D. フィールド レポート

(Field Report)

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DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

MINISTRY OF MAHAWELI DEVELOPMENT

MAHAWELI AUTHORITY OF SRI LANKA

FIELD REPORT

ON

THE FORMATION OF

INTEGRATED AGRICULTURAL DEVELOPMENT DEMONSTRATION PROJECT

IN

MEHAWELI AREA

DECEMBER 1984

PROJECT FORMATION TEAM

JAPAN INTERNATIONAL CO-OPERATION AGENCY

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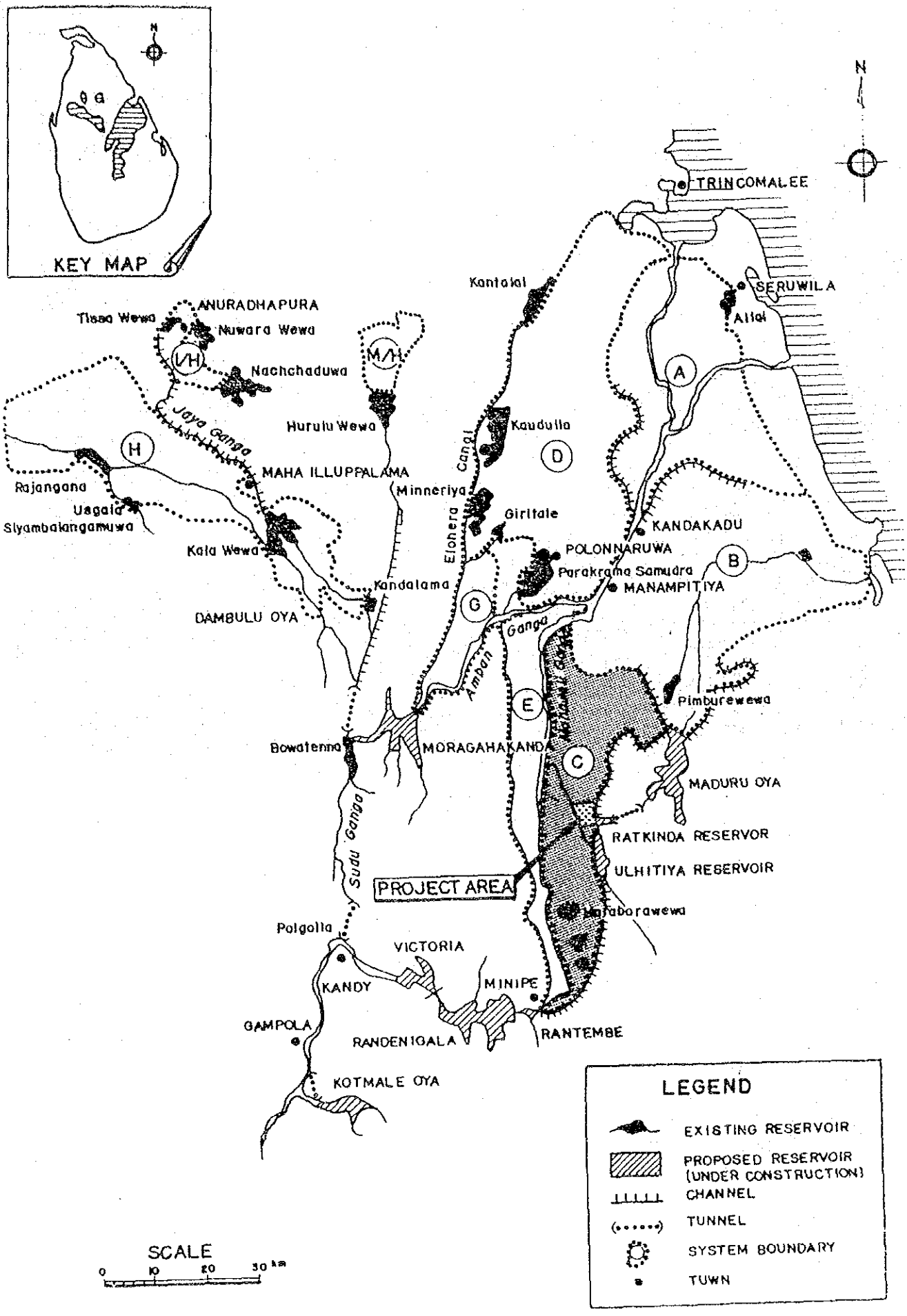
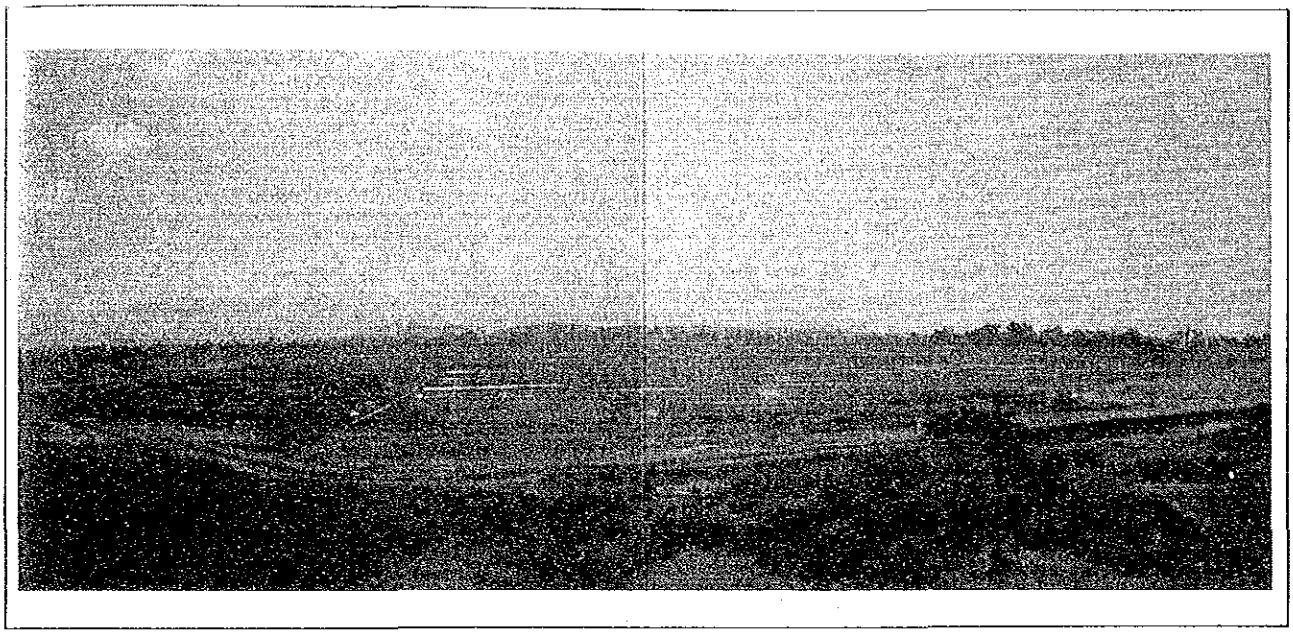

KEY MAP
N
TRINCOMALEE
Kantalai
SERUWILA
Allai
ANURADHAPURA
Tissa Wewa
Nuwara Wewa
Nachchaduwa
Jaya Ganga
Hurulu Wewa
Kaudulla
Elahera Canal
MAHA ILLUPPALAMA
Minneriya
Giritale
KANDAKADU
POLONNARUWA
Parakrama Samudra
MANAMPITIYA
Rajangana
Uagala
Siyambalangamuwa
Kala Wewa
Kandalama
DAMBULU OYA
Ganga
Amban
Pimburewewa
Bowatenna
MORAGAHAKANDA
MADURU OYA
RATKINDA RESERVOR
ULHITIYA RESERVOIR
PROJECT AREA
Sudu Ganga
Polgolla
VICTORIA
KANDY
MINIPE
GAMPOLA
RANDENIGALA
RANTEMBE
KOTMALE OYA
A
B
C
D
E
G
H
M
VH
LEGEND
EXISTING RESERVOIR
PROPOSED RESERVOIR (UNDER CONSTRUCTION)
CHANNEL
TUNNEL
SYSTEM BOUNDARY
TOWN
SCALE
0
10
20
30 km



A View from the Embarkment of Rathkinda Dam

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CHAPTER I INTRODUCTION OF STUDY

1.1 BACKGROUND OF FIELD STUDY

This Mission was dispatched by Japan International Cooperation Agency (JICA), the Government of Japan to formulate the draft detailed scheme of the Technical Cooperation and prepare the draft list of necessary machinery and facilities for the Technical Cooperation in accordance with the Tentative Note of Understanding on the technical cooperation framework of Integrated Agricultural Development Demonstration Project in Mahaweli Area between Sri Lanka Authorities concerned and Japanese Preliminary Survey Mission of the Project.

The Mission firstly prepared its Inception Report which describes the approaches to be taken for the formulation of the proposed Technical Cooperation for the Project.

Next, through a series of discussions with Mahaweli Economic Agency (MEA) of Mahaweli Authority of Sri Lanka (MASL) as Sri Lanka counterpart, making a field study at the proposed project area and visiting related organizations, the Mission formulated an Interim Report which mentions the Outline of the proposed Technical Cooperation. And the Mission presented it to MASL and came to reach a mutual consent on the major items regarding the detailed scheme of the Tehcnical Cooperation on 12th November, 1984.

Finally, the Mission made another field study once again at the project site and related organizations for the purpose of shaping a further concrete scheme of the Technical Cooperation.

1.2 Itinerary of Field Study

NO.	DATE		PLACE OF VISIT	ACTIVITIES
1.	October	4.	System C	- Travel from Colombo.
2.		5.	Office of Resident Project Manager System C	- Greeting Discussion on purposes of field and general informations. - Field observation in Blo. 302 & zone 2.3 - Discussion on proposed project and on individual fields.
3.		8.	Regional Research Station, Giranduru Kotte	- Discussion data collection.
4.		9.	University of Sri Lanka, Peradeniya	- Discussion and exchange view on post harvest.
5.		10.	Office of Resident Project Manager System C	- Field observation Unit 1, present facilities. - Soil examinations. - Discussion. - Selection on proposed machinery and processing plants.
6.		14.	Sigiriya	- Travel from System C
7.		15	Office of Resident Project Manager System H	- Field observation and data collection System H.
8.			Government Seed Farm, Pelwehera	- Collecting information on seed paddy production.
9.			Assistant Director Office, Pelwehera-	Discussion and collection of information on distribution of paddy seed.
			Paddy Storage and Rice Processing Center, Bulnewa	- Observation on facilities and data collection
10.			Flow monitoring Unit, Kalawewa	- Data collection on water management.
11.		16.	Regional Research Station, Mahaillupallama	- Data collection, discussion and on irrigation and method and water requirement.
12.			Concrete Pipeling Pilot Project	- Observation on irrigation systems.
13.			Rice Processing Research and Development Center, Anuradhapura	- Observation facilities, discussion and data collection.
14.			Farm Mechanization Research Center, Mahaillupallama	- Observation, discussion on farm mechanization and data collection.
15.		17.	Office of Resident Project Manager	- Discussion on water management.
16.			University of Sri Lanka, Peradeniya	- Discussion and exchange date on rice processing.
17.		18.	Colombo	- Travel from Kandy.
18.	November	15.	System C	- Travel from Colombo.
19		16. 29.	Office of Resident Project Manager	- Greeting, discussion on Interim Report
20.		17.	Government Seed Farm, Hingurakgoda	- Observation, discussion and data collection.
21.		18.	Government Sugar Corporation, Kantale	- Observation discussion on utilization, operation, repair and maintainance of of farm machinery. - Observation and discussion on water management and its facilities. - Travel to System C.

22.	November - 19. Office of Unit Manager, Millettewa, Ulhitiya 23. Wewa Medagama and Diyawiddagama	-	Conduction farmers survey
23.	20. Rice Millers in System C	-	Observation their facilities and collection.
24.	22. 20. Office of Resident Project Manager System G	-	Discussion and Observation on water management.
25.	24. Development Center, Giranduru Kotte	-	Collecting information and discussion on farm demonstration.
26.	25. Health Center, Giranduru Kotte,	-	Collecting information.
27.	26. Government Seed Farm, Alutharama	-	Data and information, collection on seed paddy production.
28.	Assistant Director Office, Alutharama	-	Collecting information on distribution of paddy seed.
29.	27. Office of Resident Project Manager	-	Discussion on Capital and recurrent budget and demecation between Regional Research Station and Development Center.
30.	27. Mid East Shopping Center, Mahiyangana	-	Observation on sale of agricultural machinary.
31.	Tractor Pool, MEA, System C	-	Observation and discussion on utilisation, operation, repair, maintanance of tractors and vehicles, supply and storage of spare parts.
32.	28. Office of Resident Manager	-	Discussion on cropping pattern for Demonstration. Experiment and Seed Farm and Draft for TIP.
33.	29. Central Rice Breeding Station, Batalagoda	-	Discussion and views exchange on paddy varieties in Sri Lanka. Travel from System C.
34.	30. Irrigation Training Institute, Galgamuwa	-	Collecting information on its activities.
35.	Office of Resident Project Manager, Tambuttegama, System H	-	Discussion and Observation on Concrete Pipeline Pilot Project assisted by USAID.
36.	Rice Processing Research and Development Center, Anuradhapura	-	Discussion adn data collection on rice quality and processing of paddy parboiling.
37.	Farm Mechanization Training Center, Anuradhapura	-	Observation on their activities.
38.	Sri Lanka Construction Industry Training Project, Galkulama	-	Observation on their activities.
39.	December - 1. Rice Millers, Anuradhapura and Srawastipura	-	Observation of facilities and sample collection.
40.	Experiment and Demonstration Farm, Block 408, System H, assisted Chinese Government	-	Discussion and field observation on their activities.
41.	Colombo	-	Travel from Anuradhapura.
42.	December 1-10 Studies		

In the latter parts of the field Trip, the Mission faced such unexpected hindrances and difficulties as Curfew imposed at the time of the communal troubles, heavy monsoon rains, etc.

CHAPTER II - FINDINGS OF FIELD STUDY

General feature of the proposed project area is mentioned below;

(1) Location of Project Site :
Unit 1, Block 308, System C, Mahaweli Project.

(2) Area of Project Site :
57.5 Acres (23 ha) in Unit 1. (see Fig.1, 2 & 3)

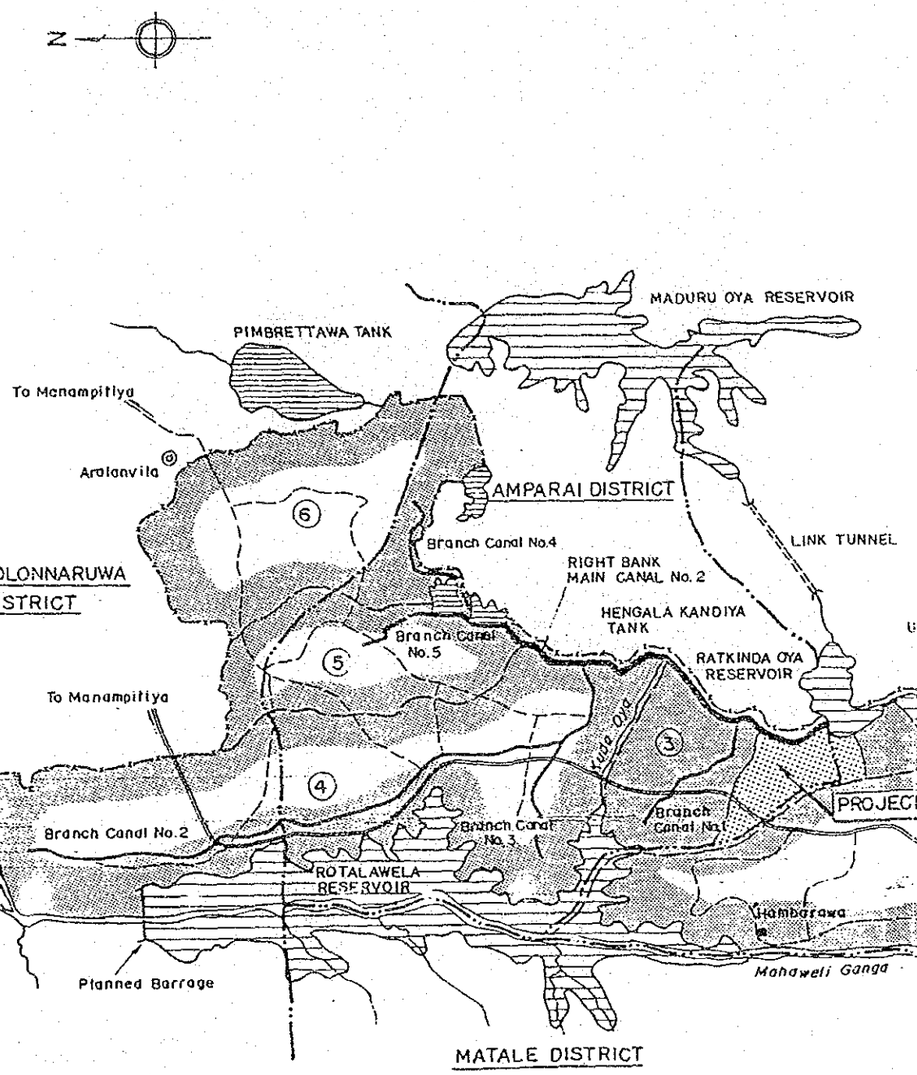
(3) Climate Conditions :
Climate Zone : Located in between Intermediate and Dry Zone.
Annual Rainfall : 1,850 mm.
Rainfall Distribution : 72% of annual rainfall is in Maha.
Mean Temperature : Max. 33.5°C - Min. 21.9 °C (see Fig. 4).

(4) Water Source :
D1 Canal Minor Branch Canal of Block 302, Rathkinda Main Canal.

(5) Soils in Unit 1 :
Higher portion : Well-drained RBEs
Lower portion : LHGs

(6) Settlement :
Unit 2 : 200 families (197 families from Kotmale)
Unit 3 : 194 families (194 families from Ampara)

(7) Organizations :
Organisation charts for System C and proposed Technical Co-operation Project are given in Fig 5 and Fig 6.



LEGEND

- Project Area
- Existing Tanks
- Tanks and Reservoir Under Construction
- Town
- Climatological Stations
- Main Roads
- Market / Link Roads
- Main Canals
- Branch Canals
- Rivers and Streams
- Zone Boundary
- System C Boundary
- District Boundary
- ① ~ ⑥ Zone No.

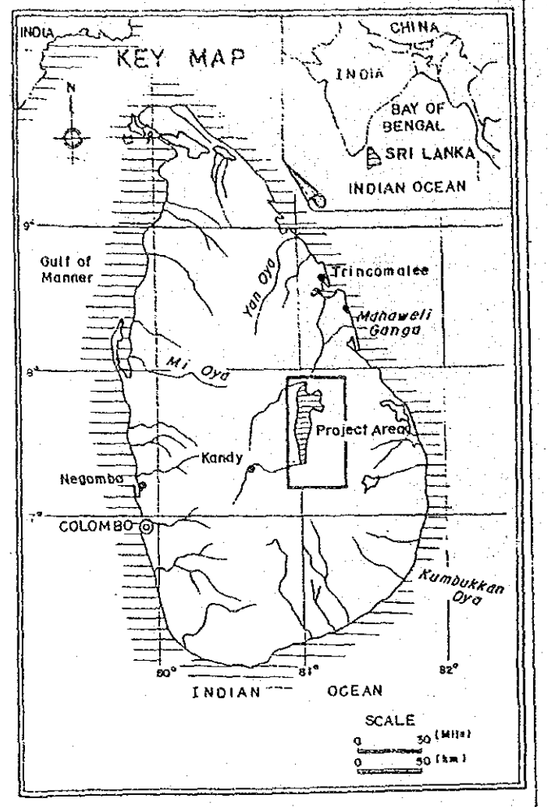


Fig. 1 GENERAL MAP

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA BASIC DESIGN STUDY ON ESTABLISHMENT OF PILOT DEMONSTRATION FARM IN MAHAWELI
GENERAL MAP
JAPAN INTERNATIONAL COOPERATION AGENCY TOKYO

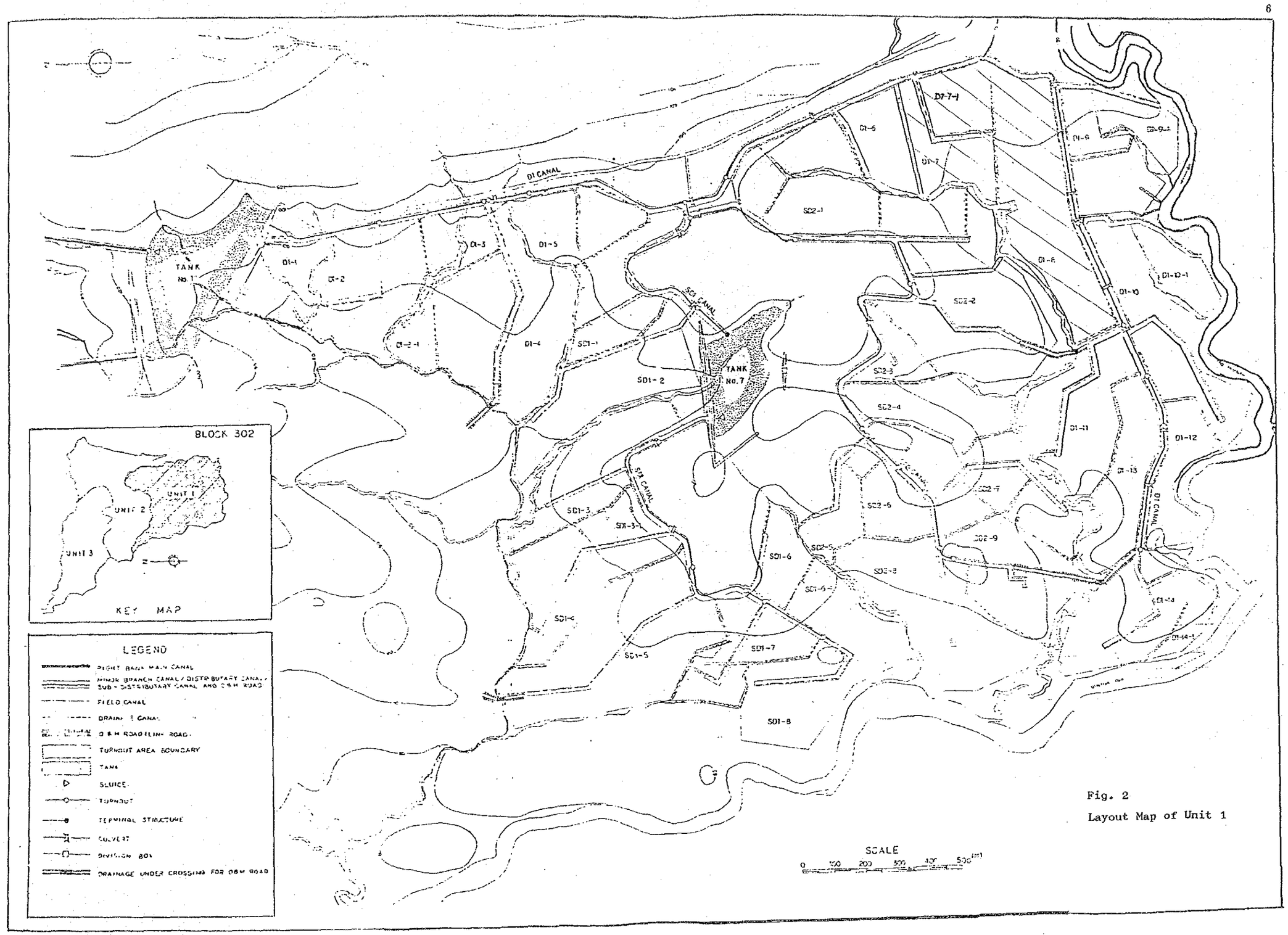


Fig. 2
Layout Map of Unit 1

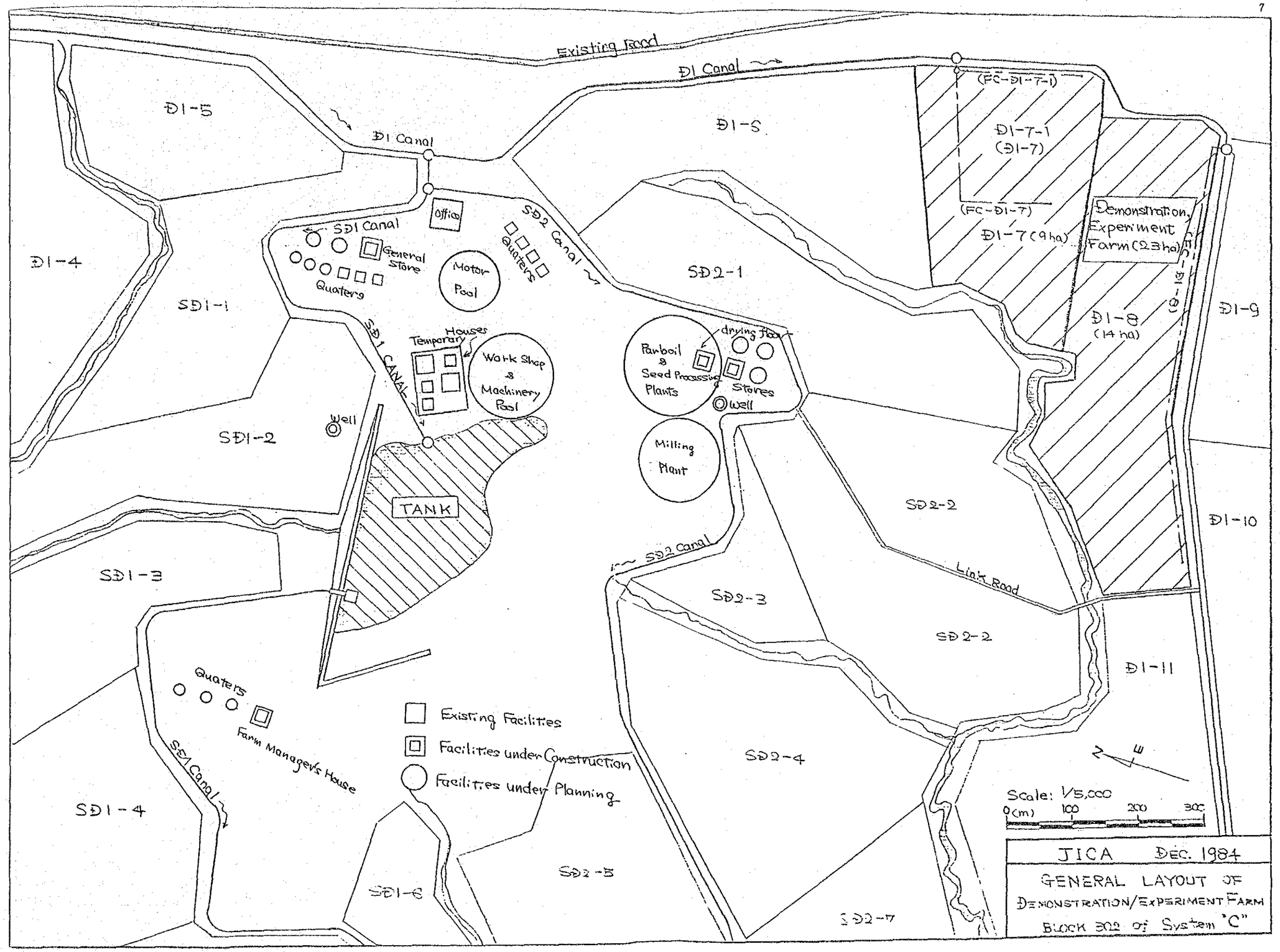

Existing Road
D1 Canal
D1-5
D1-6
(FC-D1-7-1)
D1-7-1
(D1-7)
(FC-D1-7)
D1-7 (9 ha)
Demonstration Experiment Farm (23 ha)
D1-4
SD1-1
SD1 Canal
Office
General Store
Quarters
Motor Pool
SD2 Canal
Quarters
SD2-1
D1-8
(14 ha)
D1-9
SD1 CANAL
Temporary Houses
Work Shop & Machinery Pool
Parboil & Seed Processing Plants
drying floor
Stores
Well
Well
SD1-2
Milling Plant
TANK
SD2-2
D1-10
SD2 Canal
Link Road
SD1-3
SD2-3
SD2-2
D1-11
Quarters
Farm Manager's House
SD1 Canal
Existing Facilities
Facilities under Construction
Facilities under Planning
SD1-4
SD2-4
SD1-6
SD2-5
SD2-7
N
E
Scale: 1/5,000
0 (m) 100 200 300
JICA Dec. 1984
GENERAL LAYOUT OF DEMONSTRATION/EXPERIMENT FARM
BLOCK D02 of System "C"

Fig. 4 CLIMATOLOGICAL FACTORS OBSERVED AT GIRANDUTUKOTTE

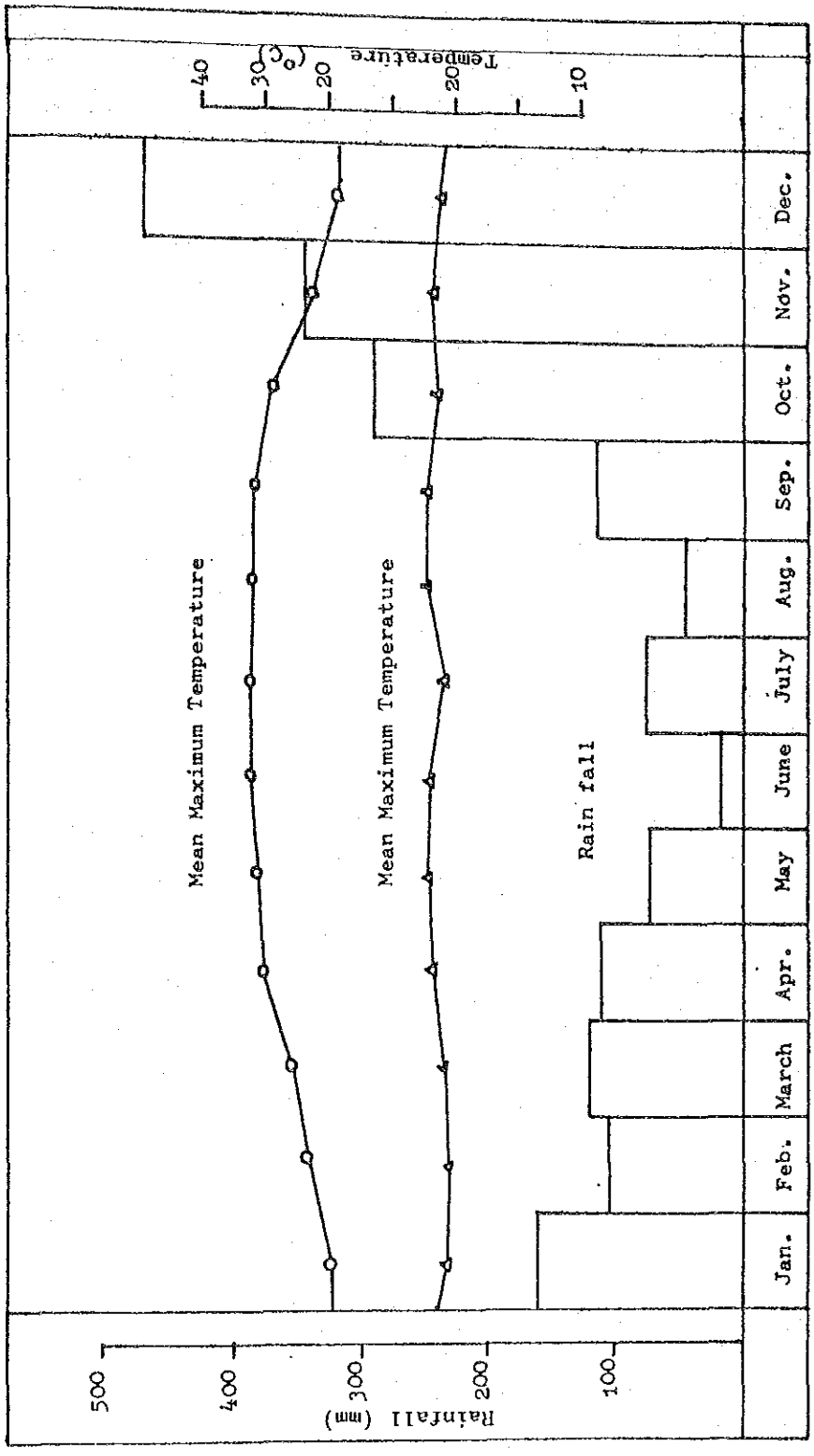
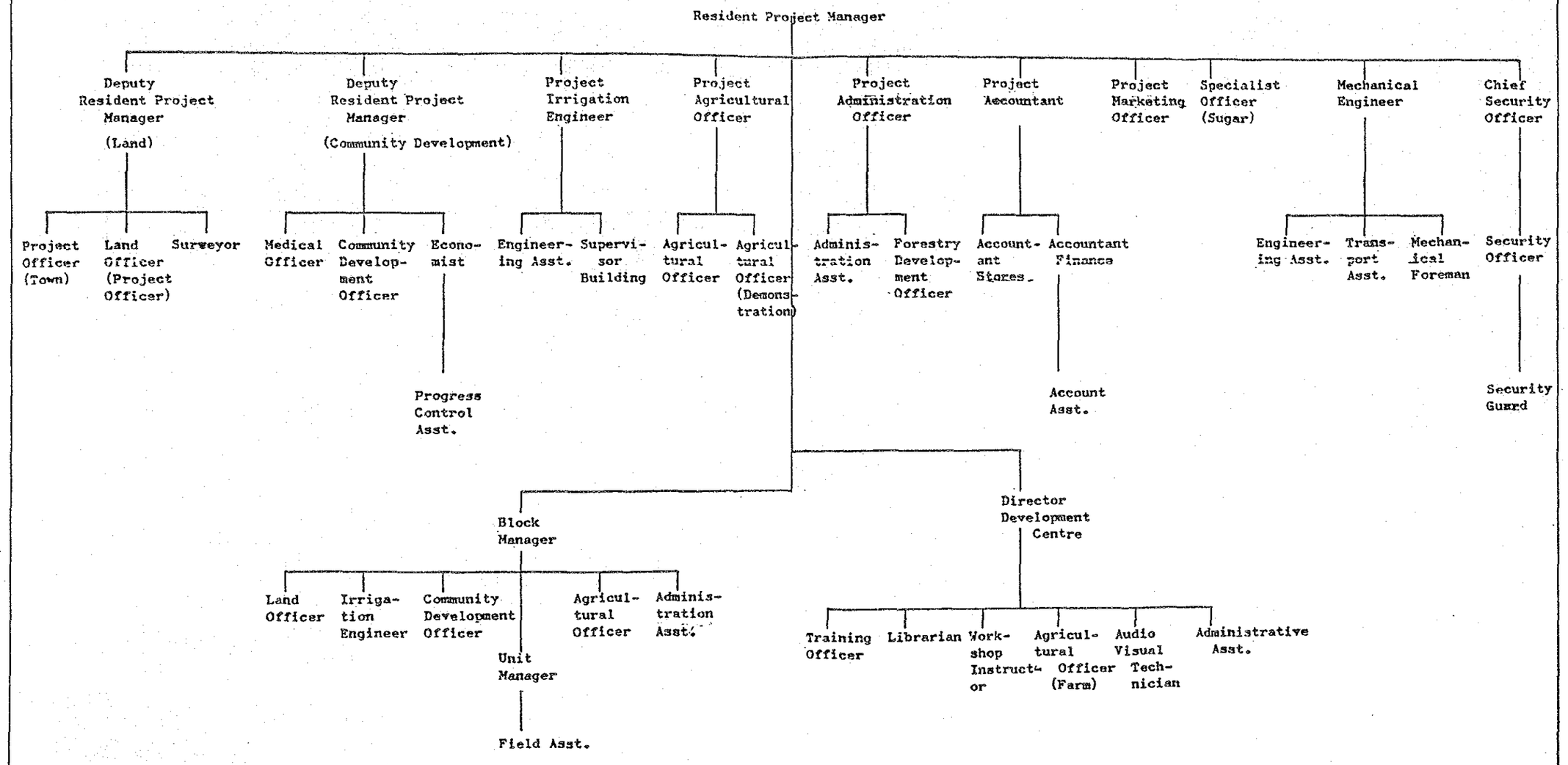
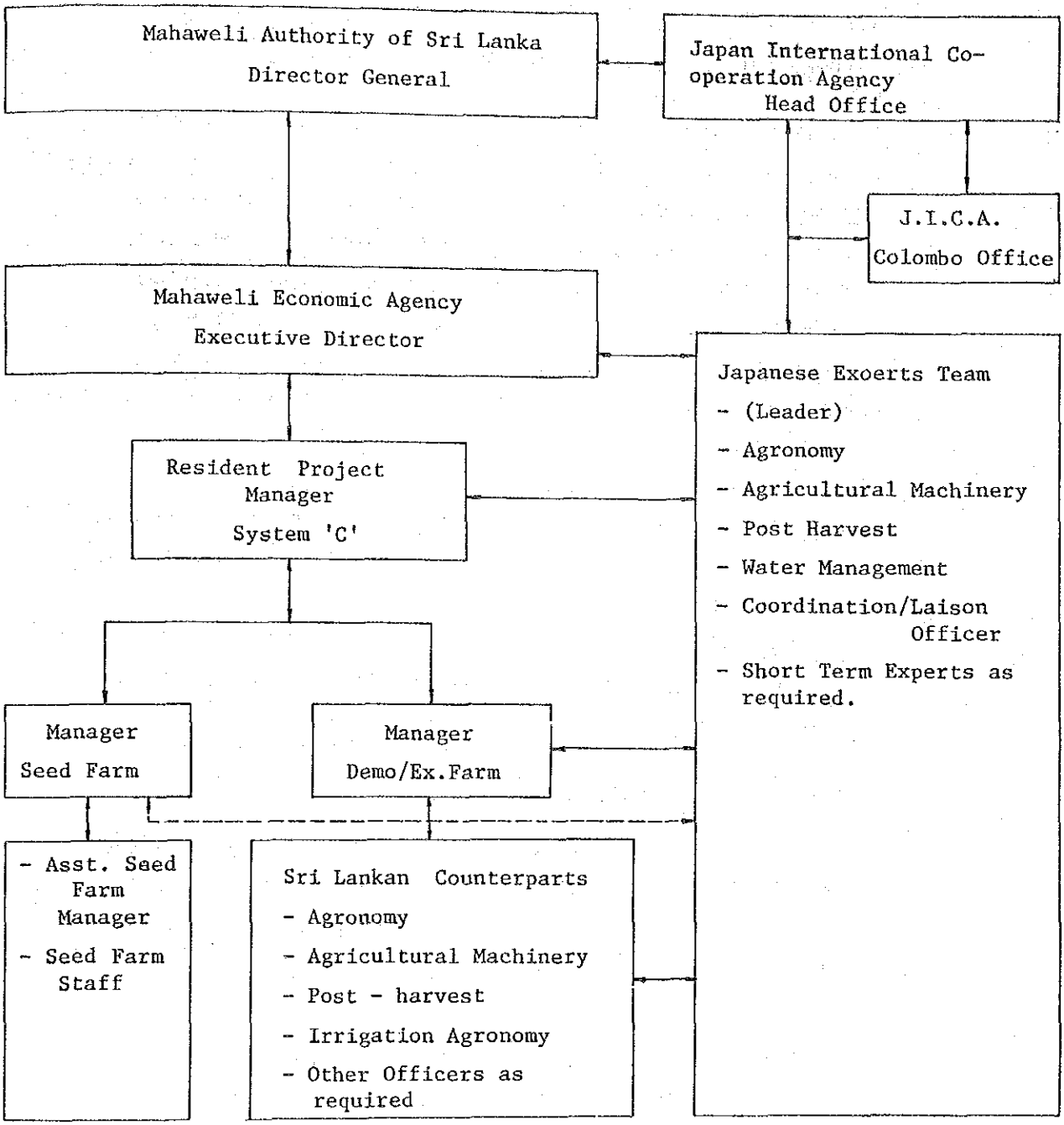


Fig. 5 ORGANIZATION CHART OF SYSTEM 'C' GIRANDURUKOTTE




Mahaweli Authority of Sri Lanka
Director General
Japan International Co-operation Agency
Head Office
J.I.C.A.
Colombo Office
Mahaweli Economic Agency
Executive Director
Japanese Exoerts Team
- (Leader)
- Agronomy
- Agricultural Machinery
- Post Harvest
- Water Management
- Coordination/Laison Officer
- Short Term Experts as required.
Resident Project Manager
System 'C'
Manager
Seed Farm
Manager
Demo/Ex.Farm
- Asst. Seed Farm Manager
- Seed Farm Staff
Sri Lankan Counterparts
- Agronomy
- Agricultural Machinery
- Post - harvest
- Irrigation Agronomy
- Other Officers as required

2.1 AGRONOMY

2-1-1 Current Cultivation practices in Zone 2 and Zone 3 area

(1) Paddy Cultivation

About 94% of the irrigable area (3567 ha) in zone 2 were cultivated with paddy in 1983/84 Maha while the corresponding figure for Yala 1984 was 3205 ha. In zone 3 100% of the allocated irrigable lands came under paddy cultivation in Maha 1983/84. However, only 405 ha went under paddy Yala 1984 due to shortage of irrigation water. It will be possible for thefarmers to cultivate the entire area under Zone 2 and 3 with paddy in 1985 Yala as irrigation water will be available.

Utlization of paddy lands for the cultivation of other field crops and vegetables is technically feasible and the MEA is considering to promote other crops in Yala in the upper liyaddas of the allotments which are well drained. Since the settlers have no experience on this type of cultivation changing over to these crops will be slow.

(i) Land Preparation

Land preparation for cultivation of paddy during Maha is done mainly by tractors (4 wheel tractor) i.e. is about 60 - 70% of the area while buffaloes are deployed in the balance area 30%.

(ii) Varieties of Paddy

Popular paddy varieties in Zone 2 and 3 are BG 34-8 and BG 276-5 (3 months varieties). Those varieties have a potential yield of 350 bu/ha. During 1982/83 Maha and 1983 Yala 60% of the area was under BG 34-8 while the balance 40% were cultivated with BG 276-5. However, in the subsequent season other new improved varieties i.e. BG 94-1 (3½ months), BG 379-2 and BG 400-1 (4-4½ months) were introduced to the cultivations.

(iii) Quality of seed paddy

Good quality seed paddy plays an important role not only to get high yeilds but also to get high quality rice. During the 1983/84 Maha season 50% of the farmers in Zone 2 and 60% in Zone 3 used certified seed paddy. But in 1984 Yala these figures came down to 6% and 31% for Zone 2 and 3 respectively. Most of the farmers use their own seed paddy which were collected from the previous year's crop raised from certified seed paddy.

Renewal of seed paddy once every 3-4 seasons is considered adequate. For the purpose of providing the farmers with good quality seed paddy under a well organized regular seed renewal scheme the establishment of a seed production farm within the system is a basic necessity.

(iv) Crop establishment and weeding

Broadcast sowing is distinctly popular compared to transplanting. This may be due to financial constraints and labour scarecity. Migration of labour from other populous areas during the cultivation season is comparatively less. Labour sharing (Attam) in their neighbourhoods is not yet fully established.

Experimental data indicates that there is hardly any difference in the yield between transplanted and broadcast sown paddy under ideal conditions. However, uneven germination and creation of vacancies under broadcast sowing cannot be avoided under normal field conditions. Therefore, transplanting has a definite advantage over broadcasting under local conditions. Furtherthe quality of paddy produced from broadcast sowing is inferior due to mixing of abortive paddy and weed seeds. Also Transplanting is an excellent method of weed control, since the paddy plants can smother the weeds in a short time. Due to the absence of smothering of weeds in broadcast paddy, weedicides will have to be used. The use of weedicides, however,is expensive.

Percentage transplanted during 1983/84 Maha and 1984 Yala seasons in Zone 2 and Zone 3 were only 2.6% and 9% respectively.

(v) Application of Fertilizer

Many farmers in Zone 2 are cultivating without the use of fertilizer. 80% of the farmers in Maha 1982/83 (their second Maha cultivation) 60% of the farmers in Yala 1983 did not apply any fertilizer. However, use of fertilizer is gradually improving with the effort of the MEA (Agriculture and Extension Division) extension service and 70% and 75% of farmers used fertilizer in 1983/84 Maha and 84 Yala respectively. But use of basal fertilizer is still very low.

The non application of fertilizer could be primarily attributed to lack of capital and secondarily to the uncertain yields under rainfed conditions. Under uncertain conditions investment in terms of fertilizer (which) they usually do not credit) could turn into highly increased fixed debts. They may also not have relied so much on fertilizer at their places of origin.

(vi) Pest Control

According to the information available at the Research Station Girandurukotte, leaf rollers and stem bores have been the major pests of the area. Fortunately there has been no serious threat of brown plant hopper which has caused severe damage at Ampara and other districts. However, the farmers are more concerned about control of pests and they use more pesticides which such interest is not shown towards use of fertilizer. Continious vigilance has to be maintained in respect of the brown plant hopper.

(viii) Harvesting and Threshing

Harvesting is done manually using the toothed sickel, using family and a few hired labour.

Threshing plays an important role in the production of quality rice. The traditional method of threshing is trampling by buffaloes and lately by running of 4 wheel tractors over the harvested paddy at the 'Kamata'. However, in this process gravel and other inpurities get mixed up, loweringthe quality of both the paddy and rice. In Zone 2 and 3 areas 65-70% settlers thresh paddy with 4 wheel tractors, while 30% use buffaloes. A small percentage (2-3%) resort to manual threshing where harvested paddy is trampled by men.

(viii) Yields

Yields varied from 20-100 bushels per acre while cases of complete crop failure has also been recorded. Average yields for Maha 1983/84 in Zone 2 and 3 have been 51 bu/acre and 40 bu/acre respectively. Low yields could be attributed to low or non application of fertilizer, poor weed control and broadcast sowing.

Paddy yields in Zone 2 and 3 are much lower than the national average in spite of the farmers using new improved varieties.

(2) Crop Diversification

The soils of System 'C' are of two main types, the Low Humic Glay Soils (LHG) and the Reddish Brown Earth (RBE). In the Zone 2 and 3 it is estimated that LHG and RBE occupy about 50% of the area each. This classification however, needs further investigation.

In System 'H', which is the first area to be developed and settled under the Mahaweli Programme, the entire irrigable area is grown under paddy during Maha season. However, during the Yala season, a considerable extent of well drained soils goes under other field crops, of which chillies is predominant. The preference towards cultivation of chillies is mainly due to the high net income obtainable from this

crop. This has resulted in a very limited extent to be grown under other crops such as pulses. However, it is predicted that Sri Lanka will reach self-sufficiency in chillie in near future. Under these circumstances, an attempt should be made to improve the standards of cultivation and thereby increase the production and net income from alterative crops to make it sufficiently attractive to induce farmers to take up their cultivation.

New cropping patterns in System 'C' were discussed among the Mission and Counterpart of MEA, and the following crops were listed i.e. Bombay Onion, Green Gram, Cowpea, Soyabean, Chillie and some exotic vegetables such as Sweet Melon, Water Melon and fruit vegetables. But chillie is only for self-consumption. Available data on crop budgets show that net return from adapting cropping patterns with above crops are more than that of a crop of paddy in RBE soils during Yala season. One study on crop buegets shows that net return from paddy pattern is Rs. 14,627 per hectare a year. The proposed cropping pattern of 1.0 ha paddy in Maha and 0.7 ha, paddy, 0.1 ha. Green Gram, 0.1 ha. Bombay Onion, 0.05 ha. Cabbage and 0.05 ha. Chilie (totally 0.3 ha. other crops in Yala) is Rs. 17,416 (Fig. 8). However, all crops especially vegetables, are very sensitive to the changing conditions of climate and soil, etc. Before introducing crops to the cropping pattern it is necessary to assess their adaptability to the new area.

(3) Highland Cultivation

The size of the highland allotments are 0.4 ha. and 0.2 ha. in Zone 2 and 3 respectively.

It is generally utilized for the establishment of homestead were both perennial and annual crops are planted. Planting materials for some of the recommended perennials such as coconut, banana, mango, orange, lime etc. are supplied by

the MEA. The dominant annual crops are the vegetables, pulses, maize, cassava and chillie. Problems of marketing the produce from home-gardens does not arise as diversified cropping practice prevents over-production. Further, a large part of the produce are used for family consumption.

2-1-2 EXTENSION SERVICE

Agricultural extension method adopted in the Project area is a modified 'Training and Visits System' and is under the direction of the DRPM (Agriculture) System 'C'. The proposed Demonstration Farm will maintain close links with the agricultural extensions mechanism through the DRPM (Agriculture) as well as the Development Centre, Girandurukotte, to strengthen the training component in extension.

2-1-3 OTHERS

(1) The FOB (Bankok) price of Thailand grade 1, white rice was around US $ 270/mt. in November, 1984. Dr. D. Senadhira, Chief Plant Director, at Central Rice Breeding Station at Batalagoda, Sri Lanka estimates the cost of production of exportable rice in Sri Lanka to be around US $ 294/mt. He assumed a average yield of 110 bu/ac. with 55% milling rate and a market price of Rs. 62.5/bushel. Therefore, Sri Lanka should explore the ways and means of reducing her produciton cost, to enter to the International Rice Market.

(2) Exportable High Quality Rice

The Central Rice Breeding Station has begun varietal development aimed at producing exportable high quality rice. At present two lines of high quality rice have been bred under the hybridization programme i.e, Is Bg 1 (Local x South America) and Is Bg 2 (Local x IR Line). The yield potential of these two varieties are estimated about 90% that of yield potential in varieties such as Bg 400-1 and Bg 379-2.

(3) Import of the Foreign Born Crops Seeds

Sri Lanka has liberalised the import of seeds, from other countries. The Department of Agriculture advises the importers on what kind of seeds they should imprt. The DA also closely monitor the imports of seeds.

The Department of Agriuclture has close linkage with :

(1) International Rice Research Institute (IRRI)

(2) International Maize and Wheat Improvement Institute (CIMMYT)

(3) International Potato Centre (CIP)

(4) International Institute for the Tropical Agriculture (IITA)

(5) International Crops Research Institute for Semi-Arid Tropics (ICRISAT) and

(6) Asian Vegetable Research and Development Centre (AVRDC)

As a result the Department of Agriculture has an active programme to exchange and obtain seeds of improved varieties from these organizations.

(4) Recommendation for the Proposed Technical Co-operation Project

(i) Production of High Quality Rice

(a) Introduction of high quality rice varieties such as IS Bg I (Local x IR Line) and Is BG 2 (Local x Ir Line) both of which are bred at the Central Rice Breeding Centre, and also to test Basmathi and any high quality rice in the world through the Director of the Department of Agriculture.

(b) Use of the clean seed paddy.

(c) Demonstration of Transplanting, Row seeding and Dapok nursery.

(d) Weed control by standing water, mechanical method (rotary weeder) and weedicide

(e) Optimum use of fertilizer

(ii) Crop Diversification

(a) Introduction of other field crops in Yala season. eg. Bombay Onion, Green Gram, Cowpea, Soyabean and exotic vegetables (Sweet Melon, Water Melon, Brinjal, Cucumber etc.). New varieties of seeds will be imported from Japan and Other Countries through the Director of the Department of Agriculture, Peradeniya if necessary.

(b) Demonstration of optimum cultivation methods for other field crops and vegetables.

(iii) Seed Farm

Provide necessary technical advices, such as techniques of raising of rice seedlings for transplanting, optimum weed control etc.

CROP BUDGET

Table 1 Paddy (Broadcasting) Yala (3 Month Variety) Per Acre

Operation and Inputs	Paying out Expenditure				Family Labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs Rs.	Family labour man days	Cost of Family labour Rs.
General Land preparation	1 . 13	38 . 00	42 . 94		0 . 27	10 . 26
1st Plough with 4 wheel Tractor	0 . 04	47 . 00	1 . 88	213 . 72	0 . 08	3 . 76
(with Buffaloes)	(0 . 20)	(37 . 00)	-	(187 . 50)	(2 . 32)	-
2nd Plough with 4 wheel Tractor	0 . 03	47 . 00	1 . 41	211 . 36	0 . 08	3 . 76
(With Buffaloes)	0	(37 . 00)		(225 . 00)	(3 . 14)	-
Harrowing with Buffaloes	1 . 84	38 . 00	69 . 92	144 . 23	-	-
Puddling & Levelling with Buffaloes	0 . 02	38 . 00	0 . 76	30 . 64	0 . 73	27 . 74
Planting Bands	1 . 84	35 . 00	64 . 40		0 . 49	17 . 15
Seed Paddy		1 bushel 82 . 50		2 bushels 165 . 00		
Broadcasting	1 . 79	29 . 00			1 . 09	31 . 61
Basal dressing V				75 Kg 225 . 00		
1st Top - dressing Urea				40 Kg 120 . 00		
2nd Top - dressing TDM				40 Kg 120 . 00		
Application of Fertilizer	0 . 49	35 . 00	17 . 15		0 . 37	12 . 95
Weed Control with Weedicide	0 . 37	44 . 00	16 . 28	Weedicides 268 . 54	0 . 22	9 . 68
(Weed Control with Manually)	(6 . 99)	(38 . 00)	(265 . 62)		(0 . 30)	(11 . 40)
Pesticides				264 . 57		
Application of Pesticides	0 . 77	32 . 00	24 . 64		0 . 34	10 . 88
Gravity Irrigation	1 . 30	36 . 00	46 . 08		5 . 54	199 . 44
Bird Scaring & Watching	4 . 24	25 . 00	106 . 00		-	-
Harvesting & Transport to Threshing Floor	5 . 15	26 . 00	133 . 90		2 . 64	68 . 64
Threshing with 4 wheel Tractor	3 . 43	36 . 00	123 . 48	193 . 82	0 . 53	19 . 08
Winnowing with Fan	0 . 72	28 . 00	20 . 16	-	1 . 95	54 . 60
Transporting Produce to Stores	0 . 61	30 . 00	18 . 30	50 . 59	-	-
T O T A L	23 . 77		687 . 30	2,007 . 47 (2,694 . 77)	14 . 33	469 . 55
Gross Income	Yield Per Acre upper field 85 . 00 bushels		@ Rs. 62 .50 per bushel	5,312 . 50		
Net Income (Excluding Family Labour)			(Rs)	2,617 . 73 (6544)		

Source : Cost of Cultivation of Agricultural Crops - Yala 1983 Paddy, Kalawewa Department of Agriculture, modified.

Table 2

CROP BUDGET

Paddy (Transplanting) Yala (3½ Months Variety) Per Acre

Operation and Inputs	Paying out Expenditure				Family Labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery Rs.	Family labour man days	Cost of family labour Rs.
General Land Preparation	1 . 13	38 . 00	42 . 94		0 . 27	10 . 26
1st Plough with 4 wheel Tractor	0 . 04	47 . 00	1 . 88	213 . 72	0 . 08	3 . 76
2nd Plough with 4 wheel Tractor	0 . 03	47 . 00	1 . 41	211 . 36	0 . 08	3 . 76
Harrowing with Buffaloes	1 . 87	38 . 00	69 . 92	144 . 23	-	-
Puddling & Levelling with Buffaloes	0 . 02	38 . 00	0 . 76	30 . 64	0 . 73	27 . 74
Plasting Bunds	1 . 84	35 . 00	64 . 40		0 . 49	17 . 15
Nursery Preparation and Management	2 . 00	35 . 00	70 . 00		2 . 00	70 . 00
Seed Paddy				1 bushel 82 . 50		
Fertilizer & Insecticides				120 . 00		
Transplanting with uprooting	19 . 00	29 . 00	551 . 00		1 . 00	29 . 00
Basal dressing V				75 Kg 225 . 00		
1st Top - dressing Urea				75 Kg 225 . 00		
2nd Top - dressing TDM				50 Kg 150 . 00		
Application of Fertilizer	0 . 60	35 . 00	21 . 00		0 . 40	14 . 00
Weed Control with Manually	6 . 99	38 . 00	265 . 62		0 . 30	11 . 40
Pesticides				264 . 57		
Application of Pesticides	0 . 77	32 . 00	24 . 64		0 . 34	10 . 88
Gravity of Irrigation		36 . 00			5 . 75	207 . 00
Bird Scaring & Watching	4 . 24	25 . 00	106 . 00		-	-
Harvesting& Transport to Threshing Floor	5 . 15	26 . 00	133 . 90		2 . 64	68 . 64
Threshing with 4 wheel Tractor	3 . 43	36 . 00	123 . 48	145 . 91	0 . 53	19 . 08
Winnowing with Fan	0 . 72	28 . 00	20 . 16		1 . 95	54 . 60
Transporting Produce to Stores	0 . 61	30 . 00	18 . 30	50 . 59	-	-
T O T A L	49 . 73		1,515 . 41 3,426 . 84	1,911 . 93	12 . 35	547 . 27
Gross Income	Yield Per Acre upper field 100.00 bushels		@ Rs. 62.50 per bushel	6,250 . 00		
Net Income (Excluding Family Labour)			(Rs)	2,823 . 16 (7057)		

Source : Cost of Cultivation of Agricultural Crops - Yala 1983 Paddy, Department of Agriculture, modified.

CROP BUDGET

Table 3 Paddy (Broadcasting) Maha (4-4½ Month Variety) Per Acre

Operation and Inputs	Paying out Expenditure				Family Labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs Rs.	Family labour man days	Cost of family labour Rs.
General Land Preparation	3 . 11	38 . 00	118 . 18		3 . 77	143 . 26
1st Plough with 4 wheel Tractor	0 . 37	47 . 00	17 . 39	213 . 72	0 . 56	26 . 32
2nd Plough with 4 wheel Tractor	-	47 . 00	-	211 . 36	0 . 50	23 . 50
Harrowing with Buffaloes	1 . 84	38 . 00	69 . 92	144 . 23	-	-
Puddling & Levelling with Buffaloes	2 . 31	38 . 00	87 . 78	30 . 64	1 . 53	58 . 14
Plasting Bunds	3 . 92	35 . 00	137 . 20		2 . 57	89 . 95
Seed Paddy				2 bushels 165 . 00		
Broadcasting	1 . 13	29 . 00	32 . 77		1 . 41	40 . 89
Basal - dressing V Mix				75 Kg 225 . 00		
1st Top - dressing Urea				50 Kg 150 . 00		
2nd Top - dressing TDM Mix				50 Kg 150 . 00		
Application of Fertilizer	-	35 . 00			0 . 79	27 . 65
Weed Control with Weedicides	0 . 09	44 . 00	3 . 96	268 . 54	0 . 56	24 . 64
Pesticides				264 . 57		
Application of Pesticides	0 . 08	32 . 00	2 . 56		0 . 41	13 . 12
Gravity Irrigation	-	36 . 00	-		6 . 75	24 . 30
Bird Scaring and Watching	4 . 24	25 . 00	106 . 00		-	-
Harvesting & Transport to Threshing Floor	6 . 91	26 . 00	179 . 66		4 . 12	107 . 12
Threshing with 4 wheel Tractor	2 . 32	36 . 00	83 . 52	145 . 91	0 . 91	32 . 76
Winnowing with Fan	1 . 06	28 . 00	29 . 68		0 . 51	14 . 28
Transporting Produce to Stores	0 . 08	30 . 00	2 . 40	51 . 79	0 . 27	8 . 10
T O T A L	27 . 46		871 . 02	2,020 . 76 (2,891 . 78)	23 . 66	816 . 73
Gross Income	Yield Per Acre 90 . 00 bushels		@ Rs. 62 .50 Per bushel	5,625 . 00		
Net Income (Excluding Family Labour)			(Rs)	2,733 . 22 (6, 833)		

Source : Cost of Cultivation of Agricultural Crops - Maha 1983/84
Paddy, Department of Agriculture, modified

CROP BUDGET

Table 4 Paddy (Transplanting) Maha (4-4½ Month Variety) Per Acre

Operation and Inputs	Paying out Expenditure				Family Labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs Rs.	Family labour man days	Cost of family labour Rs.
General Land Preparation	3 . 11	38 . 00	118 . 18		3 . 77	143 . 26
1st Plough with 4 wheel Tractor	0 . 37	47 . 00	17 . 39	213 . 72	0 . 56	26 . 32
2nd Plough with 4 wheel Tractor	-	47 . 00	-	211 . 36	0 . 50	23 . 50
Harrowing with Buffaloes	1 . 84	38 . 00	69 . 92	144 . 23	-	-
Puddling & Levelling with Buffaloes	2 . 11	38 . 00	87 . 78	30 . 64	1 . 53	58 . 14
Plasting Bands	3 . 92	35 . 00	137 . 20		2 . 57	89 . 95
Nursery Preparation & Management	2 . 00	35 . 00	70 . 00		2 . 00	70 . 00
Seed Paddy				1 bushel 82 . 50		
Fertilizer & Insecticides				120 . 00		
Transplanting with Uprooting	19 . 00	29 . 00	551 . 00		1 . 00	29 . 00
Basal Dressing V				75 Kg 225 . 00		
1st Top - dressing Urea				100 Kg 300 . 00		
2nd Top - dressing				50 Kg 150 . 00		
Application of Fertilizer	0 . 60	35 . 00	21 . 00		0 . 60	21 . 00
Weed Control with Manually	6 . 99	44 . 00	307 . 56		0 . 30	13 . 20
Pesticides				317 . 80		
Application of Pesticides	0 . 77	32 . 00	24 . 64		0 . 34	13 . 12
Gravity of Irrigation	-	36 . 00	-		6 . 75	243 . 00
Bird Scaring and Watching	4 . 24	25 . 00	106 . 00		-	-
Harvesting & Transport to Threshing Floor	6 . 91	26 . 00	179 . 66		4 . 12	107 . 12
Threshing with 4 wheel Tractor	2 . 32	36 . 00	83 . 52	193 . 82	0 . 91	32 . 76
Winnowing with Fan	1 . 06	28 . 00	29 . 68		0 . 51	14 . 28
Transporting Produce to Stores	0 . 08	30 . 00	2 . 40	51 . 79	0 . 27	8 . 10
T O T A L	55 . 52		1,805 . 93 (3,846 . 73)	2,040 . 86	25 . 17	892 . 63
Gross Income	Yield Per Acre 110 bushels		@ Rs. 62. 50 per bushel	6,875 . 00		
Net Income (Excluding Family Labour			(Rs)	3,028 . 27 (7,570)		

Source : Cost of Cultivation of Agricultural Crops - Maha 1983/84 Paddy, Department of Agriculture, modified.

Table 5 CROP BUDGET

Cowpea (Green Gram, Soyabean) Irrigated Per Acre

Operation and Inputs	Paying out Expenditure				Family labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs	Family labour man days	Cost of family labour Rs.
Grand Land Preparation	0 . 20	27 . 50	5 . 50		6 . 42	176 . 55
1st Plough with Buffaloes	0 . 05	26 . 50	1 . 33		1 . 87	49 . 55
Harrowing with Buffaloes	0 . 20	26 . 00	5 . 20		2 . 71	70 . 46
Preparation of Beds and Ridges	2 . 25	24 . 50	55 . 12		3 . 37	82 . 57
Seeding	0 . 90	27 . 50	24 . 75	Seed : 68 Kg 90 . 00	4 . 44	122 . 10
Basal Dressing				V : 50 Kg 150 . 00		
Top dressing				Urea : 25 Kg 75 . 00		
Application of Fertilizer	0 . 40	27 . 50	11 . 00		0 . 81	22 . 27
Weed Control Manually	1 . 51	28 . 50	43 . 04		7 . 53	214 . 60
Earthing - up	2 . 20	29 . 00	63 . 80		5 . 91	171 . 39
Pesticides				115 . 00		
Application of Pesticides	0 . 28	25 . 50	7 . 14		1 . 33	33 . 92
Gravity Irrigation	0 . 35	25 . 00	8 . 75		3 . 50	87 . 50
Bird Scaring	-	25 . 00	-		15 . 10	377 . 50
Harvesting & Transport to Threshing Floor	2 . 10	31 . 00	65 . 10		9 . 63	298 . 53
Threshing Manually	0 . 26	27 . 50	7 . 15		2 . 77	76 . 18
Winnowing Manually	0 . 17	28 . 00	4 . 76		1 . 15	32 . 20
Processing (Drying)	0 . 25	30 . 00	7 . 50		1 . 78	53 . 40
TOTAL	11 . 12	Cowpea	310 . 13	430 . 00	68 . 32	1,868 . 72
			Cowpea 740 . 13 Green gram 1040 . 00 Soya bean 940 . 00			
Gross Income	Yield Per Acre - under good management Cowpea 700 Kg. Rs. 3850 . Rs. 5.5/Kg Green gram 550 Kg. Rs. 4125 . Rs. 7.50/Kg Soyabean 650 Kg. Rs. 3900 . Rs. 6 / Kg.					
Net Income (Excluding Family Labour)			Ac.	(Ha)		
	Cowpea	Rs.	3110	(7775)		
	Green Gram	Rs.	3080	(7700)		
	Soyabean	Rs.	2960	(7400)		

Source : Cost of Cultivation of Agricultural Crops - Yala 1983
Other Field Crops, Department of Agriculture, modified.

Table 6

CROP BUDGET
Bombay Onion in Yala (Irrigated) Per Acre

Operation and Inputs	Paying out Expenditure				Family labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs	Family labour man days	Cost of family labour Rs.
Nursery Preparation & Establishment	5 . 84	30 . 00	175 . 20		34 . 76	1,042 . 80
Nursery Fertilizer	1 . 39	31 . 00	43 . 09	V, urea, TDM 45 Kg 135 . 00	2 . 28	70 . 68
Nursery Weed Control	0 . 75	30 . 00	22 . 50		6 . 27	188 . 10
Nursery Pest Control	-	32 . 00	-	Pesticides 145 . 05	1 . 26	40 . 32
General Land Preparation	1 . 52	34 . 00	51 . 68		1 . 47	49 . 98
1st Plough with Buffaloes	0 . 98	34 . 00	33 . 32		1 . 44	48 . 96
(1st Plough with 2 wheel Tractor)	(0 . 47)	(40 . 00)	(18 . 80)		(0 . 81)	(32 . 40)
Harrowing with Buffaloes	0 . 85	34 . 00	28 . 90		1 . 42	48 . 28
(Harrowing with 2 wheel Tractor)	(0 . 51)	(40 . 00)	(20 . 40)		(0 . 72)	(28 . 80)
Preparation of Beds & Ridges	13 . 42	32 . 00	429 . 44		7 . 66)	245 . 12
Transplanting	12 . 25	28 . 00	343 . 00	500 . 83	20 . 41	571 . 48
Basal Dressing				V : 125 Kg 375 . 00		
1st Top - dressing				Urea : 125 Kg 375 . 00		
2nd Top - dressing				TDM : 100 Kg 300 . 00		
Application of Fertilizer	2 . 97	36 . 00	106 . 92		9 . 59	345 . 24
Weed Control Manually	14 . 47	28 . 00	405 . 16		22 . 96	642 . 88
Loosening Soil	9 . 21	34 . 00	313 . 14		14 . 08	478 . 72
Pest Control	1 . 46	35 . 00	51 . 10	Pesticides 494 . 95	3 . 31	115 . 85
Gravity Irrigation	3 . 55	30 . 00	106 . 50		14 . 42	432 . 60
Harvesting	3 . 14	34 . 00	106 . 76		8 . 63	293 . 42
Processing (cleaning & drying etc.)	1 . 65	35 . 00	57 . 75		6 . 10	213 . 50
T O T A L	73 . 45		2,274 . 46	2,325 . 83 (4,600 . 29)	156 . 06	4,826 . 93
Gross Income	Yield Per Acre At present in Dry Zone 1000 Kg / Ac. Under good management 2000 Kg / Ac.		@ Rs. 5.25/ Kg.	10,500 . 00		
Net Income (Excluding Family labour)			(Rs)	5,809 . 71 (14 , 750)		

Note : (1) Target Yield : 3,000 Kg / Ac.
(2) Necessary labour force is about 230 man days for 05 months

Source : Cost of Cultivation of Agricultural Crops - Yala 1983
Other Field Crops, Department of Agriculture, modified.

CROP BUDGET

Table 7

Cabbage, Yala (Irrigated) Per Acre

Operation and Inputs	Paying out Expenditure				Family Labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs	Family labour man days	cost of family labour Rs.
Nursery Preparation & Establishment	3 . 69	29 . 00	107 . 01	Seed : 6.2 Oz. 261 . 85	4 . 17	120 . 93
Nursery Fertilizer	0 . 50	29 . 00	14 . 50	37 . 35	0 . 51	14 . 79
Nursery Pest Control	1 . 54	29 . 00	44 . 66	Veg. Mix 11.3 Kg 34 . 26	0 . 22	6 . 38
General Land Preparation	2 . 48	29 . 00	71 . 92		4 . 95	143 . 59
1st Plough with Buffaloes (1st Plough with 2 wheel Tractor)	21 . 15	29 . 00	613 . 35		9 . 10	263 . 90
Harrowing with Buffaloes (Harrowing with 2 wheel Tractor)	12 . 86	29 . 00	372 . 94		7 . 44	215 . 76
Preparation of Beds & Ridges					6 . 51	188 . 79
Transplanting	4 . 45	27 . 00	120 . 15		5 . 36	144 . 72
Basal Dressing				Veg . Mix 680 Kg 2,356 . 00		
1st Top - dressing				Urea 119 Kg 320 . 28		
2nd Top - dressing	-	-		- Lime 1000 kg 120 . 00		
Application of Fertilizer	4 . 26	29 . 00	123 . 54		4 . 60	133 . 40
Weed Control Manually / Loosening Soil	10 . 14	27 . 00	273 . 78		8 . 00	216 . 00
Pest Control	6 . 41	29 . 00	185 . 89	336 . 28	5 . 98	173 . 42
Gravity Irrigation	9 . 15	20 . 00	183 . 00	140 . 10	9 . 44	188 . 80
Watching	5 . 34	18 . 00	96 . 12	90 . 00	16 . 08	289 . 44
Harvesting & Transport	10 . 50	27 . 00	283 . 50	253 . 07	10 . 40	280 . 80
T O T A L	92 . 47		2,490 . 36	3,949 . 19	92 . 76	2,380 . 72
				6,439 . 55		
Gross Income	Yield Per Acre 7, 500 Kg		@ Rs. 1 . 86	13,950 . 00		
Net Income (Excluding Family Labour			(Rs)	7,510 . 45 (18,776)		

Source : Cost of Cultivation of Agricultural Crops - Yala 1983
Other Field Crops, Department of Agriculture, modified.

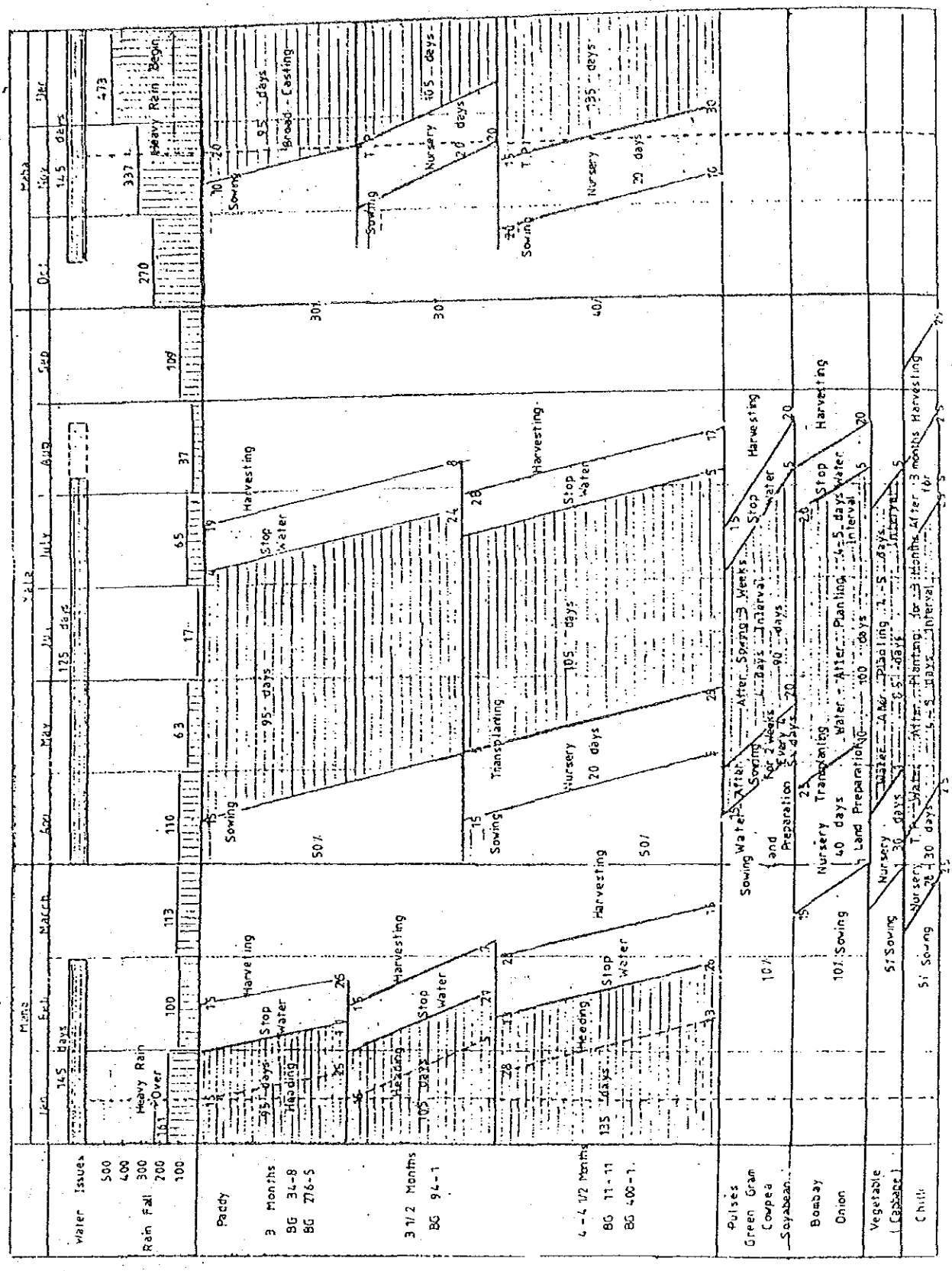
CROP BUDGET

Table 8 Chilli in Yala (Irrigated) Per Acre

Operation and Inputs	Paying out Expenditure				Family Labour	
	Hired labour man days	Wage rate Rs.	Labour charge Rs.	Cost of hire machinery and inputs	Family labour man days	Cost of family labour Rs.
Nursery Preparation & Establishment	0 . 68	29 . 00	19 . 72	-	3 . 38	98 . 02
Nursery Fertilizer	-	28 . 00	-	10 . 93	0 . 27	7 . 56
Nursery Weed Control	-	27 . 00	-	-	1 . 86	50 . 22
Nursery Pest Control	-	28 . 00	-	-	1 . 47	41 . 16
General Land Preparation	2 . 48	28 . 00	69 . 44	-	4 . 95	138 . 60
1st Plough with 2 wheel Tractor on contract	0 . 62	28 . 00	17 . 36	253 . 21	0 . 37	10 . 36
Harrowing with 2 wheel Tractor on contract	0 . 59	28 . 00	16 . 52	229 . 90	0 . 33	9 . 24
Preparation of Beds & Ridges	10 . 38	28 . 00	290 . 64	-	6 . 55	183 . 40
Transplanting	8 . 26	30 . 00	247 . 60	146 . 82	7 . 03	210 . 90
Fertilizer	13 . 17	27 . 00	355 . 59	721 . 22	4 . 97	134 . 19
Weed Control Manually	18 . 29	32 . 00	585 . 28	-	16 . 17	517 . 44
Earthing up	5 . 31	28 . 00	148 . 68	-	6 . 69	187 . 32
Pest Control	3 . 76	28 . 00	105 . 28	1,206 . 99	6 . 70	187 . 60
Gravity Irrigation	1 . 17	27 . 00	31 . 59	-	12 . 34	333 . 18
Harvesting	-	28 . 00	-	-	23 . 34	655 . 52
Processing	1 . 67	28 . 00	46 . 76	-	6 . 01	168 . 28
T O T A L	66 . 38		1,949 . 18 (3,918 . 29)	2,569 . 07	102 . 43	2,932 . 93
Gross Income	Yield Per Acre 800 Kg.		@ Rs. 21. 00	16,800 . 00		
Net Income (Excluding Family Labour)			(Ha)	12,881 . 71 (32,204)		

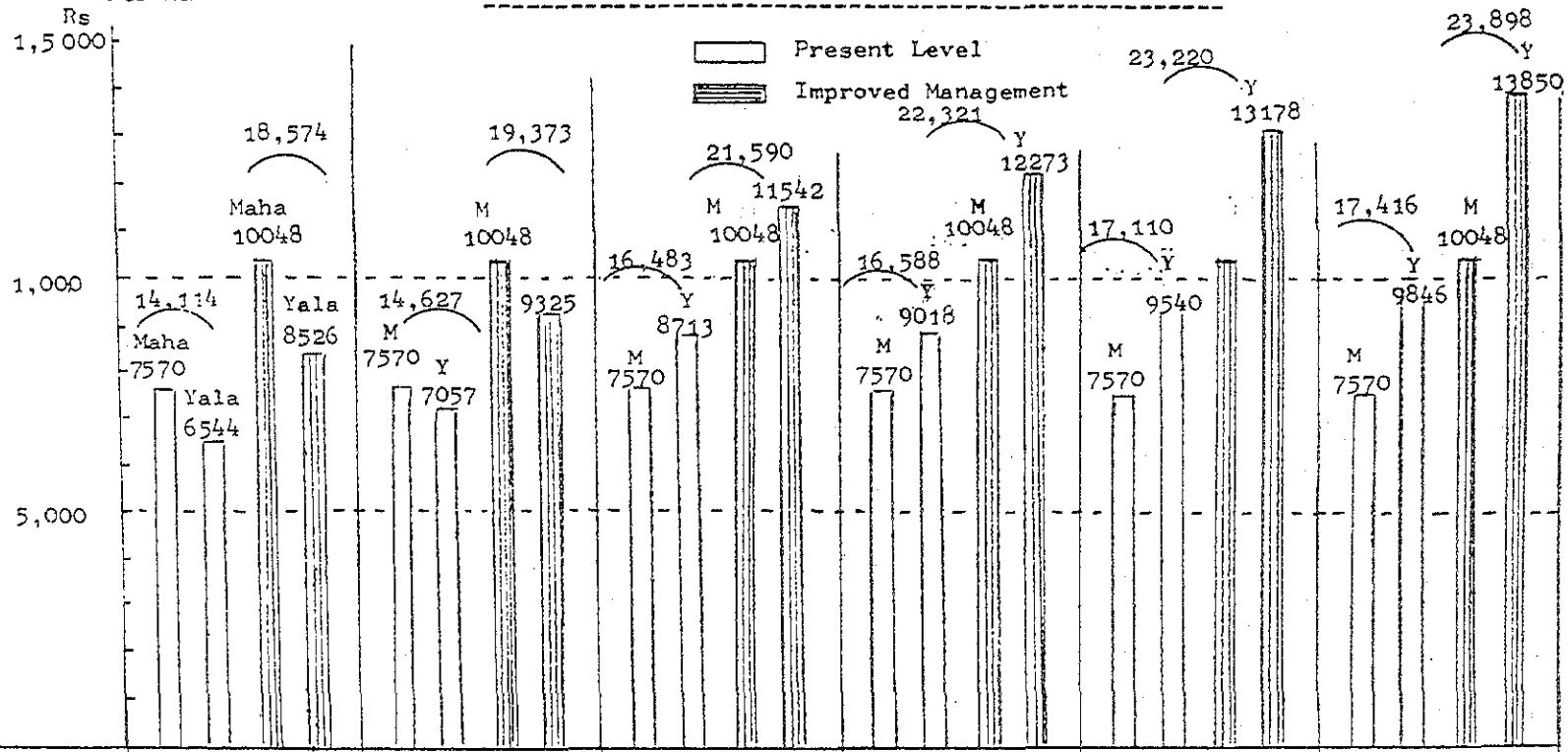
Source : Cost of Cultivation of Agricultural Crops - Yala 1983
Other Field Crops (Kalawewa), Department of Agriculture, modified.

(Fig. 7) Cropping Pattern In Demonstration And Experiment Project



Net Return Per Ha

Fig. 8 INCREASE IN FARMER'S ANNUAL NET AGRICULTURAL INCOME FROM THE NEW CROPPING PATTERN IN MAHAWELI 'C'



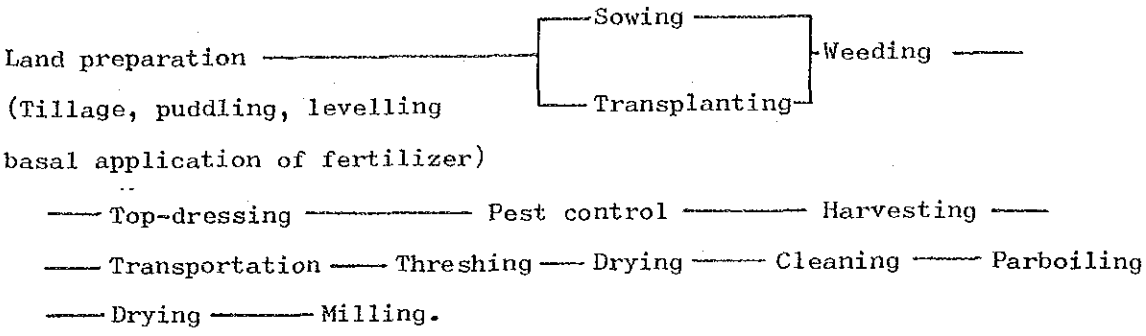
Cropping Pattern	1	2	3	4	5	6
	Ha	Ha	Ha	Ha	Ha	Ha
Maha	Paddy 4~4½ Months 1.0 Trans planting	Paddy Do 1.0	Paddy Do 1.0	Paddy Do 1.0	Paddy Do	Paddy Do
Yala	Paddy 3 Months 1.0 Broad-casting	Paddy 3½ Months 1.0 Trans planting	Paddy 3½ Months 0.7 T.P Chilli 0.05 Green gram 0.25	Paddy 3½ Months 0.7 T.P. Chilli 0.05 Green gram 0.25 Onion 0.05	Paddy 3½ Months 0.7 T.P. Chilli 0.05 Green gram 0.15 Onion 0.05 Cabbage 0.05	Paddy 3½ Months 0.07 T.P. Chilli 0.05 Green gram 0.10 Onion 0.10 Cabbage 0.05

Agricultural Machinery

01. Operational practices in paddy cultivation

Studies on operational practices were done in several paddy growing areas in Sri Lanka.

General operational practices adopted by farmers are shown below.



Most of the operations are done manually and by using animal power. Machinery is also utilized for some operations such as Tillage, Puddling, Pest Control and Threshing in the field. A case study done on present cultivation practices are shown in Table I.

1) Tillage

Most of the farmers plough their land using animal power with country draft plough which takes 12 to 20 bullock days per ha. for double tillage.

Some farmers hire tractors generally mounted with tine tillers and in case of hard soil either disc plough or disc harrows.

It was observed that no improved techniques on usage tractors are introduced yet.

2) Puddling

Puddling is generally done by using bullocks with some kind of toothed harrow and it takes 6 to 8 bullock days per ha.

Some farmers use power tiller with rotavator and mud wheels for this operation on hire basis.

3) Sowing

This is done mostly either by broadcasting or line drilling. Hand broadcasting is more popular in Sri Lanka and 2 hactares can be completed in a day. It was observed that farmers prefer this method as it is quicker and easier. They are not much concerned about the difficulties in weed control and more seed requirement involved when this method is adopted.

Fields with fine growth after line drilling were observed at Chinese assisted Demonstration and Experimental farm, Block 408, System 'H', Malwanagama.

Two types of hand drillers are being used now by some farmers and they are aware of that it makes the weed control easy and seed requirement less.

Farm Machinery Research Centre, Department of Agriculture too has introduced a hand driller to the farmers and improvements are now being done.

4) Transplanting

Transplanting is now becoming popular and some farmers accept this method even though it demands more labour, as it makes weed control easier and gives higher yields. Two methods, transplanting in lines and transplanting at random, are adopted for transplanting now. Some farmers are becoming familiar with improved nursery techniques and are willing to use simple mechanical transplanters.

5) Weed Control

Weed control is generally done by hand. This operation is rather difficult in broadcasted paddy fields and it requires about 30 man days per ha. In some transplanted fields a hand weeder similar to Japanese rotary hand weeder is being used now and it requires only 4 man days per ha.

Apart from the above methods few farmers use weedicides.

6) Pest Control

Knapsack hand operated sprayers are used for spraying liquid pesticides and the sprayers manufactured locally are available. When the paddy is in a heading stage knapsack dusters are used at present.
Sometimes granule type pesticides are also applied along with the application of top-dressing.

Fertilizer Application

Both basal and top-dressing application of fertilizer is done by manual broadcasting and it rquires 3 to 4 man days per ha.

02. Based on the observations made during the field visits and discussions had with the Officers of various Organizations and Research Institutes following operational practices and methods can he recommended for the improvement of paddy cultivation in Sri Lanka. Selection of machinery for the proposed project is also done basically on the above observations.

The recommended paddy cultivation practices and seasonal field operations are shown in Figure and Table respectively.

01) Land Preparation

Introduction of 8-10 P.S. Diesel engined power tiller equipped with rotavator, to the settlers is recommended, considering their field size and form.

Usage of bullocks for field operations in settlement areas in not recommended mainly for two reasons. One reason is that they damage irrigation and drainage canals and sometime even the fields and the other is that feeding them will likely to become a problem.

It was observed that at present the majority of new settled farmers in System 'C' do own neither draft animals nor power tillers. Therefore, it is recommended that they should be encouraged at this stage to own a power tiller of which the services may easily be shared among 5-7 farmers. With the power tiller land preparation in 5-7 hectares can be completed within the nursery period of 20 days.

Power tillers can also be used for other operations i.e. as a power source for thresher and winnower, transportation etc. Skillful and efficient operation and maintenance of the power tiller is very important and training facilities for this, is available at Farm Mechanization Training Centre, Department of Agriculture, Anuradhapura and a nominal fee of Rs. 10/= per day is charged by them.

It would be advantageous to provide some sort of assistance to the settlers to purchase power tillers considering the above facts.

02) Transplanting

Broadcasting is generally accepted in cultivation on large scale dry lands as extensive agriculture. But in intensive agriculture in irrigable lands and small scale cultivations transplanting should be accepted if higher yields and better crop management are expected. It was observed that transplanting requires more labour and almost same labour is required for weed control in broadcasted fields if it is done manually. It has also been observed that the weed growth in transplanted fields is less. Transplanting gives higher yields and ensure uniform growth in the fields thereby greatly reduce the presence of immature grains in threshed paddy which is essential for the production of high quality paddy. AT present hand operated transplanter which can be used with young or grown nursery is being developed at the Farm Machinery Research Centre, Maha Illuppallama. It is generally accepted that chemical weed control should be discouraged.

03) Weed Control

The weeds in the paddy fields are of three kinds namely, broad leaved, grasses and undesirable moss all of which affect the growth of paddy plants. Contamination of weed seeds with paddy lowers its quality.

During hand weeding the farmer has to work long hours in stooped position which is very strenuous and also hand weeding does not effectively control the moss.

Introduction of the hand weeder not only makes the operation easier but also control all types of weeds effectively.

This operaiton requires only 4 man days per hectare and the weeder can be easily manufactured locally.

04) Pest Control

Utilization of hand operated knapsack sprayer also can be considered as an advanced technique. But for efficient and faster application specially when larger areas are affected knapsack power sprayer is recommended.

03. In the Demonstration Farm of Integrated Agricultural Development Demonstration Project in Mahaweli 'C' area, semi mechanized farming techniques which will be accepted and adopted by the settlers in the future will be demonstrated.

Settler's fields in Block 302 and in other blocks are comparable in size and pattern to those of demonstration farm. Hence the farmers in the area will be greatly benefited by research programmes and demonstrations carried out by using the power tiller in the demonstration farm. It was observed that the average labour availability in the area is two labour units per family and a labour scarcity is anticipated at peak periods. Hence the introduction of small size 4 wheel tractor to the farm is recommended to ensure the timely completion of operations. Trials and experiments with the use of this small tractor too will be undertaken.

Field size of the fields in Unit 1 of Block 302 and soil resistances were measured and are shown in Table and .

Further use of rotavator is strongly recommended for land preparation.

The sizes of power tiller and the small tractor selected for the demonstration farm, were determined basically on the above observations and recommendations.

1) Average size of a plot in the demonstration farm is 25 M x 60 M (0.149 ha) and L/W ratio is 2.41 with these values 25 P.S. class 4 wheel tractor with rotavator gives 58% field efficiency.

2) Plot sizes in the experiment farm are as follows:-

   (1) 30 plots, of 15 M x 52.7 M (about 0.08 ha) with L/W ratio 3.5.

   (2) 13 plots, of 21.7 M x 51.8 M (about 0.112 ha) with L/W ratio 2.39.

   (3) Of 10 plots sizes not fixed yet.

   With these values over 65% field efficiency can be expected with 10 P.S. class power tiller with rotavator.

3) Selection of other machinery for field operations are based on the recommended cultivation practices shown in Table

   Introduction of the transplanter was greatly stressed by the Resident Project Manager, System 'C' to ease the peak labour requirement for this operations and further stated that improved nursing techniques which required for the use of this implement are available at present.

Introduction of the Reaper binder for harvesting not only minimize the labour requirement but also greatly reduce the lossses involved in trasnportation after harvesting.

At present improvement and development work on a binder is being done at the Farm Machinery Research Centre, Maha Illuppallama and they expressed their willingness to exchange views on this matter.

Power thresher will be introduced as a complete change of present methods were strongly recommended. Due consideration will be given for the introduction of locally manufactured power thresher which was originally developed by IRRI (International Rice Research Institute).

04) Completion of field operation in time is important for the timely production of quality seeds in the Government Farm. In this respect necessary assistances will be provided by the Japanese Experts.

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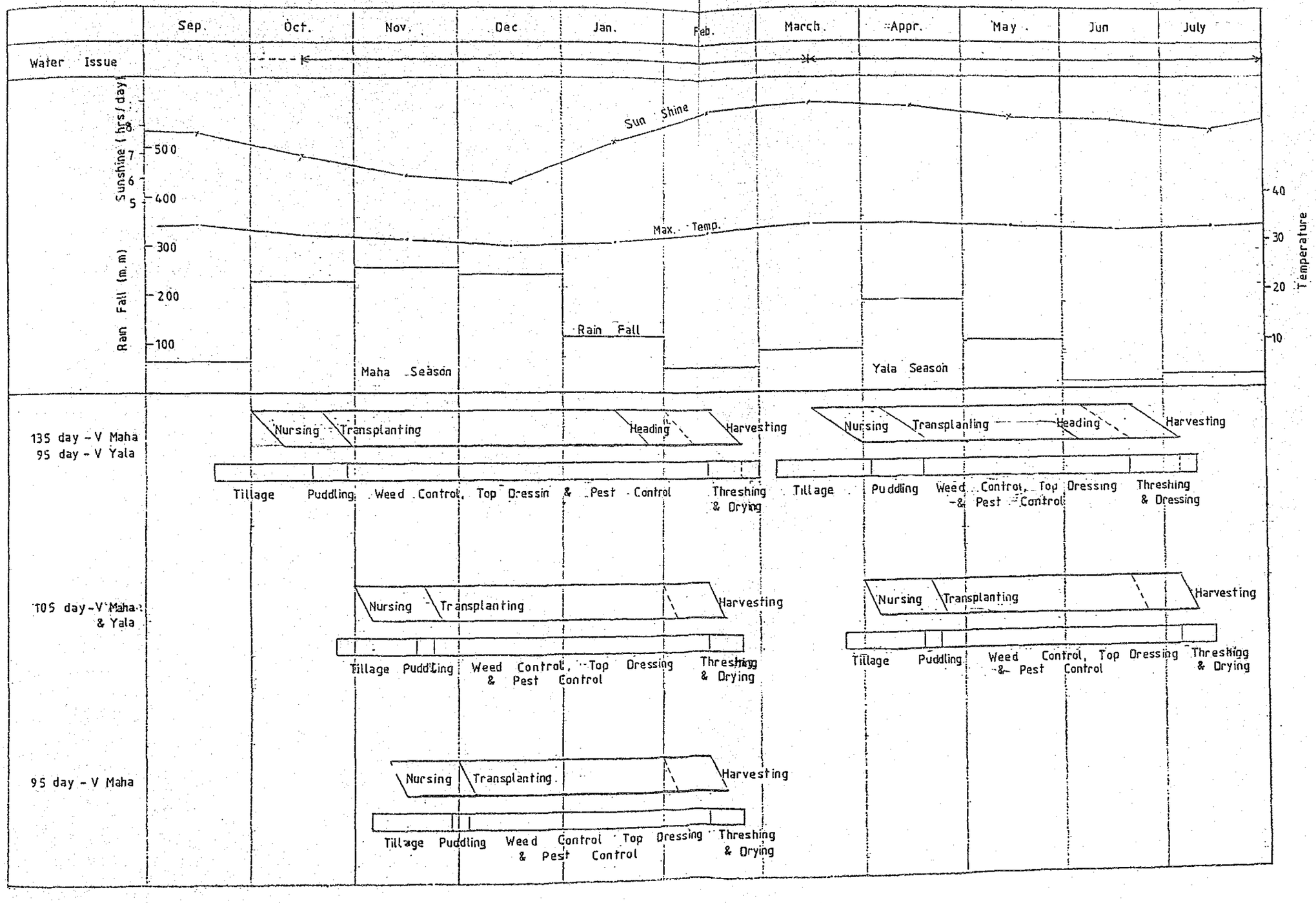
(Fig. 9) Proposed Cropping Pattern & Field Operation In Demonstration Farm.



(1) Table 9

PRESENT PADDY CULTIVATION PRACTICES
UNDER IRRIGATION - 1982

	Operation Item	Operation Method	Requirement per ha.
01.	1st ploughing	Bullock or Tractor	Bullock - 05 days or Tractor
02.	Innundation	Keep for two weeks under submerged condition	
03.	2nd ploughing	Bullock or Tractor	Bullock - 05 days or Tractor
	(In case of using tractor, 2nd ploughing and puddling are done at once)		
04.	Puddling	Bullock	Bullock - 04 days
	(Basal fertilization, Basal mixture)	Mannual	75 kg/ha.
05.	Final Puddling (levelling)	Mannual	04 man day
06.	Direct sowing or		2.5 man days
	Transplanting	Mannual	40 man days
07.	Field management	Knapsack type	
	(Pest control,	Mannual	46 man days
	weeding, fertilizing,	Pesticide	2 l.
	water management)	Urea	125 kg/ha.
08.	Harvesting	Mannual	25 man days
09.	Threshing	Mannual	100 man days
		Bullock	8 - bullock -
		or Tractor	5 days or Tractor

JICA Report- November 1982.

(2) Table 10

RECOMMENDED PADDY CULTIVATION PRACTICES

	Operation	Required Inputs	Requirements per ha.
01.	Seed Preparation	Seed	50 kg.
		Chemical	250 kg.
02.	Nursery	Labour	05 man days
		Fertilizer	30 kg.
		Insecticide	0.2 l.
		Power tiller	02 hours.
	(Area of nursery is 0.1 ha.)		
03.	Field Preparation		
	1st ploughing	Power tiller (7~10 P.S.)	15 hours
	Basal fertilizer	Fertilizer mixture	187 kg.
	Bund maintenance	Labour	10 man days
	Puddling & Levelling	Power tiller	05 hours.
04.	Transplanting (Including uprooting, transportation of seedling etc.)	Labour	40 man days
05.	Weeding	Hand weeder 2 times	
		Labour	04 man days
06.	Pest control	Insecticide	1 l. x 3 times
		Labour 3 times	1.5 man day
		Sprayer 3 times	08 hours.
07.	Top dressing	Urea	125 kg.
		TDM	125 kg.
		Labour	04 man days.
08.	Water management	Labour	10 man days
09.	Harvesting	Labour	20 man days
10.	Threshing	Thresher	08 hours
		Labour	10 man days.
	(Including Transportation of paddy, straw and related operations)		
11.	Others (Transportation, bagging & miscellaneous)		5% of above inputs.

* Basic design Survey Report - JICA 1982.

(3) Table 11

Field Size Table 12

		W m	L m Plot No.		Dimensions	L/W ratio
Demontration Farm	Medium Size	24.8	60.0	69	14.89	2.41
	Small Size	15.0	60.0	15	9.00	4.00
	Others	Unfixed about 25 plots				
Experiment Farm	Middium Size	21.7	51.8	13	11.25	2.39
	Small Size	15.1	52.7	30	7.95	3.49
	Others	Unfixed 10 Plots				

Soil Resistance Table 12

Plot No.	Depth (cm)										Average
Field No.	0	5	10	15	20	25	30	35	40	45	
P2 -2	3	12	36	38	45.3	45	-	-	-	-	22.3
-6	3	5.7	8.7	19.3	22.7	34	33.3	26	17	22	9.2
-9	3.3	14.3	30	38.7	41	39.7	42.7	42	41.5	36.7	21.6
	3.1	10.6	24.9	32	36.2	39.6	38	34	29.3	29.3	17.6
P3 -2	4.3	7.3	12.3	16.3	17	27	44	48	-	-	10.0
-4	5.6	12.7	25.3	33.3	41	47	48	-	-	-	19.2
-6	15.3	24	27.6	32	37	36	33	36.5	48	-	24.7
	8.4	14.7	21.7	27.3	31.7	36.7	41.7	42.3	48	-	18.3
P6 -1	9	19	22.7	19.3	16.7	17.3	18.7	20.7	23.3	22.7	17.5
-3	3	6.7	8.8	8	11	18.3	22.3	27.3	26.7	24.3	6.6
-5	3.3	12.3	15.6	20	29.3	31.3	31.7	33.3	43	48	12.8
	5.1	12.7	15.7	15.8	19	22.3	24.2	27.1	31	31.7	12.3
P11 -1	18.3	46.9	43	-	45	46	43	40	38	48	36.1
	7	12.7	22.3	37	45.5	48.5	49	-	-	-	19.7
	5.7	8.3	7	16	34.5	21	31	34	29	38	9.3
	10.3	22.6	24.1	26.5	41.7	38.5	41	37	33.5	43	20.9
P13 -1	19.3	30	26	26	23	37	42	50	-	-	25.3
-3	11	27.5	29	32.5	30	32	28	26	25	32	25
-5	6.3	17.5	23.5	21.5	26	25	30	34.5	43	42	17.2
	12.2	25	26.2	26.7	26.3	31.3	33.3	36.8	34	37	22.5

Post Harvest

To produce high quality rice is one of the most important subjects in Sri Lanka. Sri Lanka is likely to achieve sustainable level of rice self-sufficiency in the future. However, it can be said that the quality of rice produce is not satisfactory. The most of the rice traded in domestic market is found to be of rather low quality and contains a certain amount of breakages, bran, foreign materials, sand, madi and coloured grains and bad odour in the parboiled rice. These poor qualities spoils the taste and affect people's preference for rice which is their staple food.

When self-sufficiency is achieved in rice production, consumer will naturally tend to demand improved qualities.

Therefore, to produce high quality rice will become one of the most important subjects in Sri Lanka to meet the consumer's preference and this will also maintain a potential to export rice as stressed in National Agriculture, Food and Nutrition Strategy (June 1984).

Through the field study and discussions with certain organizations, many problems encountered in production of high quality rice have been ascertained.

The problems such as varietal mixing, non-uniformity in maturing etc. could be avoided by proper cultivation practices. The other problems can be divided into two groups mainly as the problems in processing at farmers level and problems in the process of converting paddy to milled rice.

01. Studies on the problems at farmer's level

01) Harvest in optimum time.

Most of the farmers used to harvest their paddy at over-matured stage as it makes threshing easier and also due to the shortage of labour at this period.

This improper practice leads to spoiling of paddy in standing condition and loss of well matured grains due to falling.

Harvesting is usually done on contract basis and the contract fee is generally paid according to the acreage without any relation to yield and quality. Thus, the contractor is not concerned much about the methods adapted for reaping, threshing and transporting etc.

So, harvesting in optimum period helps to produce high quality paddy and minimize losses of well matured grain. During field study and discussion with certain organizations, it was noticed that paddy maturity in harvesting period is not uniform. One considerable reason may be the uneven germination of broad-casted seed, and moreover farmers resow to fill the vacancies.

The farmers used to wait till the paddy in the whole field is matured before harvesting. But when the late sown paddy is matured rest of the paddy will be over matured and result in the loss of over matured due to falling. The majority of farmers are unaware of this.

These problems could be avoided at the initial stage of cultivation.

02) Paddy Grains

After harvesting the paddy is left for sometime on stubble. Then stack in heaps on the threshing ground. Sometimes this harvested paddy will remain in heaps for a few days. During this period, the paddy is spoiled due to the heat which is produced by decaying of straw. This results in the presence of madi grains. Therefore, immediate threshing can prevent spoiling of paddy. This can be done by making threshing facilities available to the farmers at the correct time. The paddy grains have to be dried by spreading them on a mat, sheet or floor without allowing foreign matter to get mixed with paddy.

In addition, frequent turning of paddy grain is recommended to avoid cracking during direct solar drying.

02) Transportation

It was observed that the harvested over matured paddy is transported to the threshing ground from the field in big bundles and considerable loss of grain occurs in this process.

In order to enable the direct feeding to the threshing machine, it is recommended that harvested paddy be bound in small bundles.

03) Threshing

Most of the farmers prefer to thresh paddy using bullocks or tractors.

The trampling action results in this method of threshing is the primary cause for the present increased cracked grains, and husked grains.

It was noted that about 30%-40% of cracked and damaged grains were present in paddy threshed by these traditional methods. Normally threshing is done on compacted bare grounds by adopting these traditional methods and considerable amount of foreign matter such as sand, stones etc. get mixed with paddy at this stage.

These factores were also revealed by the personnel whom we met during our field visits to the Department of Agricultural Engineering, University of Sri Lanka, Peradeniya and Farm Mechanization and Research Centre, Department of Agriculture, Maha Illuppallama.

It was concluded after having discussions with the specialized Officers of the above Organizations.

The Farm Machinery Research Centre, Department of Agriculture, Maha Illuppallama, is now trying to improve and introduce the mechanical throw-in type thresher which is originally developed by IRRI, to the farmers in tropical areas.

04) Cleaning

Generally the farmers are not worried about cleaning paddy much as this would results in decrease in quantity. However, it was noted that the farmers do the cleaning to a certain extent by dropping threshed paddy against natural wind or by using hand operated fan made out of bicycle parts. By this method only very light matter such as dust, empties and chaff can be removed and immature grain will remain and on the contrary some times foreign matter such as sand and stones will get mixed with paddy in this process. For the production of quality rice, it is important to remove immature paddy grains. The immature paddy may not affect much the quality of raw rice but it affects the quality of parboiled rice to a great extent and results in a poor taste and low milling yield. This immature paddy turns into madi rice when soaked and parboiled. Also it affects the colour and odour of the remaining matured grains.

The immature grains can be eliminated by winnowing. Hence the introduction of simple power driven winnower to the farmers is recommended.

02. Study on problems at processing level

The process of conversion of paddy to rice involves two stages i.e. parboiling and milling.

In Sri Lanka 70-80% of the consumers prefer parboiled rice and the rest prefer raw rice.

01) Parboiling

Parboiling of paddy is an ancient practice followed in India and South East Asian countries such Pakistan, Burma, Sri Lanka, Bangaladesh, Thailand, Nepal and Malaysia and also several countries in Africa, North and South America and Europe.

Since ancient times paddy was treated with boiling water and dried before hand pounding or milling. This practice has been in existence in Sri Lanka since ancient times and is adopted because parboiling hardens the rice grains and thereby

improves the milling quality. Parboiling reduces the breakages of grains to a minimum. The parboiling process consists mainly of three stages :

(1) First soaking in cool or hot water in order to increase the moisture content of paddy to about 30%.

(2) Heat treatment by introducing steam through the soaked paddy.

(3) Drying of steamed paddy either by solar drying or by mechanical dryers.

There are other various methods adopted in different countries. However, the methods followed in Sri Lanka can be classified into three groups :-

(i) Traditional parboiling
In this method paddy is simply soaked for about 36-48 hours in cool water and then steamed with boiling water for about one hour in a drum or steel tank.

(2) Goviya method of parboiling
This particular process of parboiling is only practiced in Sri Lanka. It is believed that this process is slightly better than the conventional parboiling system. In this process, a rectangular tank is used for both soaking and steaming operations. The tank has a perforated false bottom placed little above the bottom. This tank is mounted on a fire-place which has a chimney to provide a drought. Paddy husk is used as fuel and it is blown into the fire-place by means of blower. First, the tank is filled with paddy and water for the soaking operation. The water/paddy mixture is kept warm ($45^{o}C$) by keeping the furnace running. The soaking operation is continued for nearly six hours depending on the variety of paddy. Then the water from the

tank is drained by opening a discharge valve. Then heating is continued till the water in the lower section boils and steam is generated. Steam generated this way at atmosperic pressure is passed through the paddy. Then steaming operation is done for nearly one hour or so until the husks begin to split.

Rice produced by the Goviya method is of very good quality. This method reduces the soaking time. The rice is free from bad odour, the cost of processing per ton is comparatively much lower than modern methods, maintenance cost is very less and unskilled labour can be employed. The other major advantages of this method is that a major expensive item i.e. the boiler, is completely eliminated and husk is very effectively used. This method is one of the best methods that can be successfully employed in Sri Lanka. The only disadvantage in this method is that because of the longer steaming requirement and the limitation of the size of the tank, only a limited quantity of paddy can be parboiled per day. The steam consumption is relatively higher than in any modern parboiling method.

(3) Modern method of parboiling

There are several types of modern parboiling methods followed in different countries. By almost all the modern methods, very good parboiled rice can be produced. The most common modern method followed in Sri Lanka is called the CFTRI method. The basic technique in all modern parboiling methods is the hot soaking of paddy at temperature around 75^{o} and the subsequent steaming of paddy. There are several variations in the actual methods of soaking and steaming but nevertheless, the basic ideas remain the same.

This method also has three basic steps i.e. soaking steaming and drying.

i) Hot Soaking

Cleaned paddy is filled up in the overhead tank by means of a bucket elevator. The overhead tank feeds paddy to the desired parboiling tank (in some cases, a bucket elevator directly feeds the parboiling tank). After the tank is filled with paddy to the desired level, hot water is pumped from the hot water tank so that the water level is nearly one foot above the paddy level (in some cases, the hot water tank feeds the hot water to the tank by gravity). The temperature of the hot water is around $90^{\circ}C$. The resultant temperature of paddy water mixture is kept around $75^{\circ}C$. In order to do this, hot water is re-circulated for some time. Hot soaking is continued for about 3 to 4 hours depending on the variety of paddy. (3 hours for small grains and 4 hours for long grain). At the end of the hot soaking process, hot water is drained out completely by opening the discharge valve. The hot soaked paddy thus prepared is at $70^{\circ}C$ and has a moisture content of 30%.

ii) Steaming

Each parboiling tank is provided with a network of steam piping arrangement for uniform steaming of paddy. Hot soaked paddy is steamed in these tanks for about 15 to 20 minutes at a pressure of 3 kg/cm^2. Steaming in these tanks takes much less time and is more uniform. Partial splitting of the husk is the indication of complete parboiling. After steaming is completed any condensed water is drained out and then hot paddy is discharged immediately and sent to the open drying yard or for mechanical drying. The paddy thus parboiled will have a moisture

content of about 35% and is at 95 to 100°C temperature. It is very important to discharge the paddy immediately after steaming as otherwise the rice gets discoloured.

The main advantages of this method are (i) soaking time is reduced to 3 to 4 hours (ii) bad odour is eliminated (iii) most of the micro-organisms are destroyed and the bran obtained is more stable (iv) with a proper schedule of parboiling, a large quantity of paddy can be parboiled every day (v) parboiled rice can be produced at short notice depending upon the market value (vi) degree of yellowish colour required can be controlled to the customers liking (vii) labour required is less and (viii) parboiled paddy is steamed more uniformly and steam consumption is less in this method.

02) Rice Milling

Milling of paddy is a general term used to describe the processing of paddy into edible polished rice.

Rice milling is one of the oldest industries in Sri Lanka. Their processing methods are based on traditional practices developed through long experience. The paddy is milled either in raw condition or after parboiling by various types of mills. The types of mills existing in Sri Lanka can be classified into three categories :-

(1) Traditional - with steel hullers

Most of the huller mills consist of steel hullers along with a winnower to separate husk. In the huller mill, paddy is passed twice through a huller, to remove husk at first pass and to polish brown rice as well as the hulling of remaining paddy at second pass. It is observed that lowest milling yield is about 64% with raw rice 69% with parboiled and breakage of rice is very high and polishing is not uniform.

(2) Rubber roll husker with steel huller

Some mills utilize combined rubber roller husker and steel huller. Husk is removed as it is pass through rubber rollers with less breakage of grain compared to steel huller shelling. Then fed into steel huller once or twice depending on the variety, moisture content and consumer preference. Milling yield of this method is better than that of steel huller. Rubber roller has to be changed after milling 50 tons of raw rice and about 100 tons or sometimes more of parboiled.

(3) Modern mills are combined with machine units for a series of functions such as paddy cleaner, paddy husker, separator, milling machine, rice grader etc. which has processing capacities for one or two ton per hour of paddy.

Milling yield of this method is far better than others and this can produce high quality rice. There are roughly over 1,000 traditional mills, 500 rubber roller husker and steel huller mills and several modern rice mills in Sri Lanka.

According to studies, one of the objectives would be to produce high quality rice with improved facilities of rice processing and with 'Goviya' method of parboiling. Here at least the rubber roller husker combined with the polisher will have to be introduced. And another objective would be to improve the traditional parboiling and steel huller method. However, when raw rice mills are established in newly developed areas, modern rice mill is quite recommendable with modern parboiling facilities. The various personnel and researchers contacted in regard to this matter, were also in favour of our suggestion.

Some rice samples obtained from the market and rice mills were analysed according to the grading standard of world market and analysis is shown in Table 1 and Table 2.

When these results were analysed, it was noticed that with the available facilities for modern methods of milling and parboiling in Sri Lanka, high quality rice could be produced which may be acceptable to the world market.

For the Integrated Agricultural Development Demonstration Project in System 'C', modern paddy parboiling and rice milling facilities are required in order to demonstrate the production of high quality rice, which is one of the most important objectives of the Project and this will be a model for new establishment of rice mills.

The capacity was decided in considering the production ability of farm and the most suitable would be one tone per hour capacity.
Rough sketches are attached in Figure 10, 11 and 12.

03) Quality Standards

Another factor to be considered for the production of high quality rice is the Quality Standards. The quality standards when established and implemented will make the grading and pricing of the rice available in the market, easier and the pricing will be uniformed through out the country. When the quality standards are established both the consumer and the farmer will be benefited.

At present the marketing of rice in Sri Lanka is managed by the public sector as well as the private sector. Paddy Marketing Board is the premier organization engaged in paddy purchasing, processing and storage and marketing of rice.

In an attempt to promote the free marketing of rice based on the government policies, PMB is taking its efforts to stabilize the market price to protect the consumer by maintaining stocks and to protect the farmer by giving a guaranteed price for paddy.

In the public sector marketing channels of rice in Sri Lanka, which is mainly managed by PMB is shown in Figure I.

The private sector marketing channels of rice in Sri Lanka which is also encouraged by the present government is shown in Figure II.

Now the rice millers are the largest paddy collector/wholesaler in the market channels.

Due to lack of working capital and storage facilities, farmers sell 70% of their production immediately after harvest sometimes even at a low price.

In actual practice, the miller goes to the field immediately after the harvest and make spot purchases without taking any care of the quality of paddy. While the paddy producer in protected by the Government by fixing a floor price, no effective means have been introduced to encourage the farmer to produce high quality paddy, which is a pre-requisite for the production of high quality rice.

Therefore, it is concluded that enforcing effective quality standards linked with an attractive pricing system, is a must to ensure production of quality paddy which will lead to the production of high quality rice.

Production of high quality paddy is important for the production of high quality rice. In this respect necessary assistances will be provided by the Japanese Experts.

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(1) Tabl 13 LIST OF RICE MILLERS CONTACTED IN FIELD STUDIES

No	Name	Location	Production	Parbolling Facility	Milling Facility	Capital Cost	Cost Charged	Remarks
01.	A.K. Piyasena	Bathalayaya C2	300 kg/day	NHL	Steel Huller (%)	Rs. 19,000.	5 Rs/Bu.	
02.	K.V. Premadasa	Ulhitiyaya C2	300 kg/day	NHL	Steel Huller (%)	30,000.	6 Rs/Bu.	
03.	Rubber Mill	Ulhitiyaya	1500 kg/day	NHL	Rubber Roller Husker 8" Steel Huller (%)	38,000.	9 Rs/Bu.	
04.	Weragama Miller	Weragantota C1	2320 kg/day	Traditional Box type	Steel Huller (No. 8)	-	-	Dealer
05.	R.V. Premadasa	Minipe C1	400~ 500 kg/day	Traditional Drum Can Type	Steel Huller (%)	12,000.	5 Rs/Bu.	Dealer
06.	Richard Pieris Agricultural Enterprise	Anuradhapura	2500~ 40000 kg/day	Goviya Box Type	Rubber Roller Abrasive Roller Milling Plant	-	-	Dealer
07.	Victory Rice Mill	Anuradhapura	6000 kg/day	Traditional Box Type	Rubber Roller Husker 8" Steel Huller (No. 1)	-	-	Dealer
08.	P.S.R.P.C (PMB)	Bulnewa H4	45000 kg/day	CFTRI Type with LSU Dryer	Binny, Dandkeer Milling Plant	Aid	-	PMB
09.	R.P.R.D.C.	Anuradhapura	300 kg/day	CFTRI Type with LSU Dryer	Binny Milling Plant 1 Ton/Ar.	Aid	-	PMB

P.S.R.P.C. : Paddy Storage and Rice Processing Centre (PMB), Bulnewa
R.P.R.D.C. : Rice Processing Research and Development Centre (PMB), Anuradhapura.

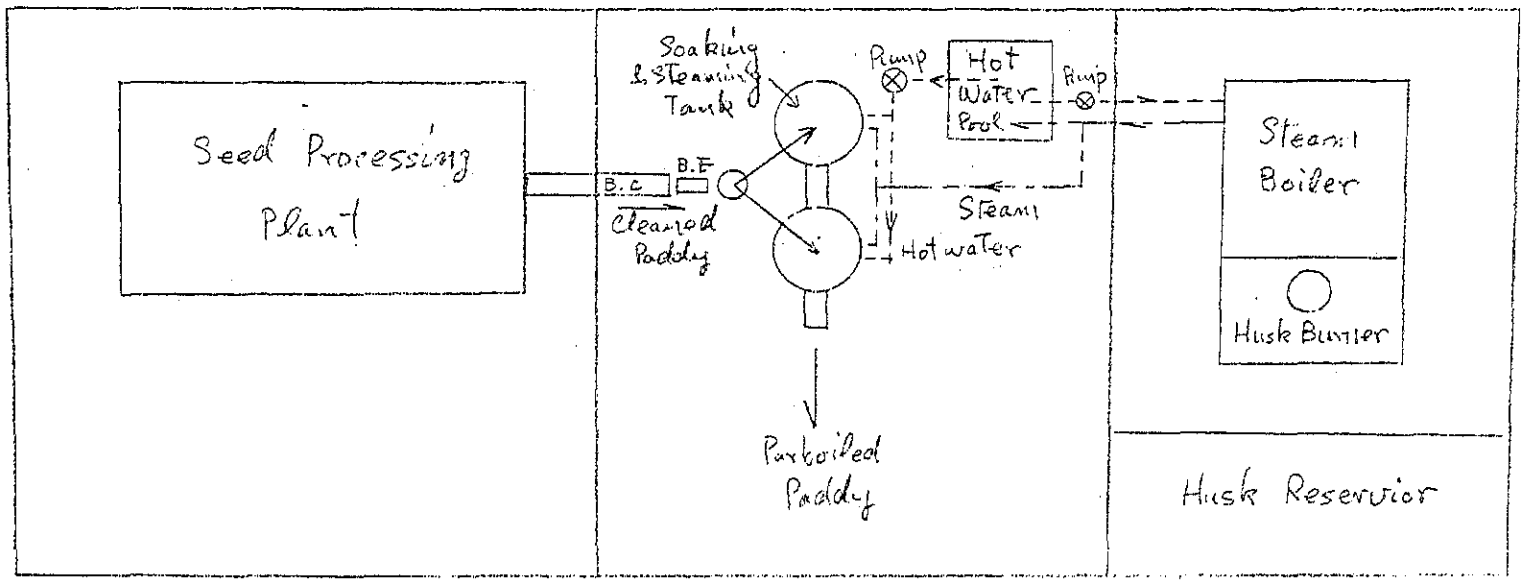
(2) Table 14

RESULTS ON RICE ANALYSIS IN FIELD STUDIES

No	Variety	Processed	Sample Taken at	Whole Grain %	Broken Grain %	colored Grain %	Madi Grain %	Foreign Materials %	Sand %	Moisture Content %	Remarks
01.	BG 34-8	Parboiled	Weeragantota	90.14	4.22	3.88	-	0.75	0.57	15.8	
02.	BG 34-8	"	Minipe	88.22	2.45	8.93	-	0.10	-	17.7	
03.	BG 400-1	"	Bulnewa	63.80	25.47	6.47	3.19	-	0.16	14.4	
04.	BG 11-11	"	Anuradhapura	94.92	3.88	0.30	0.89	-	-	14.1	
05.	BG 34-8	Raw	Bathalayaya	41.77	54.54	1.42	-	0.14	0.09	19.1	H.C.
06.	BG 370-2	"	Minipe	54.88	43.34	-	-	1.21	0.24	14.2	
07.	BG 34-8	"	Ulhitiyaya	55.30	43.87	-	-	0.27	0.27	14.7	H.C.
08.	BG 370-2	"	Ulhitiyaya	27.86	68.13	-	-	2.67	1.33	14.5	H.C.
09.	BG 94-1	"	Minipe	32.28	66.51	-	0.18	-	0.88	12.4	
10.	BG 34-8	"	Anuradhapura	77.35	22.27	-	-	0.28	0.09	14.8	

* H.C. : Home Consumption

Fig. 10 Proposed Parboiling Plant



Minimum Dimension Required

12 X 35 M. (WXL) 12 M (H)

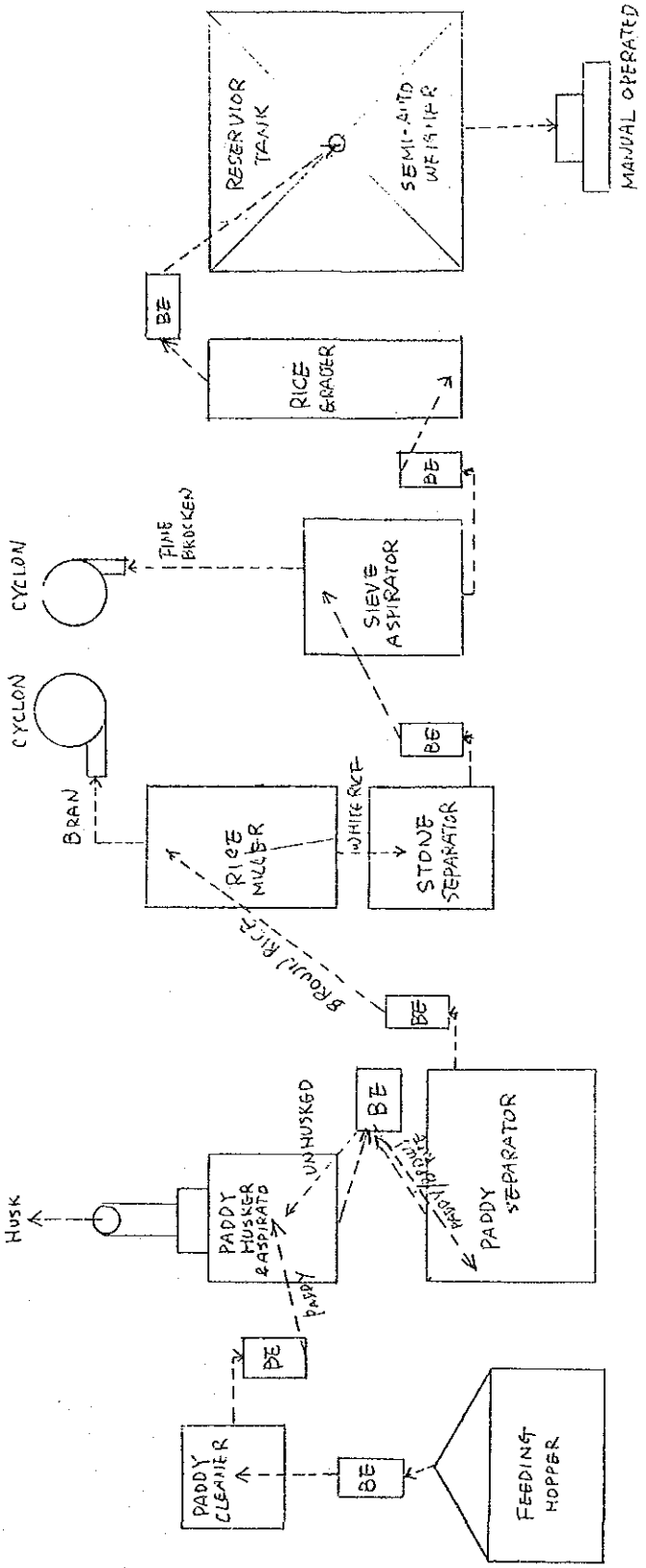
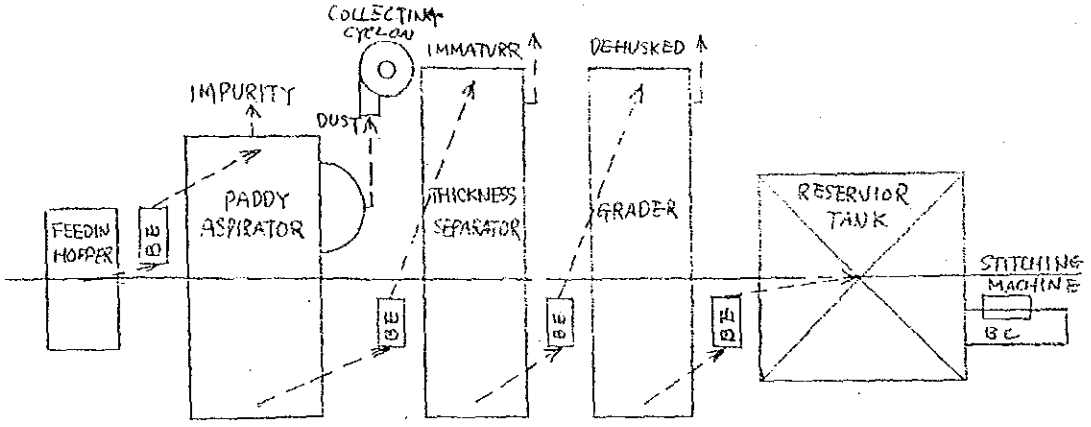


Fig. 11 PROPOSED RICE MILLING PLANT

Minimum Dimension Required
7 x 16 M. (W x L) 7 M.(H.)

Fig 12 PROPOSED RICE CLEANING PLANT



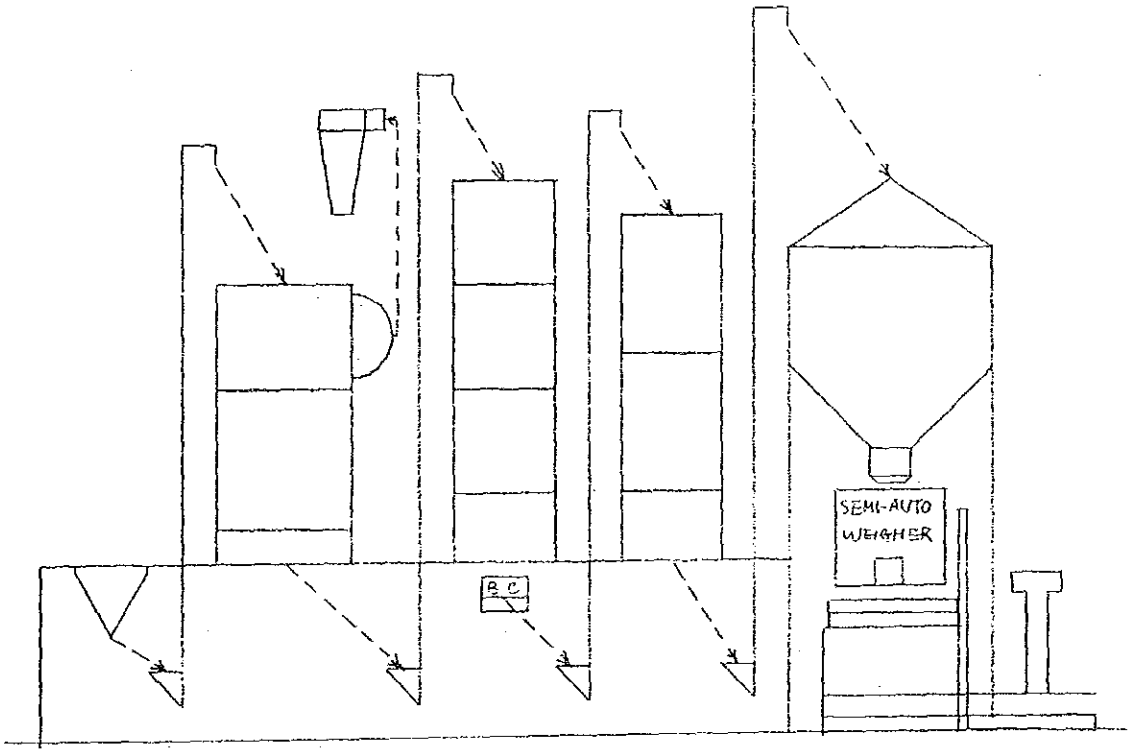


Fig. 13 PUBLIC SECTOR MARKETING CHANNELS OF RICE IN SRI LANKA

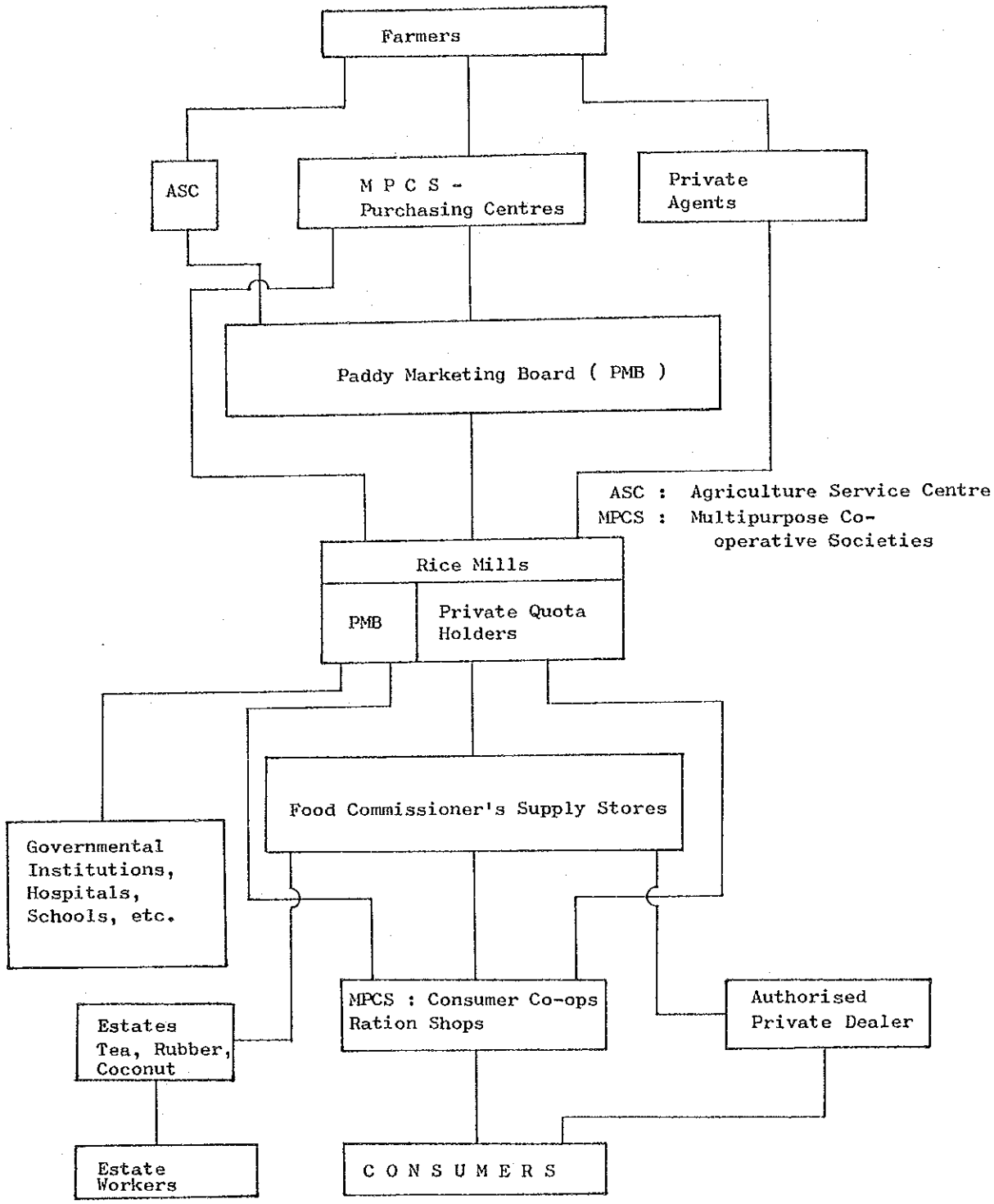
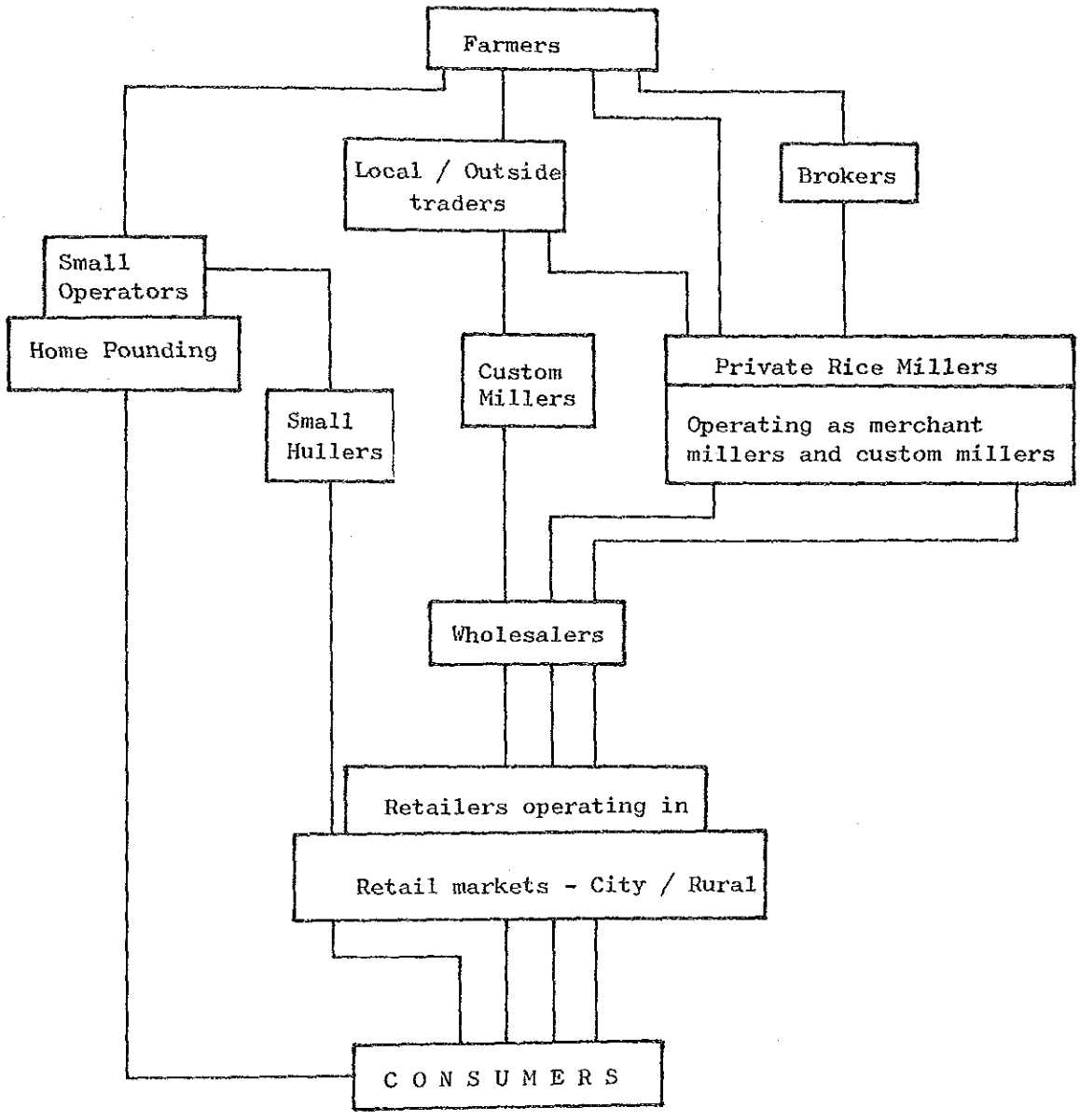


Fig. 14 PRIVATE SECTOR MARKETING CHANNELS OF RICE IN SRI LANKA



2.4. Water Management

Present conditions and constraints of water management were, from viewpoints of irrigation engineering, investigated in/around project area for the technical co-operation and in the similar project area such as System 'H'. And relevant institutes to water management were also investigated in the course of the study.

With the great help of MEA counterpart officers, visits to the following project areas and institutes were made in the field trips.

- System 'H', Block H404 & Flow Monitoring Unit,
- System 'G',
- System 'C' and Block 302,
- Maha Ilupalama Research Center,
- Girandurukotte Research Center,
- Girandurukotte Development Center,
- Irrigation Training Institute, Galgamuwa, and,
- Chinese Experiment and Demonstration Farm.

2.4.1. Factors Affecting Water Management

In proper water management, different amounts of water required for crops in respective growth stages is, evenly and effectively, conveyed and distributed to the field with less water waste. Generally target of water management from viewpoints of irrigation engineering is to reduce water waste such as field application loss, conveyance loss and operation loss and to utilize rainfall effectively in field as well.

Major factors affecting water requirement in field and at diversion points are summarized as follows;

1. Consumptive use of water for crops and permeability of water in field,

2. Field application efficiency and utilization of effective rainfall in field,
3. Conveyance efficiency of irrigation system, and
4. Operation efficiency of irrigation system.

1. Consumptive use of water for crops and permeability of water in field.

Consumptive use of water fully depends on the kind/variety of crops and the cropping patterns employed in the project area which are generally decided from various points of view including the view points of available water resources. Once cropping patterns are fixed, however, consumptive use of water can be estimated by empirical formulas or actual field experiments. Permeability of water depends on the soil characteristics and the permeability can be measured through the field experiments.

2. Field application efficiency and utilization of effective rainfall in field.

The application efficiency depends on the irrigation methods applied by farmers in the field, especially water control in the field, and it can be estimated from consumed water volume, consumptive use for crops and effective rainfall in an allotment. Effective rainfall depend on how much the farmer utilize rainfall for crop growth in his allotment and it can be estimated through water balance experiment/study in field.

3. Conveyance Efficiency of Irrigation System.

Conveyance efficiency depends on the applied type of irrigation facilities e.g. earth canal or lined canal, and it is greatly affected by the maintenance extent of irrigation facilities. The efficiency can be estimated by discharge measurement in a certain reach of irrigation canals.

4. Operation Efficiency of Irrigation System.

Operation efficiency depends on the techniques of farmers in field-canal level as well as the techniques of operation staff in project level. Water user's group association and government organization for operation & maintenance also play important roles in effective operation of irrigation facilities such as diversion/turnout structures and measuring devices.

2.4.2. Field Study

In order to grasp/estimate present conditions or levels of the above-mentioned major factor, irrigation facilities and operation & maintenance of project level and field-canal level were mainly investigated through field trips.

(1) Irrigation System and Facilities.

Canal system is composed of Main Canals, Branch Canals, Distributory Canals and Field Canals in System 'H', 'G' & 'C'. Most parts of these canals are earth canal. Concrete lined canal can be seen where canal is passing on high permeable soil but their length is considerably short out of total canal length. Generally initial investment in earth canal becomes low, but maintenance cost of earth canal becomes high, compared with those of lined canal. Conveyance efficiency of earth canal is lower than that of lined canal.

Field canal is a terminal irrigation canal to distribute water to paddy allotments which commanding area is 12 - 15 ha. on an average in System 'C'. Designed discharge of all field canals is 1.0 cusec (28 lit/sec) uniformly in System 'B' and 'C'.

Canal system in Block 302 of System 'C' Pilot Demonstration Project consists of Minor Branch Canal (MBC), Distributary & Sub-Distributary Canals (D.C.)

and Field Canals (F.C.). These canals are all concrete lined, Their conveyance efficiencies can be thought high and in the course of field investigations conveyance efficiencies were measured experimentally which is given below;

Trial Measurement (Nov.25th)

Canal	Efficiency(Ec)	Reach
M.B.C.	99%	615 m
D.C. (D-1)	98%	350 m
F.C. (D7-1)	93%	250 m

General features of irrigation system in in Block 302 are tabulated below;

Irrigation System Block 302

Item	M.B.C.	D.C.	F.C.
Total Canal Length(Km)	1.7	19.4	42.0
Designed Discharge (m^3/sec)	1.64-1.56	0.66-0.03	0.034-0.028
Canal Density (m/ha)	2.5	28.8	62.4

Designed discharge of field canal depends on the commanding area in Block 302, but the minimum designed discharge is 1 cu.sec (28 lit./sec.), taking Sri Lankan standard and construction into consideration.

Among related structures to irrigation canal, measuring devices, diversion structures and regulators play a vital role in order to distribute irrigation water on irrigation schedule. Typical type of measuring devices in System 'H' is sharp-crest rectangular weir in distributary canals and modified parshall flume (so called "cutthroat") in field canals

but those measuring devices are not always installed in respective canals. Typical types of measuring devices in System 'C' are hump-type weir at the outlet of turnout and staff gauge in canal which are seldom installed in distributary & field canals in Zone 2 but are installed mostly in Zone 3. The hump-type measuring device sometimes do not function well under following two situations. One is that the downstream water level at turnout outlet is sometimes too high to create ideal hydraulic condition of free over-flow on the crest of hump weir due to silting and growth of weed. The other is that it is not easy for local contractor to construct hump weir as it is designed, especially concrete form work.

Turnouts as a diversion structure in distributary canals in System 'H' & 'C' are conduit-pipe type with a steel gate. Typical type of regulator applied to distributary canals in System 'H' & 'C' is concrete weir type with iron crest. In some cases the regulators are attached to drop structures. Through field investigations, it is felt that quality control to related structures should be strengthened and planning/design criteria in on-farm development should be decided through discussions between design/construction side and user side i.e. MECA and MEA.

Measuring devices in Block 302 are a combination of modified sharp-crest weir and staff gauge which are attached to the outlets of turnouts at the beginning points of all distributary and field canals. This type of measuring device is generally reliable but has a disadvantage that upstream basin of the weir is silted even in lined canal system. The measuring device is subject to periodical maintenance. Turnout applied to Block 302 is the same type as that in System 'H' & 'C'. Regulator in Block 302 is stop-log type in distributary canal which can regulate upstream water level by adjustment of the height of stop-log.

(2) Organisation and Staffing for Operation & Maintenance (O. & M)

Vital organisations for O. & M. play an important role to increase irrigation efficiency of the system, especially operation efficiency. Organisations for O. & M. are divided into two organisations in System 'H' & 'C' i.e. Government O. & M. Organization (MEA organization for O.&.M. has a full responsibility up to diversion of irrigation water to field canals and maintenance of distributary canals. While, farmer's turnout groups must execute O. & M. work within their field canals under their full responsibility.

MEA O. & M. staff in System 'H' & 'C' virtually consist of project irrigation engineer at project level, irrigation engineers, engineering assistants & technical officers at block level and patrol labourers at unit level. Project irrigation engineer operates and maintains main canals and large branch canals feeding more than one block, and he gives technical guidance and advice to block irrigation engineers and other O. & M. staff in the project through education & training opportunities to O. & M. staff. Block Irrigation Engineer practically operates and maintains distributary canals in his block and small branch canals feeding only his block, and he also gives technical guidance to his staff such as engineering assistants and technical officers in his block. Water issues to field canals, with regulating turn-out gate, are carried out by patrol labourers in Unit Office. Present organized O. & M. staff are charted in Fig. 15.

Turnout groups have been organized as terminal water users groups in System 'H' & 'C'. Water users association at project level or large scale water users groups, however, have not been established

in System 'H' & 'C'. Turnout group is composed of water beneficiary farmers within the same field-canal service unit and this turnout group is planned to function not only for irrigation matters but also for other agricultural matters. A leader is planned to be elected periodically among members of the group. In Block 302 of System 'C', the establishment of most of turnout groups was completed in Unit 2 in June 1984 and most of turnout groups have been organized in Unit 3 under the guidance of MEA. In case of turnout groups in Unit 2, despite of the efforts by MEA field staff they do not function well in water distribution and maintenance of their field canal. It was seen, however, that some field canals are well-maintained in Unit 2.

(3) Operation & Maintenance (O.&.M.) of Irrigation Facilities.

Proper operation ensures that right amount of water is supplied to crops in field at right time. Regular operation of the irrigation facilities must be performed in accordance with a irrigation schedule. And proper maintenance of the facilities is indispensable in order to keep the system function proper and constant. Routine maintenance work includes regular maintenance, minor periodical repairs and so on. The above O. & M. work is generally carried out by MEA O. & M. staff and farmer's turnout groups in System 'H' & 'C'.

In System 'H' irrigation schedule on monthly basis is prepared every irrigation season which covers water issues of respective blocks. The irrigation schedule at block level is planned by Block Manager, Irrigation Engineer and Unit Managers, taking available farm power & labour in a block into consideration. Flow monitoring unit, Kalawewa monitors and evaluates the actual water issues to respective blocks, compared with the irrigation schedule and brings out "Monthly Review 'H' Area".

Since System 'H' area suffers from serious water shortage in every Yala season, it is thought that irrigation scheduling and monitoring & evaluation system were introduced in a comparatively short period. Through field investigation some measuring devices, regulators and turnouts in distributary canals were seen to be seriously damaged. Some iron gates of turn-outs are destroyed in distributary canals. It is thought that more intensive farmer education is essential.

In System 'C' detailed irrigation scheduling has not become a permanent fixture with O. & M. organization, for initial date of first water distribution is decided in accordance with the construction schedule of canal system. In the present irrigation schedule first date and final date of water issue period are mentioned. Therefore, monitoring & evaluation system has not been introduced for water distribution and irrigation scheduling. In present water distribution O. & M. staff periodically inspect their responsible area and adjust gate openings of turnouts if necessary. Farmers are executing rotational irrigation in a field canal service unit when water demand concentrate e.g. land preparation period. Fortunately most of farmers (about 80%) have not experienced water shortage yet, for water sources such as Trans Basin Canal and Ulhitiya & Ratkinda Reservoir have been completed and about 30% of total proposed land has been developed.

Maintenance works in System 'H' & 'C' are mainly carried out every irrigation off-season. Most of the works (90%) are desilting of canals and clearing of aqua-plant & plant in/on canals because most of canals are earth canal. In System 'C' maintenance works are done on contract basis. Maintenance costs of System 'C' are tabulated as follows ;

Annual Maintenance Cost (Zone 2 System'C',1984

Work Item	Cost (1000 Rs)	%
Desilting of Canals	1,200	56
Clearing of Plants	702	33
Repair of Canal Embankment	140	7
Repair of Structure	90	4
Total:	2,132	100

It is recomm ended that economic comparison between lined canal and earth canal will be made, taking maintenance cost and actual water losses into consideration. Some conveyance losses can be utilized in tertiary system. It was seen through field investigation in System 'H' & 'C' that some parts of earth canals were eroded and some structures were kept damaged.

In July 1983 the Government decided to collect O. & M. charges from beneficiary farmers. As a first step 100 Rs/Acre is collected in 1984 and O. & M. charge is scheduled to be 200 Rs/Acre after five years pass. In System 'H' 52% of farmers have paid up to October 1984. In System 'C' O. & M. charge has not been collected and will be collected after four cultivation seasons. Most of farmers in System 'C' think that O.& M.charge be paid.

(4) Irrigation Methods & Requirements

In System 'C' paddy is cultivated in both Maha and Yala season. While, in System 'H' paddy is cultivated in Maha and in small area in Yala because of water shortage in Yala. And subsidiary crops such as chillie, cowpea and so on are cultivated in paddy fields in order to save limited water resources in Yala. The Government is promoting introduction of crops more suited to permeable soils in dry and intermediate zones to maximize the use of water resources.

Irrigation method for paddy is normal type of basin irrigation. While, some irrigation methods for other crops are applied by farmers and recommended by agricultural institutes. Furrowed basin method, ridge & furrow method or check flooding method is applied as on conventional irrigation method in/around System 'H'. Among the above, furrowed basin method is recommended by Maha Ilupalama Research Center, Department of Agriculture. This conventional method was developed from the studies and suits the traditional rice farmers. It is acceptable for the farmers that present land formation can be used effectively for rice/other field crop rotation in Maha and Yala respectively. Field application efficiency is estimated to be about 65%.

Water requirements for paddy were estimated in planning stages of System 'C' and Block 302. Field irrigation requirements of paddy are 2,137 (mm/2 seasons) for System 'C' and 2,473 (mm/2season) for Block 302. Peak monthly requirement is 488 mm for System 'C' and 472 mm for Block 302. On the other hand, proper data on water requirements for other field crops in System 'C' were not collected.

2.4.3. Considerations on Water Management

The water resources development emphasis in the past has been on the expansion of cultivated area through large scale new project. However, most promising irrigation system has already been undertaken. On the other hand, water management activities were rather relegated to the background. It is afraid that the lack of efficient water management techniques will lead to the wasteful use of water. It is estimated that an increase of about 20% in cropping intensity will be realized with better water management practices, and better water management will be given priority in water resources sector. The Government stresses the necessity of improved water management at the system level as well as field level.

In System 'C' irrigable land is expanding year by year and a large-scale settlement programme is on-going. Some farmer/settlers are not accustomed to irrigated farming, and some O. & M. staff and patrol labourers are not acquainted with better water management. While, there is not a farm to demonstrate better water management in System 'C'.

Under the above circumstances, it is recommended that a demonstration farm for better water management will be established in System 'C' as early as possible. Proposed site is in Block 302, for this block was completed as Pilot Demonstration Farm of System 'C'. For the said demonstration, experiment farm is also required to carry out water management experiments such as irrigation method & requirement tests, efficiency tests and so on. Water management techniques to be demonstrated is to be on-farm level.

Newly proposed "Demonstration/Experiment Farm" should be utilized as much as possible by existing local extension systems such as Girandurukotte Development Center.

Demarcation of services between water management consultant assigned for System 'C' and new water management expert assigned for Demonstration/Experiment Farm are as follows;

(1) New expert will execute the services in Demonstration/Experiment Farm and give technical advice to Government Seed Farm in Unit 1 (See Fig. 16).

(2) Consultant expert will execute the original services except the services in the above (1).

New expert to be assigned is also recommended to aim at the establishment of a self-supporting farm organization through transfer of knowledge to counterpart officers.

For the establishment of Demonstration/Experiment Farm, some adjustment civil works such as construction of inspection paths are required to meet the purposes of the Form.

Fig. 15 O & M ORGANIZATION (SYSTEM 'C')

MAHAWELI ECONOMIC AGENCY

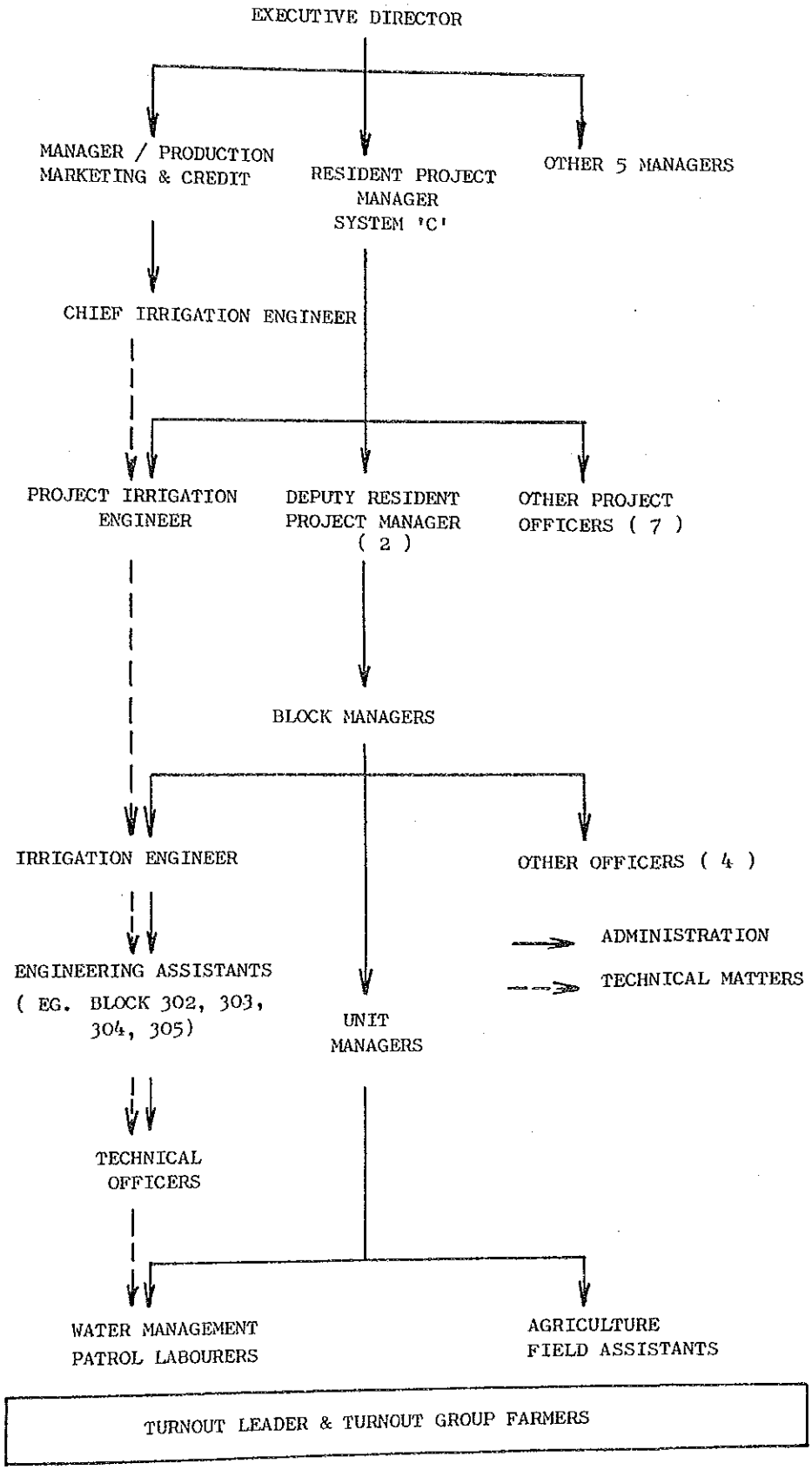
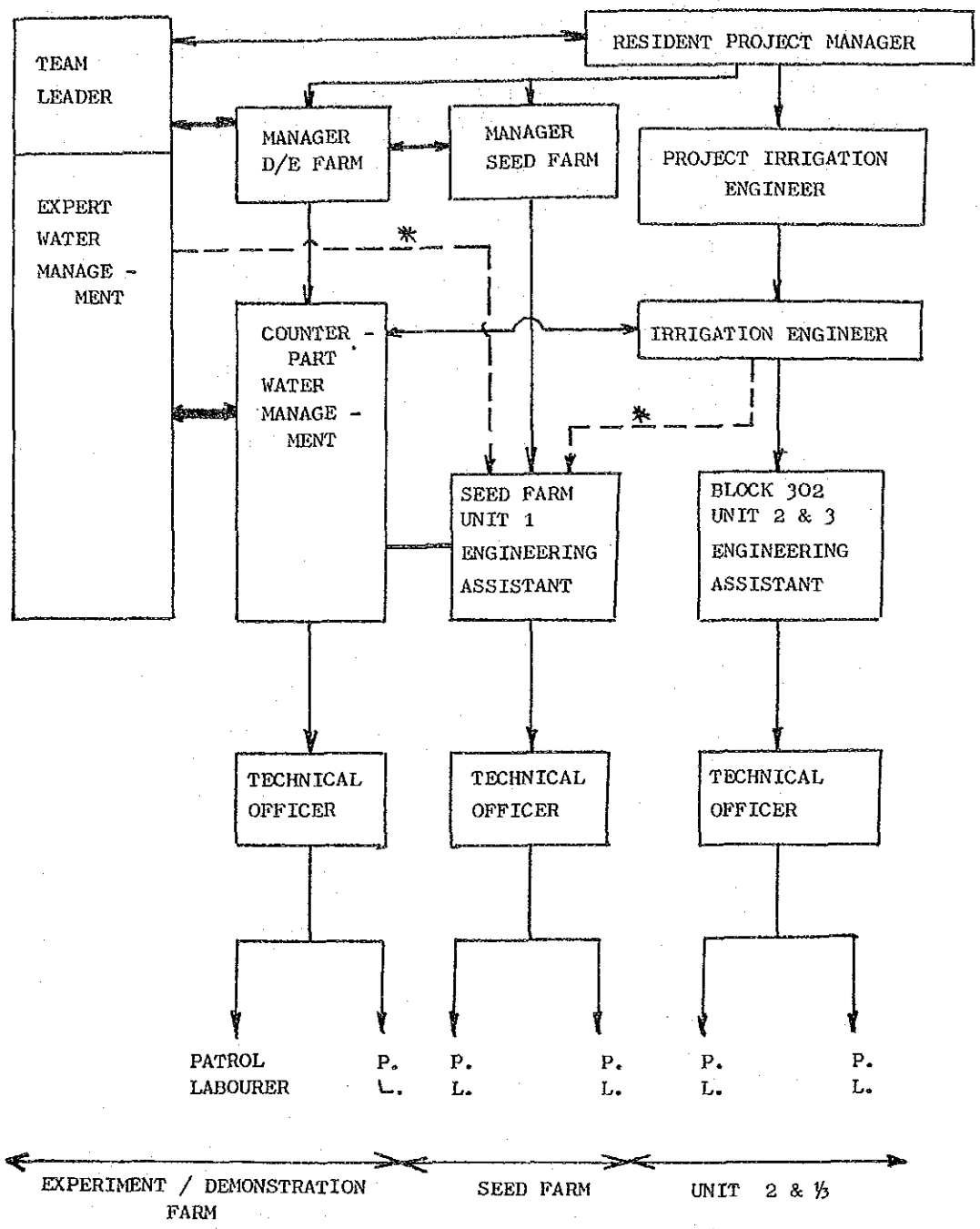


Fig. 16 PROPOSED ORGANIZATION FOR WATER MANAGEMENT



NOTE * TECHNICAL ADVICES

5. OTHERS

5-1 Seed Farm

(1) Hingurakgoda Seed Farm

Hingurakgoda Government Farm is the largest Seed Farm of the Department of Agriculture and its registered seed production is also the greatest. Supplementary irrigation water is available from Mahaweli Diversion. Its yield is comparatively high among other Government Farms, recording around 60 bu/ac.

(2) Alutharama Government Seed Farm

This farm is situated within Zone 2 of System 'C'. At present this farm produces seed paddy under the rainfed conditions. Its yield is very low and is around 30 bu/ac. It is expected to receive irrigation water in 1984/85 Maha season.

(3) Seed Farm in Unit 1- Block 302, System 'C'

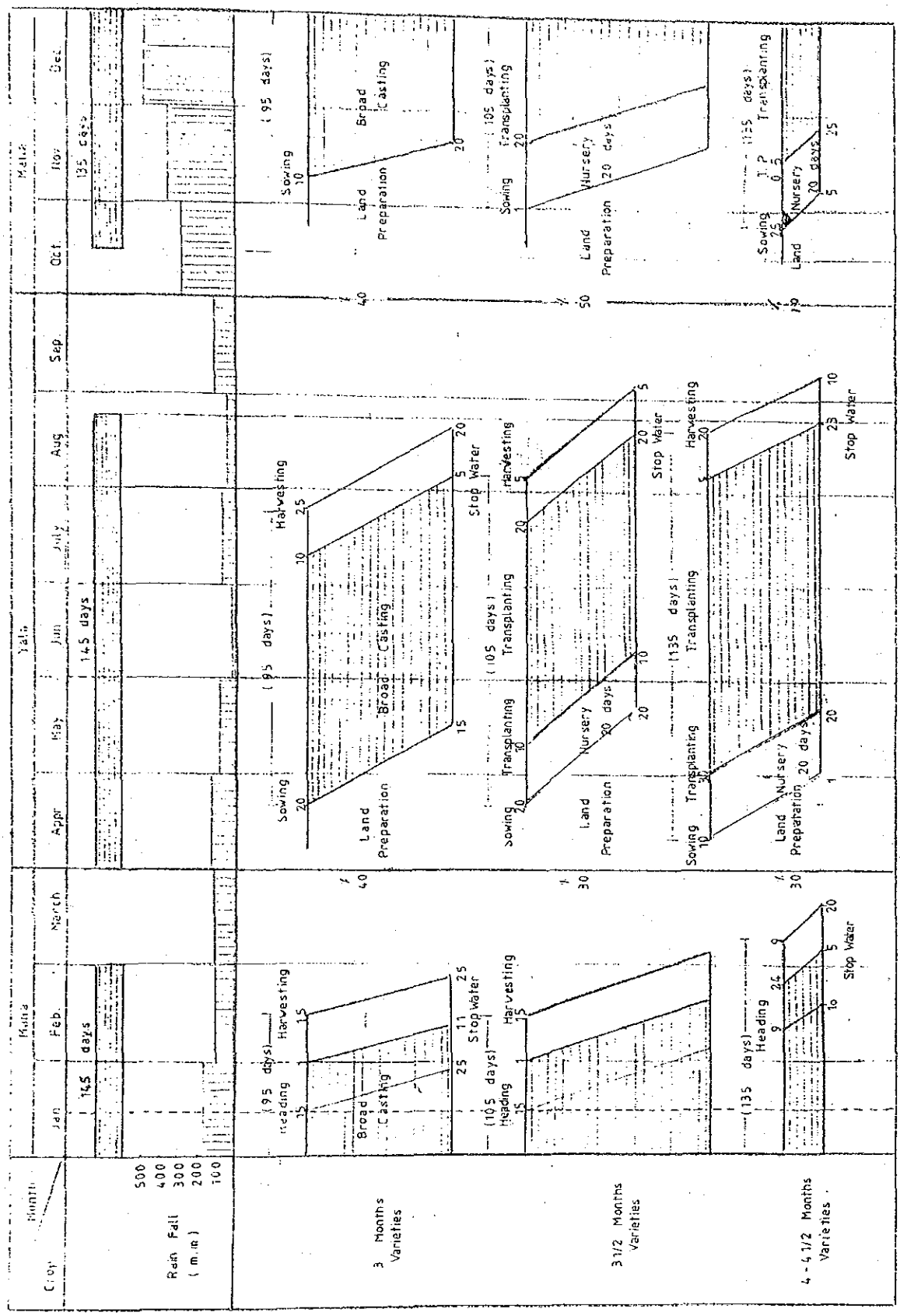
As the extent available in the Government Farms are limited for seed production, MEA could not expect any of her requirements of seed paddy from the Government Farms. MEA has therefore decided to establish a fully fledged seed production farm in Unit I of Block 302 in Zone 3 of System 'C'. With experiences gained from other Government Seed Production Farms, MEA should manage the above efficiently, to obtain the full requirement of seed paddy.

At the completion of the settlement programme in System 'C', about 27.740 ha. will be provided with irrigation water. The recommended cropping pattern for System 'C' is double cropping paddy except Zone 4 where sugarcane is recommended as an alternative crop. 24,400 ha. will be under the double cropped paddy. The estimated annual certified seed paddy requirement of System 'C' would be about 48,000 bushels.

To obtain the above requirement of seed paddy,as explained earlier, MEA has decided to establish a seed farm in Unit 1 of Block 302, where the entire land and irrigation infrastructure development work has been constructed by the Government of Japan. The extent of the Farm is 277 ha., out of which 217 ha. has been developed for paddy and the balance as irrigated highland. 23 ha. out of 217 ha. paddy area will constitute the proposed project area.

Seed paddy requirement in System 'C' and production of certified seed paddy in the Unit Seed Farm is shown .

The Japanese Government will provide main agricultural machinery and seed processing facilities for the Seed Farm under the implementation programme of the technical co-operation.


Cropping Pattern in M E A. Seed Farm Block 30/ System C (194 Ha)
Crop
Month
Rain Fall (m.m)
Maha
Jan
Feb.
March
Apr
May
Jun
July
Aug
Sep
Oct
Nov
Dec
145 days
135 days
3 Months Varieties
3 1/2 Months Varieties
4 - 4 1/2 Months Varieties
Sowing
Broad Casting
Land Preparation
Harvesting
Stop Water
Transplanting
Nursery
20 days
Heading
Heavy Rain Over
Heavy Rain Begin

Table

TENTATIVE CULTIVABLE AREA UNDER PADDY IN DIFFERENT ZONES OF SYSTEM 'C' FROM 1985 YALA (IN HECTARES)

Zone No.	Farm Area	System of Cultivation	1985		1986		1987		1988		1989		1990	
			Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha
Zone 1	3570	R.F.	-	-	-	-	-	-	-	-	-	-	-	-
		I.R.	3570	3570	3570	3570	3570	3570	3570	3570	3570	3570	3570	3570
Zone 2	4200	R.F.	-	-	-	-	-	-	-	-	-	-	-	-
		I.R.	4150	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
Zone 3	2100	R.F.	-	-	-	-	-	-	-	-	-	-	-	-
Zone 4	9300	I.R.	1800	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100
Zone 4	9300	R.F.	-	2000	-	1600	-	-	-	-	-	-	-	-
		I.F.	-	2500	3000	6000	7000	9300	9300	9300	9300	9300	9300	9300
Zone 5	2800	R.F.	-	-	-	1000	-	300	-	-	-	-	-	-
		I.R.	-	-	-	-	-	2500	2800	2800	2800	2800	2800	2800
Zone 6	2800	R.F.	-	-	-	-	-	1400	-	-	-	-	-	-
		I.R.	-	-	-	-	-	-	2800	2800	2800	2800	2800	2800
T O T A L	24770	-	9520	14370	12870	18470	16870	23370	21670	24770	24770	24770	24770	24770

* R.F. - Rainfed I.R. - Irrigated

SEED PADDY REQUIREMENT IN SYSTEM 'C' AND TARGET OF PRODUCTION
OF CERTIFIED SEED PADDY IN GOVERNMENT SEED FARM UNIT 1,
BLOCK 302 (IN HECTARES AND BUSHELS

Description	1985		1986		1987		1988		1989		1990	
	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha
Paddy Extent R.F.	-	2000	-	2600	-	1700	-	-	-	-	-	-
I.R.	9520	12370	12870	15870	16870	21670	21670	24770	24770	24770	24770	24770
(Ha.)												
Total Extent	9520	14370	12870	18470	16870	23370	21670	24770	24770	24770	24770	24770
Existing Area	9520	11870	12370	15470	15870	18570	21670	21670	24770	24770	24770	24770
Extent to be issued free seed paddy (new area)	-	2500	500	3000	1000	4800	-	3100	-	-	-	-
Total Extent	9520	14370	12870	18470	16870	23370	19503	24770	19896	24770	21055	24770
Method of Establishment existing area Broadcasting	6070	8070	8070	11020	10770	13370	15670	15670	18320	18470	18070	18270
Row seeding	400	300	500	350	600	400	700	450	750	500	800	500
Transplanting	3050	3500	3800	4100	4500	4800	5300	5550	5700	5800	5900	6000
Total Seed paddy requirement (input Req.) (Bu.)	39475	50225	51725	66662	67350	80350	* 83390	93912	* 84293	108725	* 89525	108225
1. Req. for issues	7895	10045	10345	13332	13470	16078	*	18782	*	21745	*	21645
Seed paddy Req.		12556	12931	16666	16838	20088	20848	23478	21073	27181	22381	27056
4-4½ months variety	-	(30%) 3014	-	(30) 4000	-	(25) 4018	-	(25) 4695	-	(30) 6523	-	(35) 7576
3½ months variety	(40%) 3158	(30) 3014	(40) 4138	(30) 4000	(40) 5388	(35) 5624	(40) 8239	(35) 6574	(40) 8429	(30) 6524	(45) 10071	(35) 7576
3 months variety	(60%) 4737	(40) 4018	(60) 6207	(40) 5332	(60) 8082	(40) 6428	(60) 12509	(40) 7513	(60) 12644	(40) 8698	(55) 12309	(30) 6493
2. Seed paddy Req. for free issues	-	12500	2500	15000	5000	24000	-	15500	-	-	-	-
Broadcasting												
3½ months variety	-	6250	1250	7500	2500	12000	-	7750	-	-	-	-
3 months variety	-	6250	1250	7500	2500	12000	-	7750	-	-	-	-
Total Req. for issues (1+2)	7895	22545	12845	28332	18470	40070	20848	34282	21073	21745	22381	21645
3. Seed Production												
Extent of cultivation (%)	(20.0)	(22)	(25)	(25)	(50)	(50)	(70)	(70)	(90)	(90)	(95)	(95)
(Ha.)	39	43	49	49	97	97	136	136	175	175	184	184
Yield (bu./ac)	(75)	(75)	(80)	(80)	(85)	(85)	(90)	(90)	(95)	(95)	(100)	(100)
Paddy bu./ha.	187.5	187.5	200	200	212.5	212.5	225	225	237.5	237.5	250	250
Production Paddy (bu.)	7313	8063	9800	9800	20613	20613	30600	30600	41563	41563	46000	46000
Production Seed Paddy (bu.) (85% of Paddy)	6216	6854	8330	8330	17521	17521	26010	26010	35329	35329	39100	39100
Required Seed Paddy (bu) (0% year renewal)	12556	12931	16660	16838	20088	* 20848	23478	21073	27181	22381	27056	22381
Balance (bu)	- 6340	- 6077	- 8330	- 8508	- 2567	- 3227	2532	4937	8148	12948	12044	16719
Excess Seed Paddy (Ton)	0	0	0	0	0	0	52	89	170	270	251	349

Note : 01. 0% year renewal
02. R.F. - Rainfed I.R. - Irrigated
03. Seed paddy requirement
(1) Broadcasting : 5 bu/ha. (2) Row seeding : 3.75 bu/ha. (3) Transplanting : 2.5 bu/ha.
04. Free issued seed paddy provided by commercial seed
05. Extent of cultivation in Seed Farm is depended on introduction of machinery from Japan
06. * Extent of paddy cultivation 90% in Yala 1988, 80% in Yala 1989 and 75/ in Yala 1990
07. Weight of seed paddy : 20.86 kg./bu.

05-2/ Regional Research Station Girandurukotte :

(i) Site : Girandurukotte, Zone 2, System 'C'

(ii) Establishment : 1981.10.17.
This station succeeded the Research Centre, Alutharama, which was established in January 1976 and situated 10 km. away from the station.

(iii) Organization chart which incorporates the respective areas of research activity is shown.

(iv) Area

Total	:	66 ha.	
Experimental area		40	ha.
Irrigable paddy field	:	24 ~ 28	ha.
Rainfed paddy field	:	12 ~ 16	ha.
For building, road	:	16	ha.

(v) Function
Carry out applied and adaptive research and programmes, introduction of new technology, varietal screening and selection relevant to System 'C' under the National Coordinated Varietal Test (N.C.V.T.).

(vi) Buildings

(a)	Office, Directors Room, laboratory (1) and work rooms (7)		366.2 m^2
(b)	Seed, fertilizer and agro-chemical store (2)		336.5 m^2
(c)	Garage (1)	(1)	124.3 m^2

(d) Building for staff

o Grade 5	(1)	258 m^2	o Grade 4	(3)	495 m^2
o Grade 3	(1)	-	o Grade 2	(6)	441 m^2

(vii) Machinery and Vehicles

4 wheel Tractor :	3
2 wheel Tractor :	1
Vehicle : 5 ton truck	1
Diesel Jeep	1
Pick up (2 ton)	1
Car	1

(viii) Daily Labour

Registered 228 persons

Employment, average per day 140 persons

Number of working days per month 22

Number of persons per year 40,000

Labour charge Rs. 35/= per day

About Rs. 1,500,000 a year.

(ix) Budget

Expenditure for the year 1984 is as follows :-

- Capital - Rs. 6.239 million
  (Land development, vehicle and building etc.)
- Recurrent - Rs. 3.004 million
  (a) Personnel emoluments Rs. 0.400 million
  (b) Others
  (maintenance of building, fuel, labour cost etc.) Rs. 2.604 million

(x) Experiment and trial 1984/85 Maha

- o Cultivation of paddy
  Comparison of row-seeding, transplanting and broadcast sowing
- o Methods of weed control
- o Introduction of potato in Maha season.

(xi) Screening of varieties

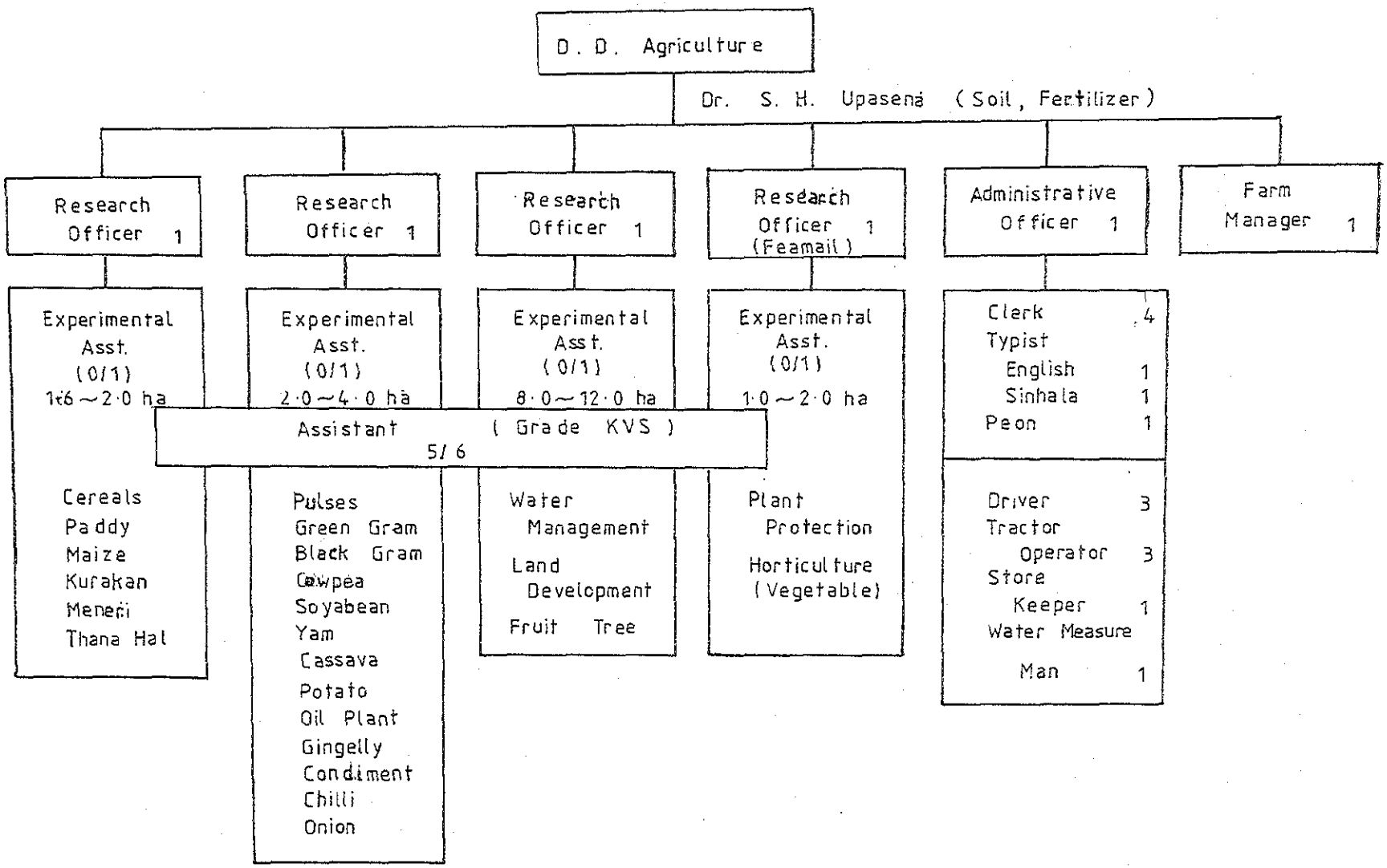
	1983/84 Maha	1984/85 Maha	Note Selected
Paddy : 3 months variety	9	7	
3½ months variety	14	8	
4-4½ months variety	14	7	
Maize : Line	850	300	
Potato: Variety	-	40	

(xii) The research programmes for each season is prepared by the DD (R) incorporating the problems highlighted at the Regional Technical Working Group Meetings and is approved by the Mahaweli Research Committee after discussions and modifications. Mahaweli Research Committee is represented by the Department of Agriculture and MEA.

(xiii) Demarcation of work between Research Station and Demonstration Project.

Research Station	Demonstration Project
1. Research	1. Study and selection material from the Research Station
2. Preservation of crop species	2. Establishment of extension materials
3. Generation of new technology First stage of fundamental and experimental test	2nd stage of measurement Large scale trials and Mass scale of demonstration. Materials from the Research Station.
(1) Selection of crop and variety under the National Co-ordinated varietal Test (N.C.V.T.) by small scale	3. 2nd stage selection of variety and practices of technology.
(2) Investigation and suggestion	
(3) Package of practice Fertilizer, Planting time, Plant protection, Method of planting Weed control etc.	
(4) Solving farmer's problems	
(5) Economic evaluation.	

Organization Chart For Regional Research Station Girandurukotte.



(2) Agricultural Research Station, Girandurukotte.

This section will be presented in separate papers. Later this section will be inserted in this paper.

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(Figure Page 76)

(3) DEVELOPMENT CENTER, GIRANDURUKOTTE

New building complex for Development Center were nearly completed in Girandurukotte, System "C" in 1984 and various training courses have been commenced through the complex.

The Center is attached to MEA Resident Project Manager's Office (PRM Office) of System "C" and is headed by a director. Under the director following staffs are working. In 1985, present

Present Staffs		
Training Officers	2	persons
Workshop Instructor	1	person
Librarian	1	"
Audio Visual Office	1	"
Audio Visual Technician	1	"
Clerk	1	"
Typists, Drivers & Others	9	persons

Organization will be reinforced e.g. instructors & agricultural officer. Provision in the center are buses (2 nos), audio visual instruments such as movie projector, slide projector and video tape recorder, lecture room, farm and so on.

The training in the center is broadly divided into two types. One is "Staff Training" which is opened for MEA Staffs such as engineers, engineering assistants, officers, block managers, unit managers and so on. Lecturers are senior officers and senior engineer's of RPM Office and are sometimes dispatched from universities and institutes concerned when proper lecturerer is not found. Based on needs of project staffs, trainings are organized by training officers in the center in collaboration with senior engineers and senior officers of RPM Office. Major training items in 1984 are agriculture, water management, community development, land administration, marketing, accounts, management and transport.

The other training is "Settler Training" which is opened for farmer/settlers in System "C" . Lecturers are mainly MEA senior staffs. The training are organized by training officers and senior engineers & officers in RPM Office. Major training items are Crop Cultivation, home economy, health, water management and workshop vocational training. Detailed contents of staff & settler training are tabulated in Table.

Training and demonstration farm is attached to the Center, and coconuts, fruits and paddy is cultivated in 25-acre area. Planting time of cereals, planning of home garden, dapog nursery, weed & pest control for chilli & paddy were demonstrated and trained in the farm. According to RPM Office, the farm will be used for demonstration of settler's home stay and for job-oriented training. Actually field trainings organized by the center are carried out in the other places of research stations.

In the center most of the trainings belong to extension works, and most of field trainings are not executed in the attached farm. Proposed Demonstration/Experiment Farm in Block 302 will be able to provide the farm to the center for their extension activities. It is recommended that through Development Center as well demonstrated techniques in the proposed Demonstration/Experiment Farm in Block 302 will be transferred to the farmers in Unit 2 & 3, Block 302.

Table 15 TRAINING COURSES IN 1984

(Girandurukotte Development Centre)

" STAFF TRAINING"

Course	Participant	Course	Participant
C1. Agriculture		Agricultural Insurance	65
Pre-Seasonal T. ining	47	Storage, Stock Control	60
Bee - Keeping	72	Standards in Marketing	60
Rural Agri. Development	7	Marketing & Purchasing	50
New Staff Training	2	6 Accounts	
02. Water Management		New Store Procedure	16
Seminar on W / M	30	Asset Register etc.	30
Lecture on W / M	40	Accounts & Audit	4
Water Issue & Distribution	40	7 Management	
Training in W / M	16	Officer Management	60
Survey	15	Security	15
Construction	25	Duty & Responsibility	15
Community Development		8 Transport	
Management in C / D	10	Driver's Responsibility	40
Objectives in C / D	40	Jeep Refresher	3
Home Development Activity	5	Tractor Maintenance	15
Land Administration	45	Engine & Hydraulic System	4
Marketing		Operation & Maitenance	4
Credit	60		

" SETTLER TRAINING"

Course	Participant
- Cultivation of Subsidiary Crops	3 , 500
- Water Management (Unit 2 Block 302)	200
- Agriculture	2,, 500
- Home Garden, Marketing & Credit	900
- Health Volunteer Training	300
- Nutrition & Home Economics	300
- Vocational Training at Workshop	102

CHAPTER III - TENTATIVE IMPLEMENTATION PROGRAMME

Tentative implementation programme is proposed by the JICA Mission in collaboration with MEA Counterpart officers, which is given in Fig

This tentative implementation programme is required to be finalised by the mutual agreement between the Governments. However, this programme should be subject to minor adjustments in the course of its implementation.

3 . 1 TENTATIVE PROJECT ACTIVITIES

Project activities, which are prepared in the tentative implementation programme, will be carried out in the following two stages. The Project activities will be a joint work to be done by Counterpart/Expert.

In the initial stage, efforts will be made mainly for experiments & trials, following after organization setting up. And in the latter stage demonstration, based on the experiment & trials, will be executed. The project activities by the subject matters are shown below respectively.

(1) AGRONOMY & AGRO-ECONOMY

Follwoing activities are recommended in the two stages.

INITIAL STAGE

- Preparation of field designed for cultivation plan,
- Trial cultivation for field stabilization for initial two crop season,
- Experiments on variety selection and cultivation practices in experimental scale,

- Experiments on adaptability of other field crops,
- Establishment of package practices to cultivate high quality rice, and
- Establishment of improved cropping patterns on the basis of experiments.

LATTER STAGE

- Demonstration of improved package practices confirmed by experiments,
- Demonstration of improved cropping patterns confirmed by experiments, and
- Instructions to Counterparts for cultivation of high quality rice

(2) AGRICULTURAL MACHINERY

Following activities are recommended in the two stages:

INITIAL STAGE

- Installation and assembling of machinery & equipment.
- Improvement of operation staff's techniques for machinery & equipment installed and assembled,
- Consolidation in Demonstration & Experiment Farm,
- Utilization, operation, maintenance and repairing of of machinery and equipment,
- Stock and supply on spare parts for machinery & equipment,
- Conducting and execution of applicability & adaptability tests for mechanized farming, and
- Study on present conditions at various farmer's levels for bench marks.

LATTER STAGE

- Analyses and reporting on adaptability trials by using of machinery & equipment.

- Demonstration on confirmed adaptable machanized farming through local extension system e.g. Development,
- Introduction and adaptability trials of local manufactured machinery & equipment, and
- Conducting survey on farmer's utilization of machinery and tools.

(3) POST-HARVEST

Following activities are recommended in the two stages.

FIRST STAGE

- Installation, assembling and test operation on machinery & equipment,
- Utilization, operation & maintenance and repairing of the machinery & equipment,
- Conducting study on analyses of rice quality at present and to be in future, and
- Preparation to produce high quality rice.

SECOND STAGE

- Analysis and reporting on rice quality,
- Preparation for adaptable procedures to produce high quality rice,
- Trial production and demonstration of high quality rice,
- Carrying out study on production of high quality rice through processing,
- Preparation of necessary data for rice quality standard, and
- Conducting study of rice quality through marketing system.

4

(4) WATER MANAGEMENT

Following activities are recommended in the two stages:

FIRST STAGE

- Planning of concrete field experinents based on the concrete cultivation plan,
- Planning of concrete demonstration contents,
- Installation and assembling of experiment apparatus,
- Instructions to Counterpart how to use the above apparatus
- Execution of planned field experiments,
- Study on water requirements, and
- Planning of the bench mark survey for evaluation.

SECOND STAGE

- Execution of demonstration on better water management techniques confirmed through field experiments
- Instruction to Counterpart on better water management techniques,
  (irrigation planning, irrigation scheduling & irrigation methods)
- Continuous execution of planned field experiment,
- Study on the suitable water management for local people,

3 . 2 MONITORING OF THE PROJECT

The project should be constantly monitored for the improved implementation of the project and evaluated finally at the end of the project implementation as post-project evaluation.

As for the post-project evaluation, it is technically difficult to conduct it on quantitative terms, simply because the project is designed for demonstration purposes. But, the concept of 'Institution Building' should be taken into the first consideratio at the time of its post-project evaluation.

When it comes to project monitoring, the following check points by the subject matters are regarded as recommended.

(1) AGRONOMY

Following check-points are recommended for the monitoring of the Project :

- Effectiveness of demonstration for cultivation fo high quality rice,
- Effectiveness of demonstration for other field crops,
- Capacity of counterpart in demonstrating techniques transferred by Japanese expert

(2) AGRICULTURAL MACHINERY

Following check-points are recommended for the monitoring of the Project :

- Utilization, operation, maintenance and repair of machinery and equipment,
- Storage of machinery, equipment and spare parts in accordance with operation procedure, and
- Effectiveness of demonstration in mechanized farming.

(3) POST HARVEST

Following check-points are recommended for the monitoring of the Project :

- Operation and maintenance of processing plants,
- Supply of high quality rice to particular markets as on trial,
- Impacts to rice millers in and around project area through processing of high quality rice, and
- Capacity of Counterpart in processing techniques transferred by Japanese expert.

(4) WATER MANAGEMENT

Following check-points are recommended for the monitoring of the Project :

- Maintenance of the irrigation and drainage facilities in the farm,
- Irrigation water distribution in on-farm system,
- Irrigation water consumption in the monitoring plot,
- Effectiveness of demonstration on water management techniques, and
- Capacity of Counterparts in water management techniques transferred by Japanese expert.

Fig. 19 TENTATIVE OPERATION PLAN FOR INITIAL STAGE

Sri Lanka fiscal year	January 1985				1986			
Japanese fiscal year		April 1985				1986		
Operation	4/4	1/4	2/4	3/4	4/4	1/4	2/4	3/4
01. Mission								
- Detail design team	———							
- Implementation Survey Mission	———							
02. Staff requirement		———	———	———				
03. Experts assignment								
- Preparation of A-1 form		———						
- Preparation of B-1 form		———	———					
- Agreement			———					
- Assignment			———	———				
04. Infrastructure								
- Consolidation of Demo/Expt. farm			———	———				
- Water supply system			———	———				
- Power supply system				———				
- Tele-communication system		———	———					
- Workshop shed		———	———					
- Tractor shed		———	———					
- Paddy processing shed			———	———				
- Rice milling shed			———	———				
- Expansion of office								
- Staff and expert quarters	———	———	———					
- Processing open shed			———	———				

Fig. 20 TENTATIVE IMPLEMENTATION PROGRAMME

Item	1985	1986	1987	1988	1989	1990
Infrastructure	———					
Assignment of Sri Lanka Staffs	———	———	———	———	———	———
Assignment of Japanese Experts	———	———	———	———	———	———
Experiment Farm	———	Agronomy Experiments ———	———	———	———	———
	———	Experiments on Water Management ———	———	———	———	
Demonstration Farm & Processing Plant Complex		———	Paddy Cultivation ———	———	———	———
			Other Field Crops Cultivation ———	———	———	———
	———	Agricultural Machinery * ———	———	———	———	———
		———	Water Management ———	———	———	———
			Post - Harvest Processing * ———	———	———	———
			Guidance to Local Extension System ———	———	———	———
Consignments Arrival	—	—	—	—	—	—
Installation of Plants		Seed Plant	Parboil Plant & Milling plant			
Training in Japan	Senior Officials ———	———	Counterparts ———	———	———	———

CHAPTER IV - FUTURE PROCEDURE

4.1 FURTHER ACTION TO BE TAKEN BY JICA MISSION

The draft detailed scheme of the Technical Co-operation and the draft list of necessary machinery and facilities for the Technical Co-operation will be finalised through the discussions with government officials conserned of Sri Lanka and also with government officials concerned of Japan after the JICA missiom returns in December, 1984.

4.2 FUTURE PROCEDURE

After the examination of the reports which will be submitted by the mission, Japanese authorities concerned will despatch Implementation Survey Mission in February - March 1985, for signing of 'Record of Discussion' by both Governments. Commencement date of the project implementation will be stipulated in the 'Record of Discussion'.

JICA is ready for the despatch of Detailed Design Team in January 1985, The Team will assist MEA in the detailed design of infrastructure such as, buildings, consolidation for the farm and so on for the Technical Co-operation.

FLOW CHART OF FUTURE PROCEDURE