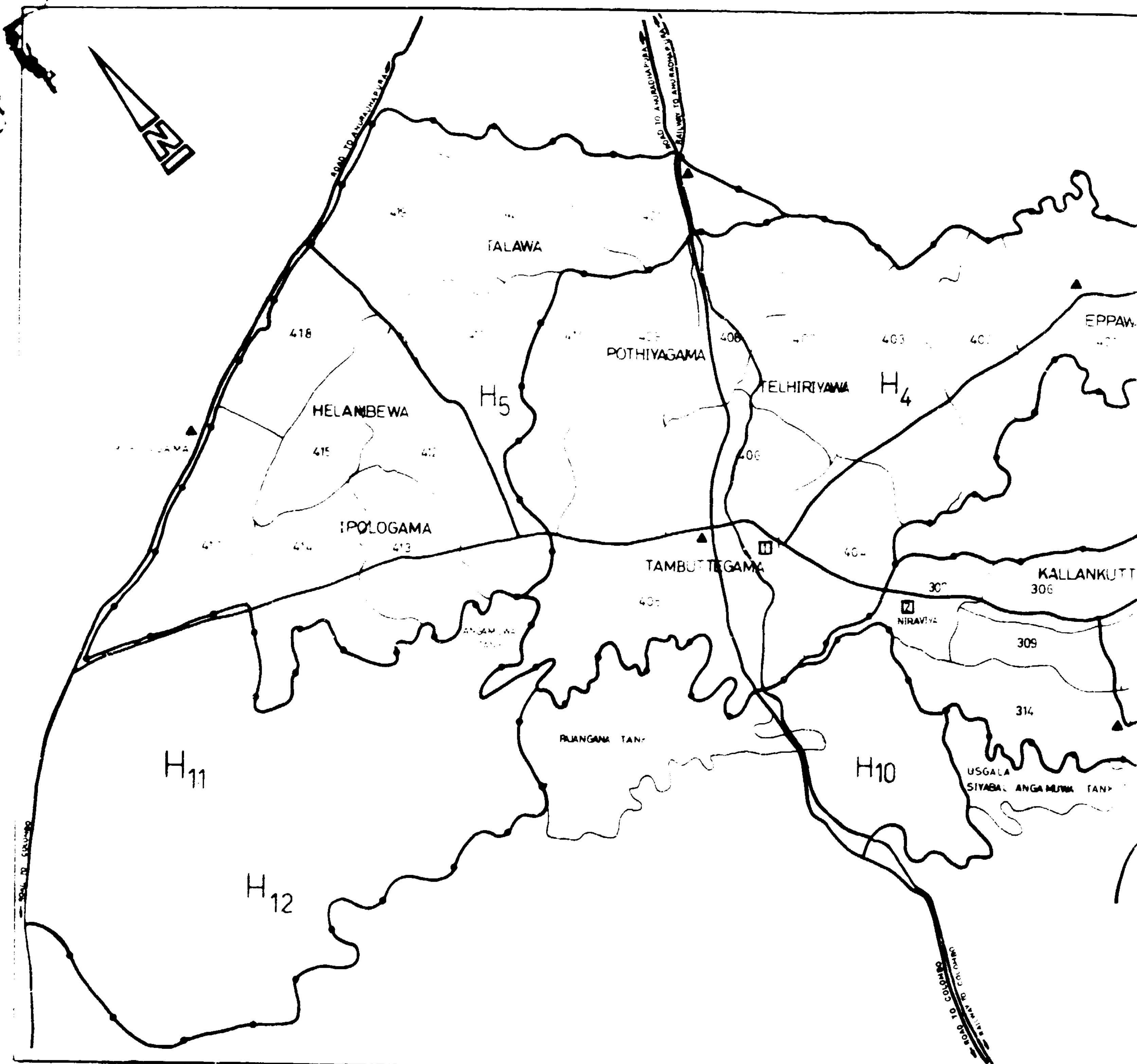
There is a large agricultural experimental station in Maha Illuppallama as well as a dairy farm at Niraviya and an agricultural machinery service station in the Tambuttegama area.

At present, there is no area in System "H" which concentrates on industrial activity. In the master plan for System "H" no areas have been specifically marked for industrial activity. The master plan only designates sites which comprise a concentration of population who will not deal in agriculture, but in the supply of commercial services. These sites are suitable for industrial activity, i.e. those locations chosen for activity other than agriculture. All these sites are located close to roads or railways leading to Colombo or other towns in the area. Some of these sites are already connected to the electric supply, or will soon be linked to the electric network.

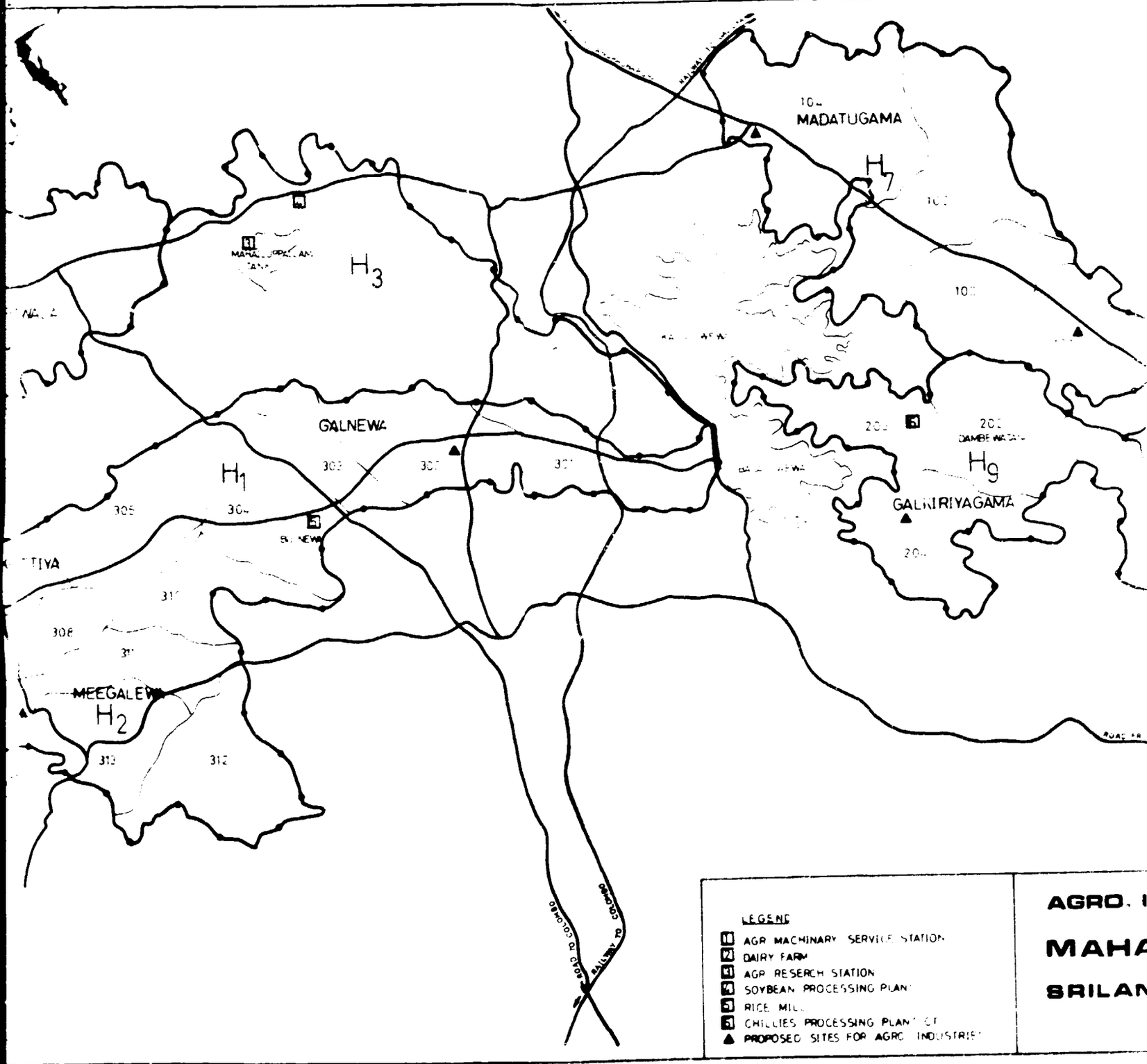
Our reference to the location of agro-industrial projects is only general. In each case the specific location of the various projects will be actually determined only after study and consideration of the relative advantages and facilities.

Obviously, those agro-industrial projects which are already established will be expanded at their existing location. These could possibly attract other projects, thus naturally creating an industrial area. The supply of industrial infrastructure services, technical maintenance, transportation, etc., should be taken into consideration for any agglomeration of agro-industrial activity.

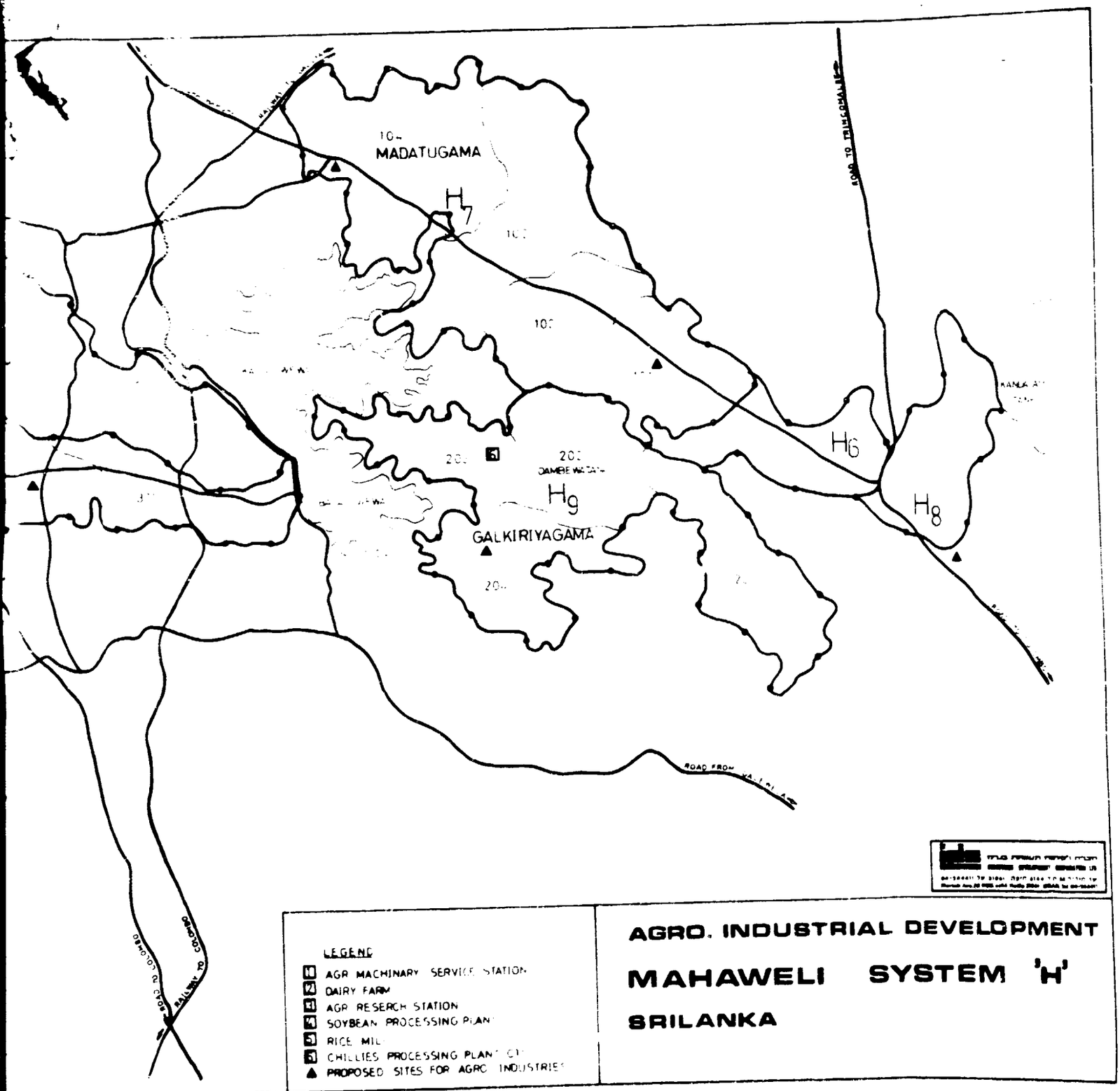
The map hereafter presents the agro-industrial development activity of the region and the proposed sites for future agro-industries.


TALAWA
POTHIYAGAMA
HELANIBEWA
IPOLOGAMA
TAMBUTTEGAMA
TELHIRIYAWA
KALLANKUTT
EPPAW
NIRAVIYA
USGALA
H5
H4
H11
H12
H10
418
415
413
406
403
404
306
309
314

SECTION 1


MADATUGAMA
H7
H3
GALNEWA
H1
GALNIRIYAGAMA
Hg
MEEGALEWA
H2
LEGEND
AGR MACHINARY SERVICE STATION
DAIRY FARM
AGR RESERCH STATION
SOYBEAN PROCESSING PLANT
RICE MILL
CHILLIES PROCESSING PLANT
PROPOSED SITES FOR AGRO INDUSTRIES
AGRO.
MAHA
SRILAN

SECTION 2


MADATUGAMA
H7
H6
H8
H9
GALKIRIYAGAMA
ROAD FROM
ROAD TO COLOMBO
LEGEND
AGR MACHINARY SERVICE STATION
DAIRY FARM
AGR RESEARCH STATION
SOYBEAN PROCESSING PLANT
RICE MILL
CHILLIES PROCESSING PLANT
PROPOSED SITES FOR AGRO INDUSTRIES
AGRO. INDUSTRIAL DEVELOPMENT
MAHAWELI SYSTEM 'H'
SRILANKA

SECTION 3

5.6 Manpower Requirements and Training of Personnel

Economic operations which are not agricultural or administrative in nature, are rare in system "H". Very few professionals with industrial experience reside in the area, thus any industrial development will require a training system and instruction for recruiting manpower. The second generation, seeking means of earning a living, and better educated than their elders, will be able to fulfil functions in production and in R&D. Some of the senior personnel should be trained outside the region, and will thereafter comprise the nucleus which will train the lesser skilled workers.

5.6.1 Personnel for Production Activities

The following personnel will be required for the new plants to be erected in the region:

a. Plant managers, accountants, clerks, marketing officers, etc. The candidates for this senior staff will be local people with suitable background who will be trained in Colombo and/or newcomers to the region with suitable experience.

b. Senior technical staff for the future food plants will be selected from the skilled food technicians in charge of the Canning Centers. This staff may also be chosen from technicians who analyze the quality characteristics of the crops or instruct the farmers regarding home preparation of preserves.

c. Agricultural instructors for instruction and introducing the cultivation of agro-industrial crops which do not yet exist in system "H". These people will head the agricultural departments of each plant.

d. Electricians, mechanics, etc. will be trained in courses organized in the area.

e. Unskilled agro-industrial staff. Short courses on hygiene and introduction of unit operations of food plants to unskilled workers could be organized in the area by the above-mentioned senior staff or visiting lecturers. In addition to the agro-industrial development (new plants), the more talented workers can become supervisors and operators of the more sophisticated equipment.

5.6.2 Personnel for R&D Activities

The following personnel will be required for the Canning Centers system and other R & D facilities:

a. Head of the Canning Centers - a senior food chemist or technologist to organize and supervise the Canning Centers. Agro-industrial research will be contracted in Sri Lanka or abroad.

b. Head of the agricultural research station oriented for agro-industrialization, to organize and supervise the agricultural research and development needed for agro-industrialization. An agronomist with suitable background will be contracted in Sri Lanka or abroad.

c. Food technicians for the Canning Centers will be trained in the Colombo area in an intensive training program which will include courses in food technology and quality control and some practical work experience in food plants.

5.7 R&D for System "H"

This sub-paragraph will summarize what has already been stated in former sections regarding R & D and will also present a general framework for operations of the various units which will deal with this subject.

The subject of R&D in agro-industrial development is of the utmost importance since the outcome of this activity is the basis for identification and design of future projects. Therefore, no serious attempts for agro-industrialization can be made before this data is available. In addition, R & D allows a permanent follow-up and development of industries which will be erected.

5.7.1 Existing Situation

Since System "H" is a distinct agricultural area, at present growing crops only for direct consumption, no efforts whatsoever have been made to obtain data regarding cultivation of crops intended for industrial processing or concerning elements of basic importance to industrial processing. Only some administrative information, mostly estimated, exists with the Mahaweli Authorities on yields of paddy, chilli and some pulses; however, this information does not include data regarding varieties, quality characteristics, etc. Unfortunately, even after all our efforts, we could not receive from other sources any data concerning quality characteristics of most crops (including chilli), and specifically for fruits and vegetables cultivated in the area.

The agricultural station, Maha Illuppallama is located in System "H". This station is involved in the introduction of agricultural practices, new crops and varieties. From information obtained during our visit to the station no data was accumulated there on varieties of fruits, vegetables or crops intended for agro-industries.

Maha Illuppallama agricultural station is the local branch of the Peradeniya (Kandy) Station, where a food laboratory is operated on a small scale. We received there some data on quality characteristics of some fruits and vegetables in Sri Lanka, but not specifically for those grown in System "H".

R & D facilities for the food and agro-industries exist in Colombo at the Ceylon Institute of Scientific Research (CISIR). Some preliminary R & D is carried out there regarding dehydration of spices, but no data is available for System "H".

5.7.2 Required Data

In order to be able to plan the future agro-industrial development of System "H", agricultural and agro-industrial data concerning existing and potential crops is a basic necessity. This data must include:

a. Agricultural Aspects: Such as soil, climate, season (Maha, Yala), expected yields, resistance to diseases, transport, storage, etc. of crops and varieties grown and of reasonable potential for growing in the area.

b. Agro-industrial Aspects: Seasonal distribution of each crop and its varieties, peak season, quality characteristics of each variety such as texture, color, flavor, juiciness (if relevant), dry matter content (if relevant), sugars, total soluble solids (^{o}Bx), acidity, pH, etc. In addition to this data other specific characteristics for certain crops is also required such as the intensity of some aromatic compounds or their essential oils for spices, off-flavors, such as astringency in some mango varieties.

5.7.3 Suggested Framework for R & D Activities

The R & D services which will be offered to System "H" should be coordinated and organized and partially financed by the department which will be formed in the frame of the Mahaweli Authority to encourage agro-industrialization in the area.

The following are the principal units which will operate within this framework:

a. The Canning Centers - will supply basic information regarding existing crops grown at present and which will be grown by the farmers.

b. An agricultural research station oriented to agro-industrial crops - This station will evaluate existing crops and varieties with agro-industrial potential and will introduce new crops and spices for System "H". This unit can be operated in cooperation with the Mahaweli Authority and the Ministry of Agriculture, through the Agricultural Research Station in Maha Illuppallama.

c. An Agro-industrial Research Station - intended to evaluate the potential of the existing or newly-introduced crops for transformation into processed products. This unit can be organized through the collaboration of the Mahaweli Authority, the Peradeniya Research Station in Kandy, and CISIR in Colombo. These units should coordinate and collaborate their work. The best location for units b. and c. is the Maha Illuppallama station, but some activities can be carried out at the CISIR facilities in Colombo.

A general approach how this system should work is presented hereafter: At the first stage and with the help of the Canning Centers and the present Mahaweli agricultural experts, data regarding crops of fruits, vegetables, spices, etc. grown in System "H" will be collected and supplied for evaluation. The agricultural and agro-industrial units will evaluate the existing crops and determine and recommend which crops possess the best agro-industrial potential whose growth should be expanded in System "H". Cultivation studies of new crops and varieties with adequate agro-industrial potential will be carried out in the Maha Illuppallama agricultural station's area, and the most promising varieties will be gradually introduced to the farmers through the Mahaweli Authorities. For example, if good potential exists for the cultivation of tomatoes in the area but, as evaluated by the Canning Centers, the varieties presently grown are not suitable for agro-industry (non-uniform maturity, weak color, off-flavor of products, etc.). The agricultural unit will introduce new proven varieties with good yields through the Maha Illuppallama agricultural station. With the help of the Canning Centers the agro-industrial unit will evaluate the quality characteristics of the tomato products prepared there.

If suitable, the new varieties will be introduced gradually through the Mahaweli Authorities to the farmers, providing that their yield will be sold to the agro-industrial plants in the area or in Colombo.

5.8 Incentives to Encourage Agroindustrialization of System "H"

This paragraph indicates the recommended lines of action which should be taken by the appropriate authorities in order to encourage agro-industry in System "H". These procedures will be in addition to those investment and fiscal incentive schemes already existing in Sri Lanka to encourage investments in general and industry in particular.

This system of incentives should cover the following activities:

a. Organization and supply of field instruction concerning the introduction of new crops and varieties for agro-industrial processing.

b. Free supply of seed for crops to be processed in agro-industrial plants in System "H".

c. Minimum price guaranty to the farmers for agro-industrial crops.

d. Organization and operation of the Canning Centers during the first years of agro-industrial development in the region. This probably could be done with the support and finance of international organizations.

e. Organization and operation of R&D support facilities for agro-industrial development and expansion of System "H".

f. The preparation of market studies on export markets. This should be done after the identification of existing and potential crops suitable for agro-industrial transformation.

g. Supply of land and infrastructure (roads, water, sewage system, electricity) for the new plants or for relocation of existing ones.

h. The availability of suitable buildings (industrial/offices) to be rented by entrepreneurs and/or to be supplied free for the first years of operation.

i. Allocation of housing for the technical and administrative staff to be installed in System "H".

j. Assistance in training programs for the future skilled and unskilled staff.

k. If farmers in System "H" take the initiative to organize the erection of an agro-industrial framework, the government should encourage and provide them with capital to enable them to start their own agro-industrial ventures.

5.9 Entrepreneurship

Agro-industrial activity in System "H" must be on an economic basis, and any activity which is not economic should be temporary, aimed at preparing the sources for establishment of projects. Involvement in projects must derive from private entrepreneurs. This approach is acceptable to the Mahaweli Authority and also by private entrepreneurs whom we met while visiting the region, and in Colombo.

In order to promote and accelerate agro-industry in the region, and in order that entrepreneurs will be attracted to invest in System "H" rather than in other areas, public and government involvement is necessary. Effort and money must be invested in the setting up of a suitable infrastructure for industrial activities in the region so as to attract and encourage the entry of the private sector.

The private sector, who possess experience and past involvement in agro-industries, are seeking new projects. This is due principally as a result of the present situation which lacks a reliable supply of raw agricultural material. The guarantee of such a supply would convince them to begin activities in System "H". This is the basis and background for justifying direct governmental financing and organizational involvement in agro-industrial activities. In para. 5.3 we have made recommendations regarding the desired involvement in the application of each project. The following is a summary:

a. Chilli Processing Plant

The expansion of chilli powder production as well as sauces production can be carried out by private entrepreneurs, namely CTC (Ceylon Tobacco Company), or others. The only public assistance required is in the preparation of a market study regarding export possibilities.

b. Soybean Processing Plant

We recommend that the expansion of activities to soybean milk products such as flavoured soybean milk powder or to full fat soybean flour be implemented by Rajarata Food Grain Processing Co. Ltd., the company actually operating the plant. Government involvement is recommended only regarding the introduction into the national diet of the end products of soybean origin.

c. Dairy Products Plant

Public assistance must be given to this subject so that first steps can be taken to organize collection and equipment for milk processing in the areas near the Dairy Farm in Niraviya. Thereafter, this project should be financially profitable and the private sector could expand it to a joint venture with the government Dairy Farm.

The private sector which could be taken into consideration may be a company already dealing in milk processing, or a new body which will be organized by the government and will include milk producers or those who will distribute the end products in the "H" area and its surroundings.

d. Fruits and Vegetables Processing

The initial stages of plan implementation, establishment and operation of the Canning Centers system, will be organized and financed by public/ government authorities. Only after the system receives enough data to present an adequate base which will justify operation of a vegetables and fruits processing project, will it be possible to attract the private sector. There exist today private groups who would be interested in establishing in the System "H" area industrial projects of this type if raw material was available.

We would recommend a joint venture with one entrepreneur* we met, the owner of a fruits and vegetables processing plant near Colombo.

e. Peanut and Sesame Processing Plant

This project could be attractive to private entrepreneurs with commercial and/or technological capabilities in the confection field. Governmental or public sector involvement is envisaged only for the preliminary stages of implementation, covering mainly the required assistance at the agricultural phase. Public involvement will also be required for a market study regarding export oriented products.

f. Spices Growing and Processing Project

In spite that we envisage the processing phase of this project should be implemented by the private sector, the role of public involvement in this project will be dominant during the preliminary stages when all the agricultural elements have to be considered and determined.

(*) Miss Beulah Moonesinghe, 562/15B Lower Begatell Road, Colombo 3.

g. Animal Feed Mill

This subject is closely linked to the government policy of expanding economic activity in the area and of offering additional income options to the farmer. Despite the fact that activity will be on an economic basis, at a first evaluation this project should be promoted and operated by a public authority.

Investment in organizing and establishing a system will be supplied by a public body. Only after the system operates will it be feasible to transfer it to a private entrepreneur who will undertake the production and marketing of the products to the farmers of the area.

5.10 Estimate Investment Requirements

This paragraph presents a summary table of the estimate of investment for each of the proposed agro-industries. These estimates can provide the Government of Sri Lanka with an indication of the magnitute of financial requirements for the projects' implementation. The investment requirements given herein are a preliminary and general estimate only. Any estimates used as data in an investment plan or feasibility study must be based on a detailed study which should be prepared for most of the subjects, as recommended in many instances in this report.

Financial estimates refer only to foreseen investments required for equipment, its erection, industrial activities, and processing building. We have not referred to the price of land, land preparation, supply of electricity and water, sewage, roads, etc., out of the plant's bounaries.

For some of these projects it is recommended that, during the first years, the Government should promote their operation (e.g. Fruits and Vegetables Processing). It is natural that the required budget for this type of activity is mainly for Operating Costs, Technical Assistance, R & D, etc. The amounts required for activities such as these have not been included in this investment estimate.

The rate of establishing these investment will, eventually, be in accordance with the state and rate of internal development for each project. Division of the budgets, according to years, is based on priorities assuming that project development will be more or less as described in para. 5.3.

Interpreting the following Gant Chart, some observations should be made: The total budget for the industrial facilities required is estimated at about US$ 5 million. The flow of investment is spread evenly over five years with a peak of US$ 1.55 million at the 5th year.

Considering the nature of the projects the budget for the 4th and 5th years (US$ 3 million) will be covered solely by private entrepreneurs, whilst the budget for the 1st and 2nd years (about US$ 1.2 million) will be partially covered by public sources.

ESTIMATE INVESTMENT REQUIREMENTS

(In 1000 US $)

Project	Year of Investment					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Chilli Processing						
- CTC Plant (capacity expansion, new chilli sauces and other sauces lines)	100	100	100			300
- Two new grinding plants	100	150	50			300
						600
Soybean Processing						
- Flavoured Soybean Milk Powder	50					50
- New F.F.S.F. line (expansion of Rajarata Food Grain Processing Co. Ltd.)			200	100		300
						350
Dairy Products						
- Collection and processing of 5000 liters/day.	100	200				300
- Expansion of the collection and processing up to 20,000 liters/day			750	1000		1750
						2050
Fruits & Vegetables Processing						
- First stage of CC System	50	200				250
- Second stage of CC System		50	150			200
- Third stage of CC System				200	500	700
						1150

ESTIMATE INVESTMENT REQUIREMENTS (Cont'd.)

(In 1000 US $)

Project	Year of Investment					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Peanut and Sesame Processing						
- Cleaning, Grading Packing facilities	20	50	30			100
- Candy Confection Unit + Peanut Butter and Tehina Unit			50	50		100
						200
Spice Processing						
- Drying, Cleaning, Grading, Bulk Packing facilities			50	50		100
- Expansion of production capacity to Grinding and individual packing				50	50	100
- Essential Oils and Oleoresins					1000 →	1000
						1200
Animal Feed Plant			To Be Determined			
T O T A L	420	750	1380	1450	1550	5550

5.11 Technical Assistance by International Organizations

The need for technical assistance can be attributed directly to the present state of activity in each of the seven agro-industrial projects recommended for development in System "H". Some steps for promoting projects are presented in sub-paragraphs of 5.3, including activities which we recommend should be carried out by international organizations and/or under the auspices of the Sri Lankan government. The priority for technical assistance required to establish the proposed agro-industry is linked with the priority of projects implementation, as presented in para. 5.4.

5.11.1 Nature of Technical Assistance

The following is an outline of the technical assistance to be given by international organizations to the government of Sri Lanka.

A. Chilli Processing

a. Establishing quality control of raw material and end products. This can be achieved by a training program and technical consultancy by an expert at a local R & D center, such as CISIR.

b. The preparation of a market study to examine the specific market demand in the target countries, including marketing organization, quality, standards, packing, labelling requirements. The study should be performed by a team of experts including a spice technologist, market researcher and economist.

B. Soybean Processing

a. The development of flavoured soy milk powders. This can be achieved by a R&D program at a local institute, led by a formulated food technologist with the help of a local food industry market man.

b. The preparation of a market study and economic feasibility of Full Fat Soybean Flour (F.F.S.F.). This study should be carried out by a team of experts including a soybean technologist, nutritionist (institutional feeding expert), and economist.

C. Dairy Products

a. The preparation of a detailed program evaluating the next 5-7 years of livestock development in System "H". This program should be prepared by a multi-professional team including an agronomist, cattle breeding expert, animal nutrition specialist, agriculture economist, and people of the region already involved in cattle raising.

b. The preparation of a detailed study in order to determine the milk collection system, production programs and future expansion possibilities. This study should be carried out by a team of experts including a milk technologist, economist and one of the Niraviya farm people involved in the first steps of milk collection in the region.

c. Establishing quality control for milk and dairy products. This can be achieved by a training program in one of the local dairy plants, and technical consultancy given by an expert for 3 to 6 months in the plant to be erected in the region.

D. Fruits and Vegetables Processing

a. The preparation of a detailed program for the organization of the Canning Centers System in System "H". This program will determine the structure and organization to be in charge of project implementation, detailed plan of work including size, location and number of units of HCC and CCC as well as facilities required. This should be prepared by a team of experts including fruits and vegetables growing experts, food technologists specialized in fruits and vegetables processing and quality evaluation and control. The team leader should have wide experience of working in developing countries, and concerning the organization and operation of rural facilities.

b. Implementation of the CC System (especially the first stage) will require the assistance of technical involvement at various levels, such as a food technologist to head the CCC and coordinate the HCC activities; the training of food technicians in Sri Lanka and abroad in quality control and analysing agricultural raw material, as well as in fruits and vegetables cottage industry.

c. The implementation of the HCC and especially the CCC will require the installation of basic facilities and equipment. It is recommended that an international organization should supply the equipment required to carry out the first stage of the program.

E. Peanut and Sesame Products

a. The preparation of a preliminary agricultural survey to select suitable areas in System "H" for growing peanuts and sesame as raw material for processing. This study should be performed by an agronomist specialized in these crops, and a food technologist with experience in peanut and sesame processing.

b. The preparation of an export market study for tehina and other sesame and peanut products. This study should be carried out by a team of experts including an economist and a market researcher, with the assistance of a food technologist.

F. Spice Growing and Processing

a. The preparation of a preliminary study in order to define the spices with potential to be grown and processed in System "H". This study will cover spices already grown for self-consumption and the introduction of suitable new spices for the local market. A team of experts including an agronomist specialized in spice growing, a technologist with experience in handling and processing of spices, and an economist, are recommended to take part in the preparation of this study.

b. The preparation of an export market research for selected spices and spice products, suitable to the regions of System "H", in accordance with the overall spice development strategy for Sri Lanka. It is recommended that a spice expert should participate in this assessment.

G. Animal Feed

a. Based on the program evaluating the livestock development in System "H" (see C-a of para. 5.11), it is advisable to perform a detailed study which defines the demand for animal feed, feed alternatives, availability of raw material, prices, quantities, etc. This program could be part of the C-a study and prepared by the same team of experts which includes, among others, an animal nutrition specialist.

5.11.2 Breakdown and Schedule of Implementation

The technical assistance presented above is herewith analyzed, in accordance with the nature of activity, as follows:

Studies

- Master Plan: C-a; C-b; D-a; G-a
- Economic Feasibility: B-b
- Agriculture: E-a; F-a
- Market: A-b; B-b; E-b; F-b

Technical Consulting: A-a; C-c; D-b

Training: A-a; C-c; D-b

R & D: B-a

Facilities: D-c

The schedule of implementation recommended for the proposed technical assistance is presented in the following Gant Chart.

SCHEDULE OF IMPLEMENTATION OF
TECHNICAL ASSISTANCE

Assistance	Year of Implementation			
	1st Year	2nd Year	3rd Year	4th Year
Studies				
- Master Plan	C-a	C-b		
	D-a	G-a		
- Economic Feasibility		B-b		
- Agriculture	E-a			
	F-a			
- Market		B-b	A-b	F-b
			E-b	
Technical Consulting	A-a	B-b		
			C-c	
Training	A-a	D-b		
			C-c	
R & D	B-a	D-b		
Facilities		D-c		

CHAPTER 6

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