IIMI Case Study No. 3

Farmer-Officer Coordination To Achieve Flexible Irrigation Scheduling: A Case Study From System H, Sri Lanka

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INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

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Summary:
The institutional and irrigation infrastructure of System H of the Mahaweli Multipurpose Development Project provides adequate opportunities for achieving a high standard of water management. A coordinated approach for achieving close cooperation between agency officials and farmers at the field channel and distributary channel levels, combined with a flexible delivery schedule, resulted in an improved field water use efficiency within the H5 subsystem. An equitable allocation of water to each field channel command area and an effective utilization of rainfall have also been achieved.

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Acknowledgements

I WISH TO express my appreciation to Dr. Roberto Lenton, Director General, International Irrigation Management Institute, and the Professional Development Committee for having given me the opportunity to present this case study. I am particularly indebted to Drs. Senen M. Miranda and C.R. Panabokke who gave me much assistance and encouragement to complete this study successfully. I also wish to record my gratitude to the IIMI scientists and research staff who helped me with their valuable comments. I also thank Miss Sujatha Akuressa who typed out numerous drafts of this document.

My sincere thanks and appreciation are due especially to Mr. N.G.P. Panditharatne, former Director General, and Mr. K.H.S. Gunatilaka, Director General, both of the Mahaweli Authority of Sri Lanka, Mr. T.H. Karunatilleke, Additional Secretary to the Ministry of Mahaweli Development, and Mr. Jayantha Jayewardene, Managing Director, Mahaweli Economic Agency, for recommending my application to IIMI for the special award. The efforts of Mr. Jayantha Jayewardene in promoting effective use of farmer organizations and his initiatives in forming distributary channel organizations are also gratefully acknowledged.

I am also obliged to the former heads of the Mahaweli Economic Agency, Messrs. M.L.J. Wickremarathne and Jayathissa Bandaragoda, its Executive Directors and Project Coordinators, and the Resident Project Managers of H5, who realized the vital importance of water management, and gave me their fullest cooperation to implement this program. I also thank Messrs. Ananda Wickremarathne, Chief Irrigation Engineer, Mahaweli Economic Agency, and Mahinda Panapitiya, Assistant Director, Mahaweli Engineering & Construction Agency, whose support was significant in solving the structural problems encountered in engineering a smooth operation of the system.

My special thanks go to the entire operation and maintenance staff, leaders of the farmer organizations, and farmers in the H5 area of Mahaweli System H who in one way or another contributed much to innovate and implement the relevant concepts and methods successfully.

P. Weerakkody

Senior Irrigation Engineer

1989

Foreword

A MAJOR SHARE of Sri Lanka's investment in the agricultural sector since independence in 1948 has been on irrigated settlement projects in the sparsely settled dry zone of the country. This included the restoration of nearly all ancient abandoned major irrigation reservoir schemes, as well as the construction of new major multipurpose projects. By the early 1960s most of the ancient major works had been restored and settled by farmers under the category of 'Colonization Schemes.'

Under the category of 'Major Multipurpose Projects,' the first was the Gal Oya Project, which commenced in 1949 under the auspices of the Gal Oya Development Board. This functioned as an Area Authority that was responsible for integrated multipurpose development; its main focus was on construction and farmer settlement. No serious attempts were made to develop appropriate irrigation management institutions and practices in either of these major projects or colonization schemes until the mid-1970s. Water delivery values in excess of 1.82 hectare-meters/hectare (6 acre-feet/acre) ex sluice for *maha* (wet season) rice cultivation were not uncommon in most irrigation schemes.

Opportunities for serious attempts to optimize the use of irrigation supply were afforded under the auspices of the Mahaweli Development Board (MDB) which was set up in 1970 to carry out the integrated development of System H (43,000 hectare [ha]) of the Mahaweli multipurpose project. The MDB was subsequently superceded by the Mahaweli Authority of Sri Lanka (MASL) in 1979 to undertake the accelerated development of approximately 100,000 ha of new land which covered four major systems, of which System H was one. Under the auspices of the Mahaweli Economic Agency (MEA), which is the management arm of the MASL, a unified management model was established for System H where a high degree of institutional coordination and cooperation was envisaged. This contrasted with the previous MDB type of management and the line agency management style of the earlier colonization schemes.

System H is made up of 12 subsystems of which 6 are new settlement areas while the rest fall within older colonization schemes. Subsystem H5 (5,000 ha) is located at the tail end of System H and was the last H subsystem to be developed, around 1980-82. In common with the other subsystems, H5 has been provided with adequate facilities in respect of irrigation and social infrastructure as compared with earlier irrigation schemes. The real challenge which faced the management agency was how to utilize properly this infrastructure for achieving a high standard of water management. This was of special significance not only because H5 area is located in the tail end of System H, but also because System H as a whole has an inadequate irrigation supply during *yala* (dry season).

The International Irrigation Management Institute (IIMI) commenced its studies on Irrigation Management for Diversified Cropping in *yala* 1985 in the Kalankuttiya Block of subsystem H2. The research objectives were focused on an examination of the technical and socio-economic constraints to more intensive diversified cropping during yala. One of the more important conclusions that emerged in the first phase of IIMI's studies was that there was an urgent need to improve the interaction between irrigation staff and farmers in irrigation system management from planning and implementation to monitoring of irrigation deliveries. It was clearly recognized that closer coordination between agency and farmers is needed to meet the more demanding requirements for non-rice crops during *yala* in situations of limited and uncertain water supply.

In the second phase of IIMI's studies in *yala* 1987 when IIMI was working with the agency to pilot-test some water management innovations, its attention was drawn to a preliminary draft report prepared by Mr. P. Weerakkody, Project Irrigation Engineer of H5, then stationed at the Nochchiyagama Project Office. This draft report described the steps that were taken towards a successful implementation of a coordinated participatory approach to water management in the H5 subsystem. Recognizing the significant complementarity between what Mr. Weerakkody had already implemented in the H5 area and what IIMI's intervention research was proposing to test at Kalankuttiya, a field visit was arranged to the H5 area by IIMI senior staff along with Mr. Weerakkody and his field staff in July 1987. It was observed that the two-tier level of farmer organization developed by Mr. Weerakkody, namely the Field Channel Organization and the Distributary Channel Organization was the key to the success of water management at the tertiary level. Equally significant was the manner in which Mr. Weerakkody had drawn on the lessons learned from his initial approach to develop a coordinated strategy for achieving close cooperation between agency officials and farmers, combined with a staggered rotational delivery schedule which matched with farmers' needs and circumstances in respect of irrigation demand. The monitoring and assessment operation developed by him enabled an equitable allocation of water to each field channel area taking into consideration the areal distribution of the two main soil types within the command area of each field channel.

The foregoing management approaches that were successfully developed by Mr. Weerakkody were considered important enough to become the subject for a case study to be written under IIMI's Special Awards Program, which provides an opportunity for professionals to document and publish their management innovations as case studies.

Mr. Weerakkody, the third recipient of IIMI's Special Awards Program, has served with the Mahaweli Development Board and the Mahaweli Economic Agency since 1973. He took up duties as Project Irrigation Engineer in the H5 area of System H in 1981, when about 25 percent of the area was settled by farmers. He spent most of 1981 studying and understanding the layout and characteristics of the irrigation system in H5. Starting with the calibration of all measuring structures in 1982, he programmed his work in a way which enabled him to commence his management innovations in the 1982/83 wet season. He was able to follow-up and improve his approach over a period of a further seven seasons (three wet and four dry), from 1983 through 1987, and also to document the relevant operations over this period. A course on irrigation and drainage that he followed in Japan during 1984 also helped him to examine critically the approaches he was trying out in the H5 area.

It has indeed been fortunate that Mr. Jayantha Jayewardene, then General Manager, and now the Managing Director, of MEA, had taken a keen interest in Mr. Weerakkody's work from its inception. Apart from the guidance and direction that he provided, he was mainly instrumental in getting Mr. Weerakkody to write up the first draft of his management approach as a working document to be used by the field staff of MEA.

The case study that is presented here has benefited from the inputs provided by IIMI's research staff during the period May-June 1988, when Mr. Weerakkody was given leave of absence from his substantive position with MEA to write this report. Nevertheless, the report is his, and IIMI is pleased to share it with a larger audience.

C.R. Panabokke

Senior Associate, IIMI

1989

Executive Summary

THE MAHAWELI GANGA Development Programme harnesses the waters of the Mahaweli, the longest river in Sri Lanka. The Mahaweli Authority of Sri Lanka, the implementing agency, has undertaken an accelerated program of development work to provide irrigation water to 99,176 hectares (245,000 acres) of new lands, 74,888 hectares (185,000 acres) of lands that were to get supplementary irrigation, and to generate 540 megawatts of hydropower.

The new lands being developed are in various locations in the Dry Zone and have been divided into several systems and projects. The allocation of diverted Mahaweli water to each project for each season is decided by a central Water Management Secretariat.

System H is located in the dry zone in the North Central Province of Sri Lanka and is divided into three projects. Cultivating the full extent of System H in both seasons of the year is a desirable objective, but due to water shortages which occur principally in *yala* (dry season), the cultivable extent is limited. The saving of irrigation water in *maha* (wet season) is therefore important for increasing the cultivation in *yala*.

The water management efforts made to realize this objective, using two different approaches in the H5 subsystem of System H, and the significant results achieved, are discussed in this paper.

INITIAL APPROACH

The farmer institution for water management is involved only at the field channel level. A group of 6-15 farmers, each having a farm holding of 1 hectare fed by a field channel of 1 cusec (28.3 liters/second) capacity, has a leader. Water management in the H5 area was initially practiced on a predetermined fixed schedule basis. The water deliveries into field channels was rotated on a 5-10 day basis. Farmers received water almost on the same day of each rotational week to irrigate the land. The field channel organization leader is required to distribute the water delivered to the field channel among the allotments. The issue of water was curtailed when there was sufficient rainfall to stop one or more rotations. In the early stages of the project this approach contributed to discipline the farmers in water management. They began to realize the importance of working in close coordination with water management officials for the planning and delivery of water.

However, this rigid predetermined irrigation schedule, especially at the land preparation stage, could not be synchronized with the actual needs of the farms. The farmer was not always able to follow the officer's instructions regarding land preparation. Lack of farmer/officer communication resulted in wastage of water. The officers were unaware of the day-to-day problems faced by the farmers and the farmers were not always ready to use the irrigation water that the officers allocated. The method of utilization of rainfall was ineffective and resulted in a wastage of water.

COORDINATED APPROACH

Using the lessons learned from the initial approach, a well-coordinated strategy was introduced to overcome the deficiencies and achieve the following objectives:

a) Coordination between officers and farmers for operation planning to achieve a high degree of efficiency in water management.
b) Making a delivery schedule flexible to match the circumstances in the actual agricultural operation by organizing field channel organization leaders under a distributary channel to minimize the wastage of water.
c) Appointing a leader in the distributary channel organization to coordinate field channel organization leaders and water management officers to increase the reliability of supply to field channels in the delivery operation.
d) Assuring equitable allocation of the available water to each field channel area for land preparation and subsequent crop growth periods over the season with consideration given to the soil variability in the project area.
e) Maximizing the use of rainfall by introducing methods to estimate, on a daily basis, the approximate amount of water in the field and adjusting canal issues accordingly.

Implementing a coordinated approach with a flexible irrigation schedule, effective utilization of rainfall, and improvement in water deliveries with intensive monitoring and daily assessment have resulted in satisfying the needs of farmers and reducing water deliveries required for successful cultivation, as shown by improved field water use efficiency. Along with these, improving the equity of water distribution over the project area has also been achieved.

CHAPTER 1

Introduction

RECENT HISTORICAL BACKGROUND OF SETTLEMENTS IN SRI LANKA

THE MANAGEMENT OF settlement projects has traditionally been the responsibility of district administration in which the Government Agent played the coordinating role on behalf of a number of ministries and departments relating to agriculture, irrigation, land administration, and settler services. These ministries and departments launched the initial phase of settlement in the Dry Zone. When the next phase of settlement was put into operation, the management system was modified, and the Gal Oya Development Board (GODB), the River Valleys Development Board (RVDB), and the Mahaweli Development Board (MDB), were constituted as Statutory Boards responsible for integrated multipurpose development functions in the areas demarcated for the Gal Oya Scheme, the Uda Walawe Scheme, and System H of the Mahaweli Development Programme, respectively. These areas have been managed as separate administrative systems outside the district administration. The Mahaweli Authority of Sri Lanka (MASL), which was set up in 1979, may be considered as an improvement on previous organizations involved in settlement management, because its administration system, structure, and character are more flexible and results-oriented than those of the two earlier organizations.

When the Mahaweli Development Board was set up to carry out integrated development of System H in the 1970s, the project organization was placed under a Resident Project Manager who was responsible for the entire physical, economic, and social development of the project. The Resident Project Manager, however, had to obtain the cooperation of several other agencies, such as the Department of Agriculture (DA) for agricultural extension work, the Government Agent (GA) for statutory activities, and the Department of Agrarian Services (DAS) for work relating to farmer organizations. The Resident Project Manager still had to work with a multitude of departmental officers at the field level, and therefore the system was only a slight improvement on the earlier one.

INTEGRATED SYSTEM OF MANAGEMENT IN AREAS UNDER THE MASL

In 1979, when the Mahaweli Authority of Sri Lanka (MASL) took over responsibility, a unified management model was established with the Resident Project Manager, the block manager, and the unit manager being responsible for an integrated management system at three different levels on a territorial division of work similar to the district, division and village levels of the traditional administrative system (Figure 1). The unit manager was responsible for a settlement area constituting about 200-250 families in respect of all activities connected with settlement management in the area. As the single multifunctional officer at the base level he was to function as the direct link between the settlers and the management.

The block manager was responsible for a settlement area occupied by 2,000-2,500 families. The block was divided into several units, and the manager was assisted by specialist functionaries in areas such as agriculture, irrigation, land administration, community development, and marketing. The Resident Project Manager was responsible for a settlement area consisting of about 6,000-10,000 families divided into a number of blocks. He was assisted by several project-level functionaries in the same specialist areas as at the block level.

A high degree of coordination and cooperation was envisaged under this arrangement since it was an improvement on the original district administration system, and because all the personnel involved in these territorial and functional activities were under the supervision of the Resident Project Manager as direct employees of the MASL.

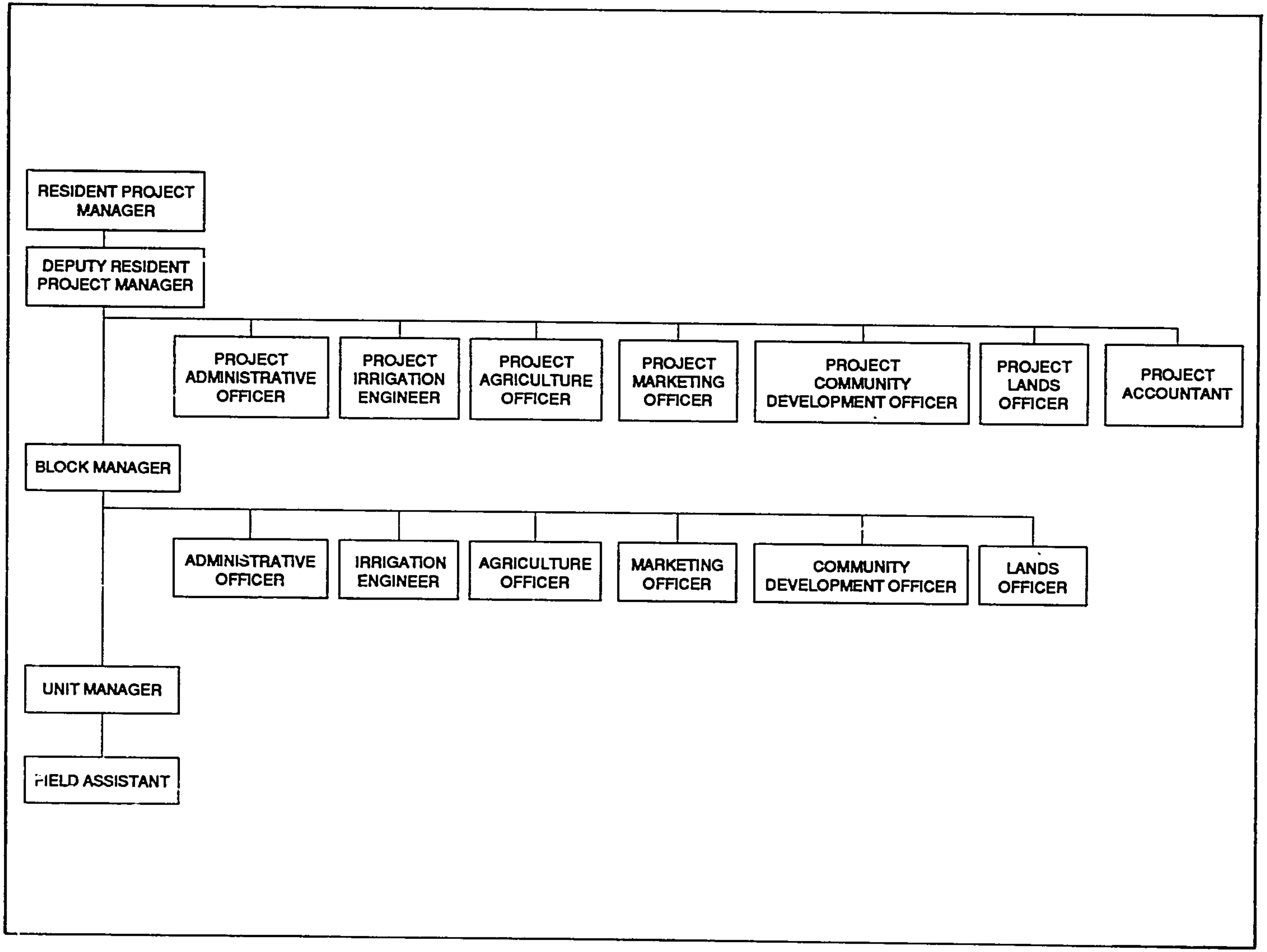


Figure 1. Project-level organizational structure of the Mahaweli Authority of Sri Lanka.

In keeping with the unified management system, a unified farmer organization system was also set up, a against a multitude of farmer organizations which prevailed in the earlier settlement phases, such as the Cultivation Committee, the Agricultural Productivity Committee and the Rural Development Society.

The farmers in each field channel (or turnout) were requested to organize themselves and elect a leader for their turnout. This leader, and another farmer who was to be the contact farmer for the field channel organization, were to be trained by the project management. The field channel leader would deal with water distribution, and the contact farmer, with matters relating to agricultural extension.

It was envisaged that with the passage of time the communities that were brought together within the settlement would need a forum with a broader base than a turnout group organization to look after their affairs such as water management, agricultural production, and religious, social and cultural activities. The MASL decided to organize Settler Development Societies in every hamlet to fulfil these needs. All settlers over 18 years of age were eligible to membership of the society and the leaders of all the turnout groups in that hamlet would form the committee of the society together with a representative each of women and youth in that hamlet.

The MASL applied the unified system of management to all its seven project areas in operation at the time. There are three projects in System H, one each in Systems B and G and two in System C (Figure 2). All project areas, each of which is headed by a Resident Project Manager, are coordinated by the Mahaweli Economic Agency (MEA), which is the settlement division of the MASL. The head of the MEA was earlier called an Executive Director but now the designation has been changed to Managing Director, and he is appointed by the MASL. The MEA consists of eight main divisions as shown in Figure 3: i) irrigation, ii) agronomy, iii) marketing and credit, iv) community services, v) project administration, vi) lands, vii) administration, and viii) finance. A Chief Irrigation Engineer and a Senior Agronomist are in charge of their respective areas, and coordinate the projects with the Water Management Secretariat of MASL on irrigation and agronomy (Figure 3).

SETTLEMENT FEATURES IN THE MAHAWELI AREAS

Each settler is given an irrigated allotment of two and a half acres [1 hectare (ha)] and a highland homestead allotment of half an acre (0.2 ha). The irrigated lot is provided with a pipe inlet of 6-inch-diameter [15.24 centimeters (cm)], to take water from a field channel which takes off from a distributary. Each field channel consists of an average of 12-15 standard allotments, but field channels vary from 6-22 allotments.

The homesteads are clustered into hamlets and located in suitable sites within close proximity to their respective farmlands. In selecting settlers for such hamlets, care has been taken to ensure that, as far as possible, individuals allocated to one area are selected from the same locality. A hamlet consists of 100-125 families, and 4-5 such hamlets form a village center where the basic services for the farming population have been provided. About 2-4 such village centers were placed under the umbrella of a township, which caters to 3,000-5,000 families. The township was provided with high level social infrastructure facilities such as post offices, multipurpose cooperative societies, hospitals etc.

Figure 2. System areas of present Mahaweli Programme.

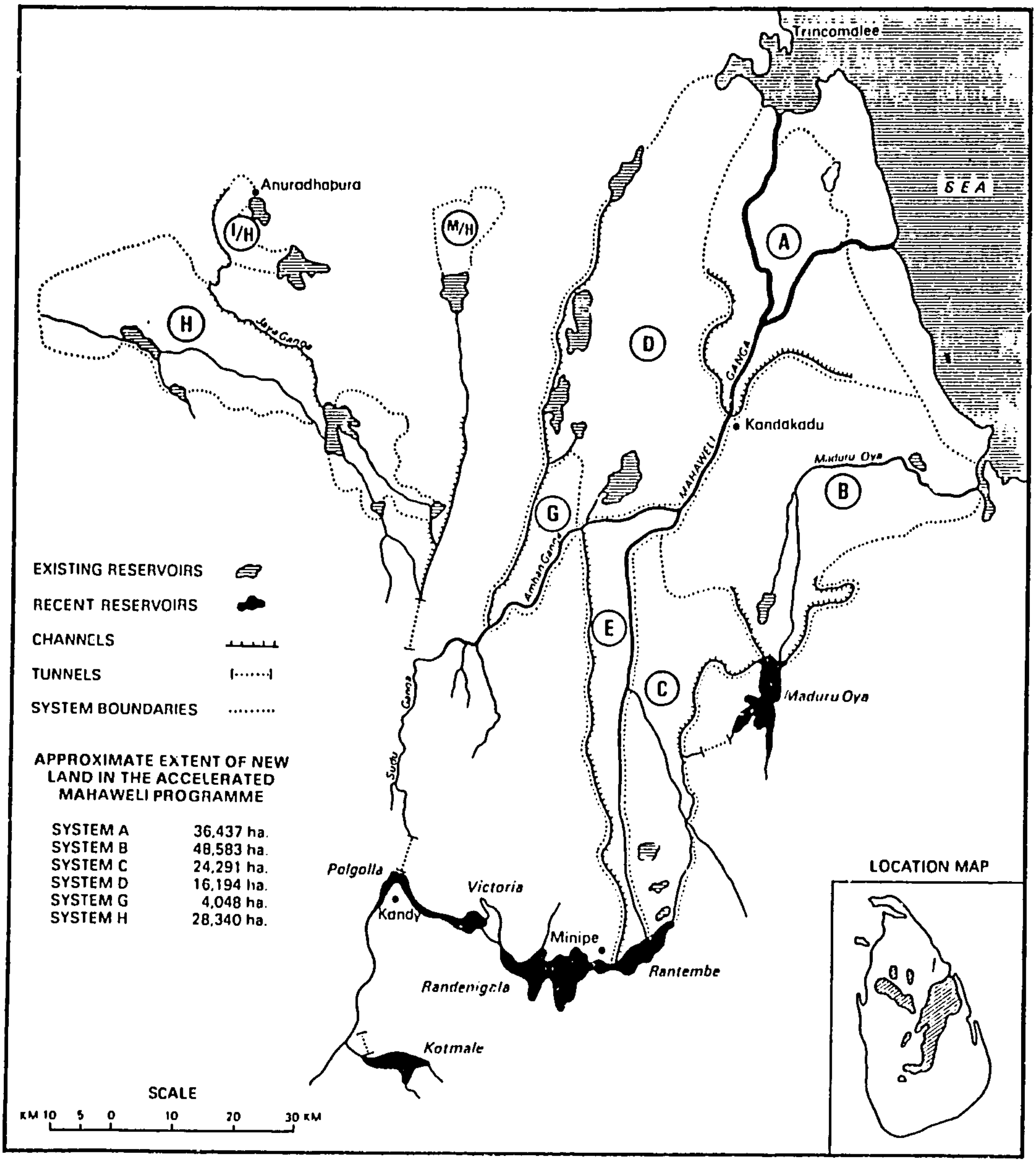
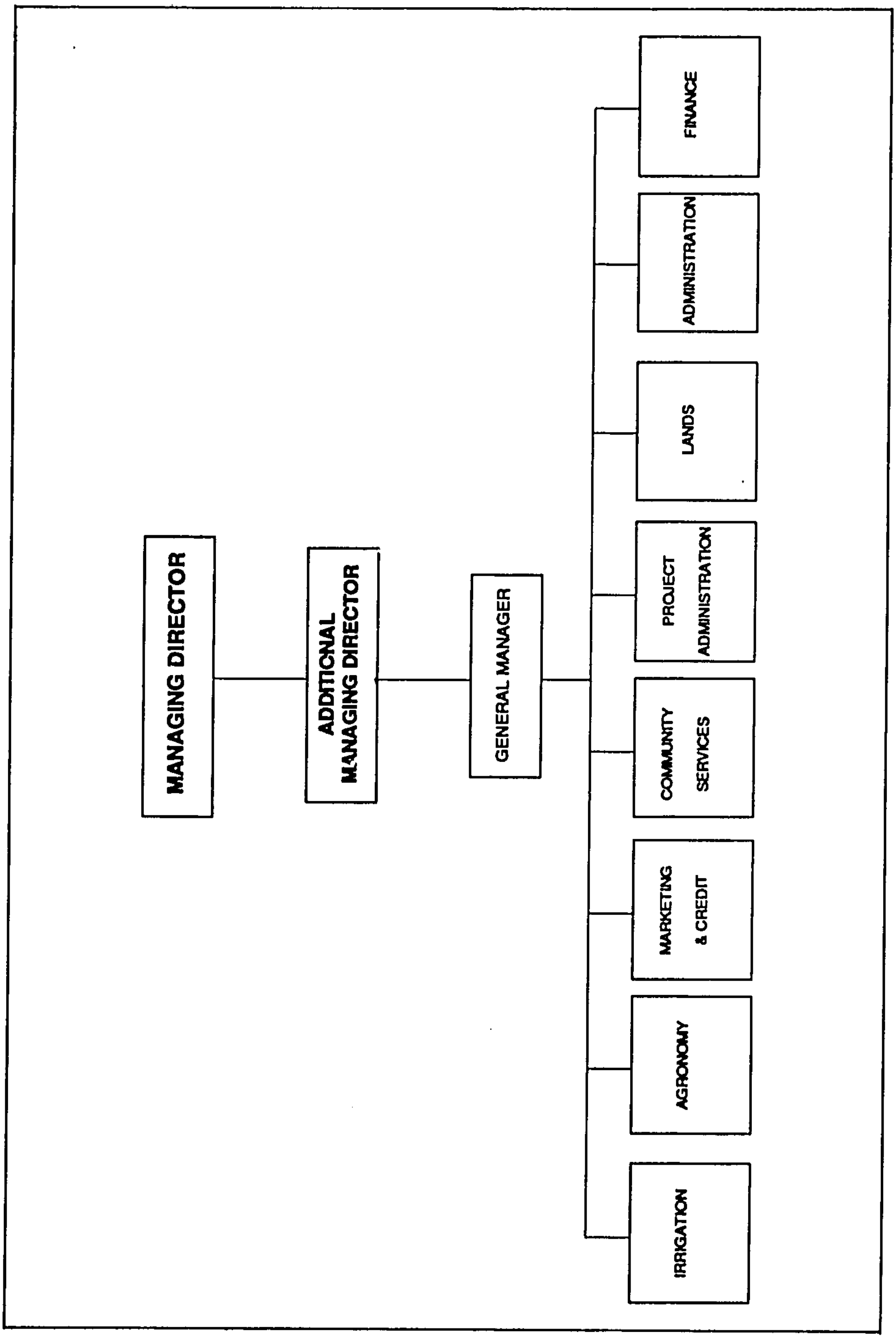


Figure 3. Organizational structure of the Mahaweli Economic Agency of the Mahaweli Authority of Sri Lanka.



CHAPTER 2

Project Description of System H

LOCATION AND ORGANIZATION

SYSTEM H is located in the Dry Zone in the North-Central Province of Sri Lanka. The area lies within the Kala Oya Basin about 16 kilometers (km) south-west of the historic town of Anuradhapura, the capital of the North Central Province. The project area covers a contiguous area of 106,000 acres (42,898 ha) of irrigable land, out of which 35,000 acres (14,165 ha) are old irrigated areas and 71,000 acres (28,734 ha) are newly developed lands.

A map of System H is given in Figure 4. System H is made up of twelve subsystems, of which H1, H2, H4, H5, H7, and H9 are new settlement areas, and the others are old colonization schemes. During the period when the settlement activities were under the MDB, the entire system was managed by the Resident Project Manager, Kalawewa. Later, because of the rapid influx of settlers, the system was divided into three project areas, each under an Resident Project Manager. The three project areas are Kalawewa (H1, H2, H6, H7, H8, and H9); Tambuttegama (H3 and H4); and Nochchiyagama (H5), as shown in Figure 4.

PLANNING AND FUNDING

Besides a UNDP-FAO Mahaweli Master Plan which gave an overview of the development of System H, a full feasibility study was conducted by the *Sociéte' Grenobloise d'Etudes et d'Applications Hydrauliques* (SOGREAH) of Grenoble, France, consultant to the MDB in collaboration with local experts. This study was further reviewed, and the revised project was cofinanced by a consortium of donors - the World Bank, the International Development Agency (IDA), the UK, Canada, the Netherlands, USAID, and the EEC.

H5 AREA OF SYSTEM H

Source of Water and Main Features of Delivery System

The H5 area is commanded by the Kalawewa Reservoir Right Bank main canal, which is about 45 kilometers (km) long (Figure 5). The Kalawewa Reservoir is fed by its own catchment and by the waters from the Mahaweli River diverted at Polgolla. The Kalawewa Right Bank main canal supplies water to two subsystems (H4 and H5), of which the three tail-end blocks are in the H5 area. The Right Bank main canal has a capacity of 1,150 cusecs (32.57 cubic meters/second, cumecs). The main canal is routed through a number of existing tanks or reservoirs. They function as regulating tanks, and this makes the main canal more responsive to changes in the discharge. The control structures at the head of each reach of the main canal can be activated to replenish the regulating tanks.

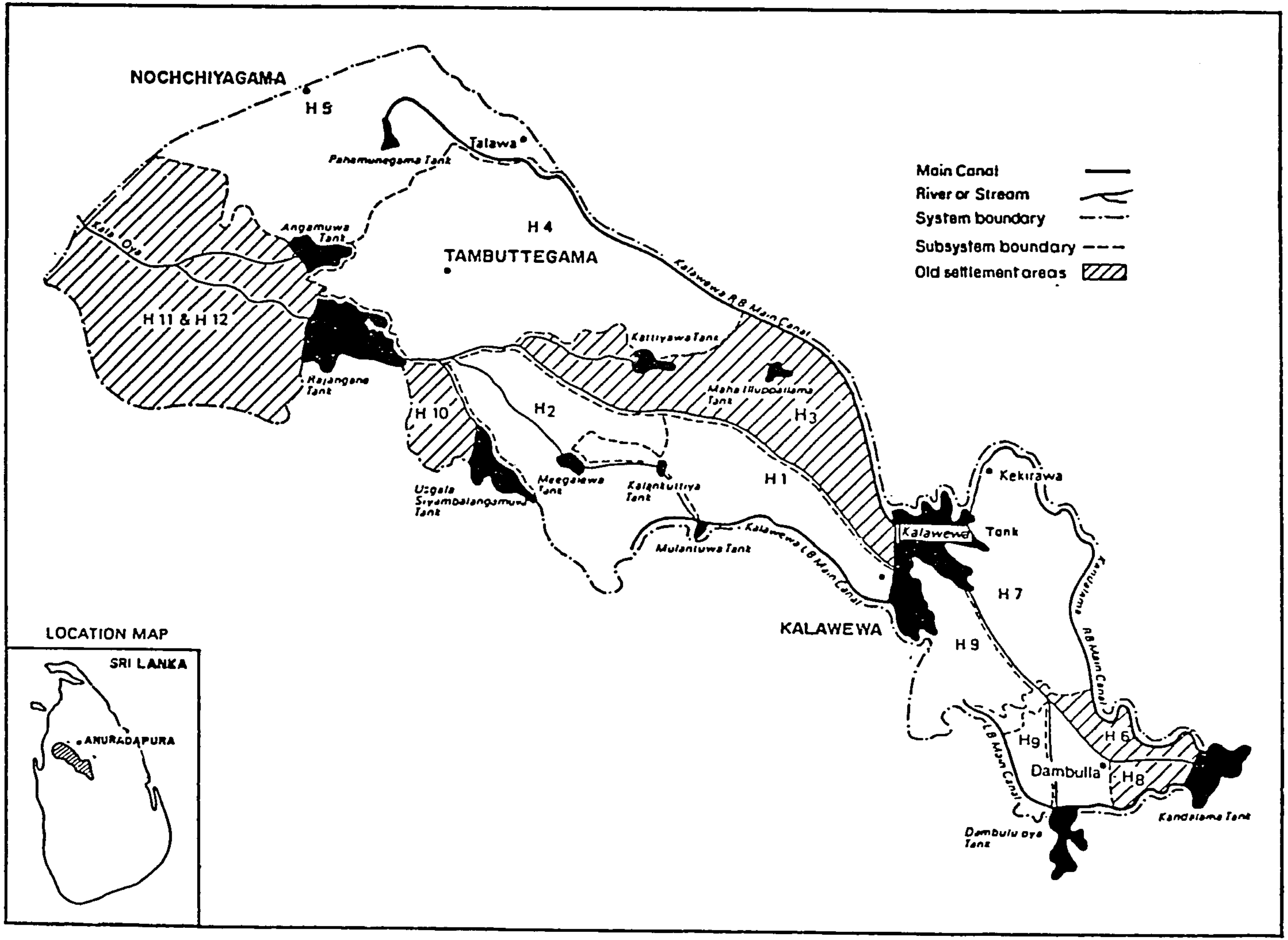
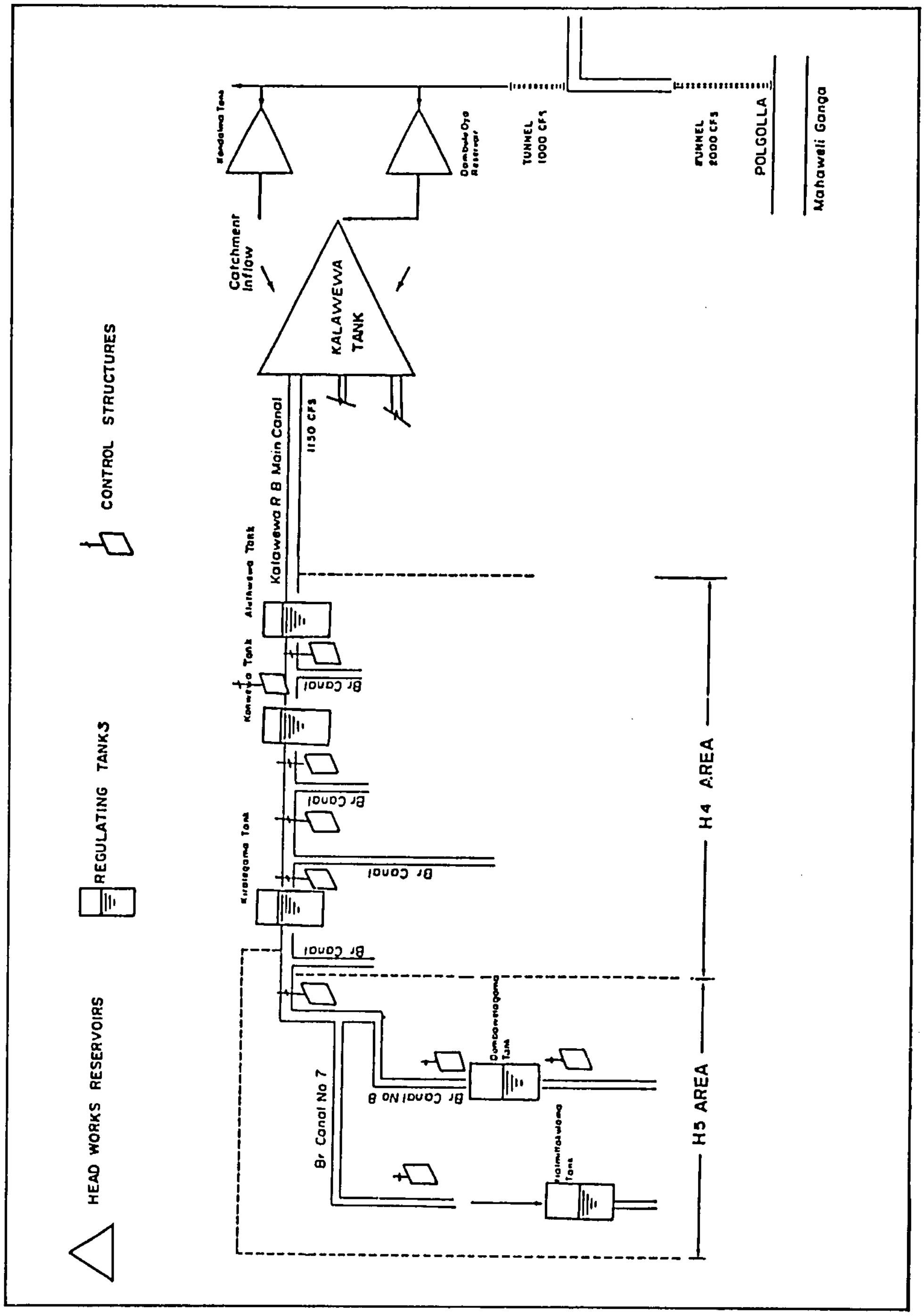


Figure 4. Subsystems of System H of Mahaweli Ganga Development Project.

Figure 5. Source of water and main delivery system of H4 and H5 areas of System H



The distributary channels, which take off from the main and branch canals, are designed to supply the peak requirement of all the field channel turnouts simultaneously (Figure 6). The control structures at the heads of distributary channels can be used to control and measure the discharge. Issues to the field channel are from the distributary channel, and the discharge from the field channel is always 1 cusec (0.0283 cumecs, or 28.32 liters/sec). A single field channel serves an area of between 12-15 allotments of 1 ha each on average. The water has to be issued into each field channel for a predetermined period, depending on the quantity needed, which in turn depends on the soil type and crop. The intention was that the field channel water would be delivered to two farms at a time, each receiving 1/2 a cusec (0.0142 cumecs). The outlets to individual farms consist of 6-inch-diameter (15.24 cm) pipes with a head control division box. The turnout structure to the field channel is provided with a screw-operated iron sliding gate with a weir to measure the discharge.

General Aspect

The Resident Project Manager, H5 is in overall charge of development activities for around 13,500 acres (5,465 ha) of irrigable land, and this area is divided into 3 blocks each of 4,500 acres (1,822 ha). These blocks are broken down into 24 units consisting of 200-250 families. A unit manager is responsible for his unit and is helped by a field assistant in agriculture extension. This system is adopted in other areas in System H as well.

Water Management Aspect

In System H, an irrigation engineer is responsible for irrigation water management within the administration block. An engineering assistant is in charge of water distribution for an irrigation block containing two to three units. The irrigation engineer functions under the guidance of a project irrigation engineer or the Deputy Resident Project Manager, who is the project-level officer responsible to the Resident Project Manager for water distribution in the entire project. There were no irrigation engineers at block level in the H5 area, and the 10 engineering assistants covering all ten irrigation blocks 411-421 (except 416) functioned directly under the guidance of the Project Irrigation Engineer for water management operation (Figure 7).

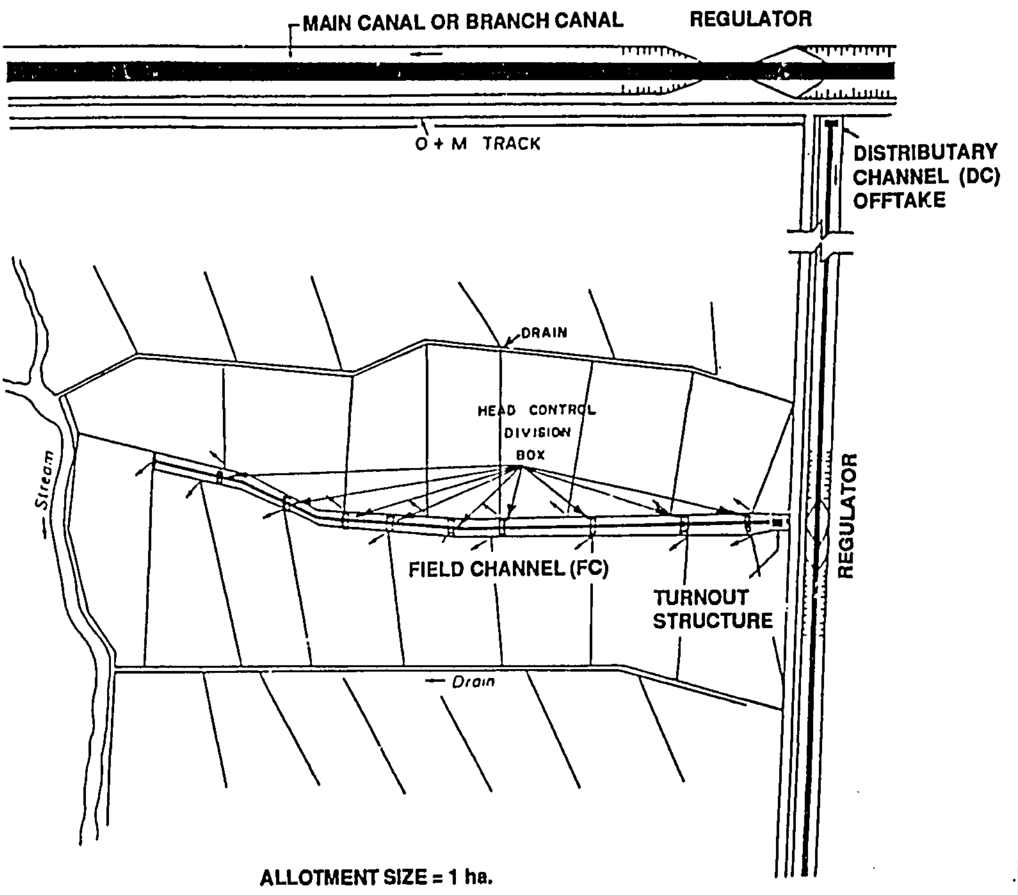
POSTCONSTRUCTION SETTLEMENT ACTIVITIES AND TRAINING PROGRAMS FOR OFFICERS AND FARMERS ON WATER MANAGEMENT

Settler Welfare/Care

The total number of irrigable lots alienated and developed for settlement in the H5 area is 5,500. The community development unit of the project was charged with the responsibility of village programs dealing with a) religious and cultural activities, b) environmental sanitation, c) community wells for drinking water, d) nutrition and mother-and-child health, e) day-care centers, f) sports, g) youth and children, h) women, i) family planning, and j) educational activities.

It was recognized that unless the community was organized into cohesive groups, community development will not take place. Communities live in hamlets and this is where they should be organized for the above programs. However, coordination with water management units will be effective at turnout levels, and not at the hamlet level. Since field channel farmers live in hamlets (on average six field channel groups per hamlet), the field channel organization of farmers was able to form small agricultural units within the hamlet.

Figure 6. Water delivery system.



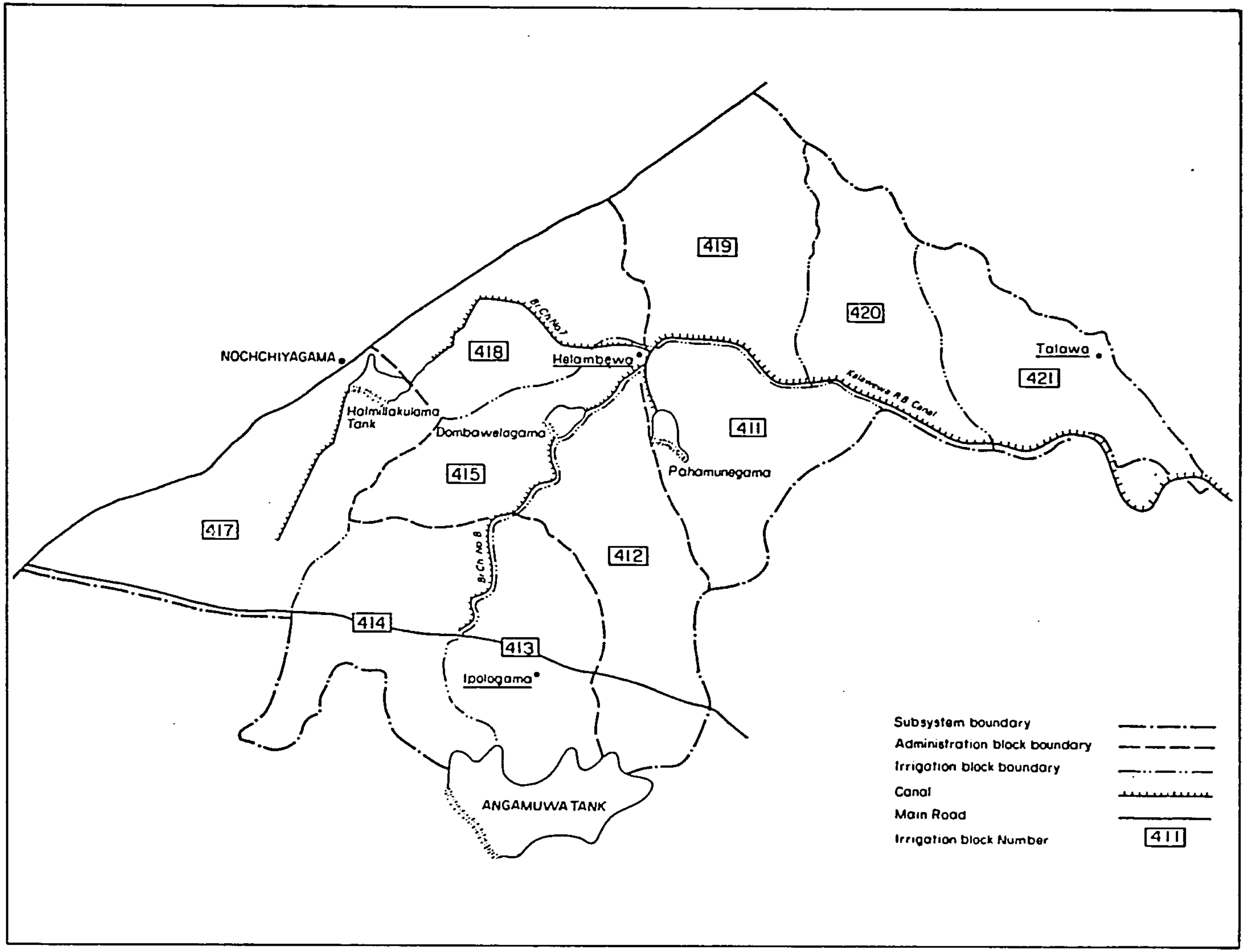


Figure 7. Subsystem H5 of System H.

Assistance for Social Development Program

At the request of the Government of Sri Lanka, the United Nations Children's Fund (UNICEF) volunteered to provide the necessary consultancy and assistance for the social development program in the Mahaweli areas. UNICEF assistance was provided for officer and farmer training, construction of domestic sanitary infrastructure, drinking-water wells, child-care centers, training of health volunteers to control malaria and other diseases, family planning, etc. A training unit was formed to program and monitor the training in the area of social development. The structure of the System H training unit is given in Figure 8. (see Annex I on page 49 for functions and duties.)

TRAINING PROGRAMS

Initially the project officers in all disciplines were made aware of the policy, planning and programs of the overall scheme, because ignorance of the structure, functions and objectives of the project on the part of the officers would lead to improper implementation and finally to failures.

Training programs were set out to make the officers fully acquainted with these important aspects. Officers were shown that they must not lose sight of the main objectives of the program, whatever their particular functions were. They were encouraged to exercise and develop their abilities, motivations, and leadership, and to resolve their problems. The programs were designed to upgrade the basic skills of the project staff. The farmer training programs were geared to upgrading basic skills in respect of agriculture, water management, community development etc., of both farmer leaders and contact farmers representing each group. The end view of the farmer training programs was to impart a comprehensive knowledge of all important aspects of agricultural and social life and to work towards a goal where their dependence on the government will diminish.

Officer Training on Water Management

Special programs for water management officers were organized to improve their knowledge of the following:

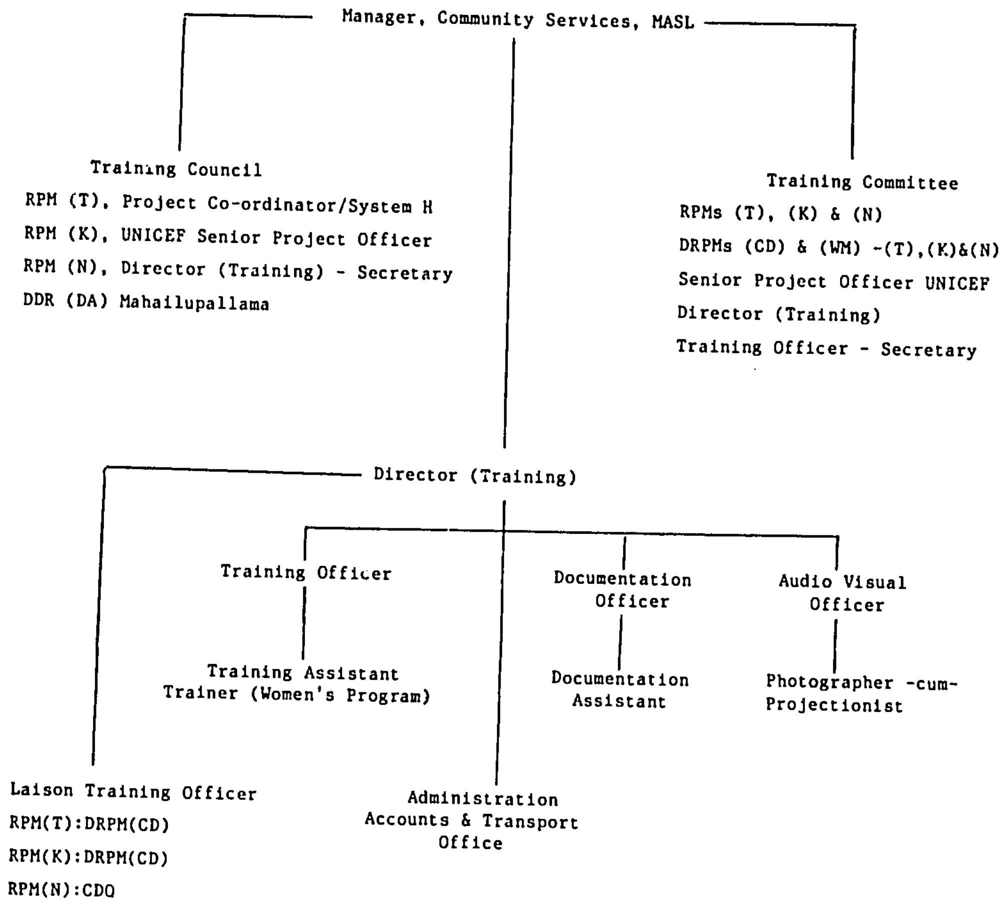
1. Determination of irrigation water requirements
2. Water management in irrigation systems
3. Water management throughout the life of a crop
4. Construction of a rice field
5. On-farm water management

To obtain comprehensive training inputs, experiences and the involvement of specialists from various government institutions, the MEA, in collaboration with relevant government institutions, set up the following training programs for officers in System H:

Seasonal in-service training programs. This 2-week training course was held twice a year just before the start of each season. The irrigation engineers, engineering assistants, agricultural officers, and unit managers participate in this training program.

Officers are instructed on the aspects of soil-crop-water relationships, water application techniques, on-farm water management and land preparation techniques at the In-Service Training Institute (ISTI) of the Department of Agriculture at Maha Illuppallama. The officers are able to acquire knowledge systematically from the researchers, specialists and trainers in the respective fields through lectures and field demonstrations.

Figure 8. Organizational chart of the Training Unit, System H, Mahaweli Project.



Key - RPM - Resident Project Manager
DRPM - Deputy Resident Project Manager
DDR(DA) - Deputy Director Research (Department of Agriculture)
CDO - Community Development Officer

CD - Community Development
WM - Water Management
K - Kalawewa
T - Tambuttegama
N - Nochchiyagama

Follow-up courses. This one day course was held on a monthly basis. The Resident Project Managers, block managers, their specialist functionaries, engineering assistants, unit managers, and field assistants participate in this course. It was set up to exchange the experiences and views and problems of officers within the project and system. Participation is arranged of specialists and professionals from government and academic institutions such as the Departments of Agriculture and Irrigation, the Agrarian Research and Training Institute (ARTI), and also the specialist officers within the Mahaweli Programme itself, with a view to resolving problems at these sessions. These sessions began at the commencement of the settlement phase of the system, and still continue to be held.

Bi-annual training programs. With the collaboration of the Irrigation Department, bi-annual training programs on water management, lasting two weeks, are held at the Irrigation Training School at Galgamuwa. These programs consisted of lectures, field demonstrations, and observation of water management in experimental fields. This course was arranged mainly for the engineering assistants to experience the water management methods used in irrigation project areas outside the Mahaweli areas.

In addition to the above training programs, there are seminars and conferences to exchange ideas and experiences among the project officers, head office staff, and officers from other systems. Officers are also sent overseas on scholarships whenever relevant courses are available. These training programs give the necessary understanding for officers to innovate procedures to suit the requirements in their respective areas of involvement.

Farmer training on water management. Farmer training programs for water management were designed to include the following aspects:

a) limited availability of water resources and equitable distribution in the project area
b) control and measuring devices in the system
c) utilization of available rainfall for cultivation and water issues during rainy weather
d) maintenance of canals, drains, and operation and maintenance roads
e) necessary feedback to the unit manager regarding extent of fields, progress of land preparation, nature of crops, maturity, and harvesting
f) the importance of organizing the turnout unit for collective action to complete the cultivation operation on schedule
g) organizational structure of project authority for water management
h) irrigation laws.

The training programs organized by the community development officers are geared essentially for farmer leaders and contact farmers. An honorarium was paid to farmer leaders who attended the training course. In addition to water management, the training classes also dealt with agriculture and community development. The participation of the engineering assistant, agricultural officer, and the community development officers of the block and the respective unit manager and the field assistant is compulsory.

The training classes are held in groups and the farmer leaders in an irrigation block are divided into 2-3 groups of approximately 70. The fortnightly classes are held at the community training center or at a school. The engineering assistant and the irrigation engineer are the instructors on water management. The course material was provided by the respective Deputy Resident Project Manager (Water Management) or the Project Irrigation Engineer.

CHAPTER 3

Farmer Participation in the Early Stages

DURING THE VERY early stages of the post construction development phase, water supply was in excess of requirements because only a small number of settlers were ready to begin farming. Subsequently, with the influx of settlers and the accelerated settlement program, it became necessary to instill in the farmers an awareness of proper water management and use. Hence the cooperation of the farmers and the irrigation authorities was imperative. It was important that the farmers served by one field channel should share the limited water available. The turnout organization thus became the basic and most important unit of the entire water management structure.

The immediate problems faced by the water management unit within a turnout area in the project were related to:

a) distribution of water among the farmers
b) maintenance of field channels and drains
c) attendance to and remedial action for minor problems in respect of land preparation, irrigation and communication.

Before the farmers underwent any training, they did not understand the principle behind rotational distribution and this resulted in confusion, with farmers damaging canal structures and measuring devices within the field channels. The officers realized that successful water distribution within the system could not be achieved unless a satisfactory standard was maintained in the operation of the field channel unit. To achieve this purpose, high priority was given to organizing farmer training courses throughout the system.

CHAPTER 4

The Initial Approach in Water Distribution in H5

SEASONAL AGRICULTURAL PLANNING

Officials in the upper rectangle of the water management communication structure comprise the Resident Project Manager, Project Agricultural Officer, Project Irrigation Engineer, Project Marketing Officer, and block managers, as seen in Figure 9. They are responsible for the project's seasonal agricultural planning, while the Chief Irrigation Engineer and the Agronomist in the MEA coordinate with the Water Management Secretariat (WMS) of the Mahaweli Water Management Panel in Colombo. The WMS for Mahaweli systems examines the availability of water for all Mahaweli systems on probability evaluations prior to each season. The Chief Irrigation Engineer in concurrence with the WMS suggests a tentative time schedule well ahead of the season. The project staff for seasonal planning direct the block managers to hold meetings with the farmers and discuss the proposals. The opinions of the farmers are then forwarded to the MEA as project proposals, and the WMS in Colombo examines them, and general guidelines for each cultivation season are set down to form the Seasonal Operating Plan with consideration given to the actual cultivation performance during the past seasons. These guidelines are limited to the allocation of water seasonally and monthly, the extent of area that can be cultivated, appropriate period for land preparation and the first and last dates of water issues for the season. The policy decisions are conveyed to and discussed with the farmer leaders representing each irrigation block at a precultivation meeting six weeks prior to the commencement of the season. The farmer leaders are then expected to inform their fellow farmers of these decisions. The farmers could then express their ideas at the cultivation meeting, and decide on detailed schedules for the entire season. The cultivation meeting has to be held four weeks ahead of the start of the season.

FARMER ORGANIZATION

The two kinds of farmer organizations that were formed during the early stages of the project (1981-1985), as described earlier, were the field channel organization and the settler development society. The field channel organization is the most important organization within the entire water management structure. The period from 1979-1981 could be considered a settling-in period for the farmers. They had been uprooted from their villages and they took time to adjust to a new way of life, and they needed discipline to apply themselves to organized cultivation. During this time no proper systems had yet been formulated, and workshops and training courses were organized to enable farmers to adjust to the new system.

METHODS OF WATER DISTRIBUTION POSSIBLE IN OPEN CANAL SYSTEMS

Of the two methods widely used in open canal systems, viz., continuous flow and rotational flow, the latter is considere to be the more applicable and efficient method due to the following reasons:

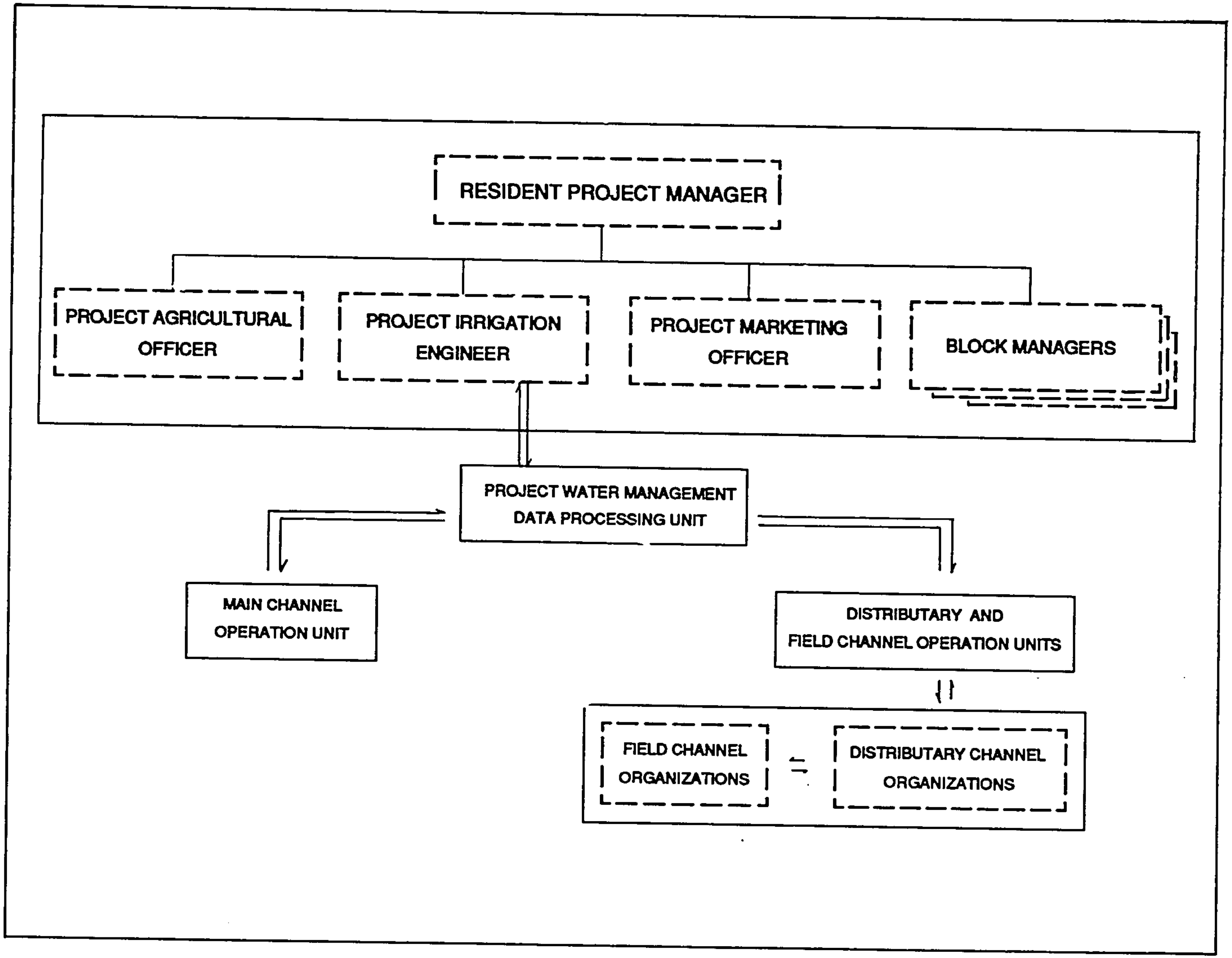


Figure 9. Project water management communication structure.

a) Even though the continuous flow method is the simpler and the more widely used method in older scheme in Sri Lanka, farmers have to work long hours to irrigate their lands, often at night under difficult condition. There is much wastage because farmers are not present to conduct water within their fields. Also, the varying head of water in the field channel results in irregular distribution of water among the allotments, causing water shortage to the tail end. It is also difficult to measure issues to individual allotments.
b) The rotational method, which requires more control and organization than the continuous method, was found to be more effective. Water is rotated on a 5-10 day basis so that farmers receive water almost on the same day of each operational week. The farmer needs only one day of the operational week to irrigate his land. In intermittent application of irrigation water, there are days of very little submergence. As a result, good use can be made of any rainfall.

In projects where there are several thousand allotments of one hectare each, an efficient rotation is complex, especially where the water has to be rotated between branch, distributary, and field channels. The timing of rotation is changed at different stages of the season to meet the actual crop needs. The success of a rotational method depends on the cooperation and coordination between the farmers and the officers.

WATER DISTRIBUTION PROCEDURES AND IRRIGATION SCHEDULING METHOD ADOPTED IN H5

Preliminary arrangements

In 1981 the foundation was laid by the Project Irrigation Engineer and the operational staff to eliminate the vague and unscheduled distribution of irrigation water for cultivation. A comprehensive program for calibration of all measuring structures in the canal system was implemented. Staff gauges were installed and rating curves were drawn in respect of all monitoring points in the main system, using existing Parshall flumes and current meter measurements. In respect of the distributary offtakes the existing measuring structures downstream of the turnout structure were provided with the necessary staff gauges, and their rating curves were drawn. In cases where the measuring structure appeared to be faulty, the discharge rates were rechecked using current meters. These activities were entrusted to an engineering assistant who was assisted by several technical officers whose primary function was flow monitoring under the supervision of the Project Irrigation Engineer of the project. This engineering assistant is usually referred to as engineering assistant (flow monitoring), and along with his technical officers, they formed the flow monitoring unit of the project.

The establishment of discharge rates of field channel turnouts was equally important in this exercise. It was clear that calibrating several hundred field channel turnouts throughout the project area within a short period could not be carried out by the project flow monitoring unit on their own. Hence, the engineering assistant in each of the 10 irrigation blocks was entrusted to carry out this exercise under the guidance of the engineering assistant (flow monitoring) with the overall supervision of the Project Irrigation Engineer. It was decided to establish the discharge level in the field channel at 1.5, 1.0, and 0.5 cusecs (0.04245, 0.0283, and 0.0142 cumecs) respectively. All the engineering assistants were provided with portable calibrated measuring Parshall flumes to cross check the discharge levels of the turnouts, since some measuring structures were found to be faulty. This calibration program in H5 was completed by the end of the 1981/82 *maha* (wet season). The function of the engineering assistant (flow monitoring) was thereafter the maintenance of the measuring devices in the main system. A mobile maintenance unit was formed by installing a tractor trailer with the necessary implements required for attending to repairs and periodical maintenance of the turnout and measuring structures.

With the 1982/83 *maha* season, a system of operation was drawn up by the Project Irrigation Engineer and his operational staff. The proposed system was discussed with the other officers such as agricultural officers and unit managers at the monthly follow-up course. The ideas of the officers were incorporated in the final system.

Irrigation scheduling

Assumptions made regarding water requirements at the design stage had to be modified slightly in order to meet the actual field requirements. The delivery schedule for land preparation in a field channel for rice was prepared on the assumption that the land preparatio.. in an irrigable plot or plots could be completed within a period of fifteen days from the date of commencement. At the first stage 50 percent of the extent was expected to commence on the first date of water issue for the season, as decided at the cultivation meeting, and the balance was expected to commence 5-10 days after the first date. The quantity of water required for first plowing, puddling and transplanting or sowing was scheduled to be given in three installments. It was assumed that land preparation would be completed within 25-30 days as recommended by the Seasonal Operating Plan and decided at the cultivation meeting. Fifteen days after the first issue of water for land preparation, the relevant extent in each turnout would be considered as the extent planted, and the schedule of delivery would be changed to meet growth requirements. Accordingly, at the end of the period given for land preparation, the total extent of the planned cultivation area was assumed to be planted. These assumptions were made to enable a staggered cultivation, avoiding the problems and inconveniences arising due to shortage of farm power and delays in credit inputs etc., during land preparation periods. During the growth period, crop needs and availability of water were taken into account to prepare fresh delivery schedules, and the following methods were adopted:

a) rotation with a variable frequency of delivery
b) rotation with a variable duration of delivery.

The rate of flow in a field channel was always fixed at 1 cusec (0.0283 cumec). Throughout the season, two farmers at a time were allowed to take water (1/2 cusec each). As the crop reached maturity the unit manager was required to report the progress of maturity to the engineering assistant so that he could cut off irrigation where it was no longer necessary, and allocate water only to land that still required water.

Irrigation was carried out from the head end to the tail end in the field channel to enable seepage from the upper high permeable reddish brown earth (RBE) to be used in the lower areas. This would reduce the quantities needed to tail-end allotments.

There were three rain gauges in the project area to measure the daily rainfall. Curtailment of canal issues against the rainfall was done only when there was sufficient rainfall to allow complete withdrawal of irrigation water for a rotation.

FARMER INVOLVEMENT IN WATER DISTRIBUTION

In the initial stages, decisions on the cultivation and water distribution operation were limited to the field channel area. The plan to stagger land preparation within the field channel unit was proposed by the officers, and it was presented to the farmers at the cultivation meeting. Farmer leaders coming within a rotational or a distributary channel area were not in any way geared to coordinate with the operational staff to extend this plan among the field channel areas. However, the officers explained to farmer leaders the schedule prepared to achieve inter-field-channel area rotation for land preparation. The farmer leaders were then expected to organize their cultivation operation with their fellow farmers to match the delivery schedule.

EFFICIENCIES

As stated before, settlers who arrived at the very beginning found no need to control water in their agricultural activities owing to the fact that there was always an abundance of water. If this practice was continued, farmers would have got used to cultivating without any of the water controls which they would eventually have to face as the number of settlers increased. This would have led to severe disruption of any controls that were enforced. Hence it was very helpful that some discipline had been introduced at an early stage so that the first settlers would not be disheartened later.

Allocating water to all farms equitably was the responsibility of the turnout leader. But if the leader does not know how much water is entering the turnout, he cannot argue with a fellow farmer who claims he is not getting enough, or is getting less than he is entitled. Hence the prompt calibration of turnouts went a long way towards the equitable distribution of water without serious disruption within the field channel areas.

Farmer leaders and farmers began to realize that they will have to work in close coordination with the water management officers for planning and delivery of water, and the farmers' awareness of water delivery schedules was significantly increased. A World Bank Review Mission visited in 1983 and examined the measuring devices and the system itself, the water management administration, and the up-to-date records, and they commended the initial approach on water management made in H5.

DEFICIENCIES

A rigid predetermined irrigation schedule at the land preparation stage could not be synchronized with the actual needs of the farms. Some of the factors which caused problems were the behavior patterns of the farmers, their financial constraints and the availability of farm power. The farmer was not always able to follow the officers' instructions regarding land preparation etc. Lack of farmer/officer communication resulted in wastage of water, mainly during the land preparation period. The officers were unaware of the problems faced by farmers, and farmers were often not ready to use the irrigation water that the officers allocated. The method of utilization of rainfall was inadequate and it resulted in wastage of water.

Lessons Learned and Remedial Action Needed

a) Coordination between officers and farmers is needed for operational planning to meet a high degree of efficiency in water management.

b) The turnout level farmer organization is not, by itself, capable of overcoming problems and making the schedule flexible to match the circumstances in the actual agricultural operation. In order to achieve this, all the turnout leaders under a distributary channel should unite as an organization and be involved in planning the operation of water distribution. Further, to increase the reliability of supply to field channels, the field channel leaders should have a leader for the entire distributary channel to coordinate among themselves and with the water management officers.

c) A leader should be appointed for the distributary channel organization, and the irrigation laborer who operates the turnouts should be accountable to this leader.

d) The engineering assistant should be kept informed of farmer activities, especially during land preparation, so that he can prepare the delivery schedules in such a way that when water is allocated, farmers are ready to use the water.

e) The unit managers and agricultural officers should increase their involvement in selecting crops to suit the physical conditions of the farms within the turnout. Also, the engineering assistant should take into account that the distribution of water among the turnouts is not merely based on the extent, but also on the physical conditions that vary among field channels.

f) Rainfall utilization has to be improved.

g) Farmers should be encouraged to cultivate rice only within the recommended area, in order to avoid water shortages.

h) Farmers' faith and confidence in the water management staff has to be established and maintained.

CHAPTER 5

Consultants' Recommendations for Systems Operation

THE CONSULTANTS WHO were engaged to advice on Mahaweli activities were, among others: a) World Bank consultant Mr. Edwin F Sullivan, b) NEDECO (Netherlands Engineering Consultants) - Irrigation Agronomy Service for Mahaweli Projects, and c) UNDP and IDA advisors for the Accelerated Mahaweli Programme. The absence of farmer cooperation and the inequitable distribution of water within the system were pointed out by the World Bank consultant. The many damaged structures and the prevalence of illicit tapping of water by cutting bunds is evidence of the problems highlighted by the consultants. The World Bank consultant proposed a set of procedures for making equitable allocations of water in the three Resident-Project-Manager areas in System H. The consultants also pointed out that as the supply of water available for System H was limited, there would be insufficient water for full cultivation in both seasons, with a shortage occurring principally in *yala* (dry season). A separate allocation plan was prepared to overcome water shortages in *yala*. In 1986 the MEA formed the System H Coordinating Panel to implement the recommendations made by the consultants. Also, the headworks and monitoring units, which already existed, were given additional responsibilities.

SYSTEM H COORDINATING PANEL

In order to manage the operation of the main reservoir sluices to serve all the subsystems, the Panel was set up consisting of the three Project Irrigation Engineers in charge of water management of the Galnewa, Tambuttegama and Nochchiyagama projects. The function of the Panel was to meet at the beginning of each irrigation season, and periodically during the season as necessary, to review the operating guidelines issued by the Water Management Secretariat (WMS) and the MEA in relation to the actual position of storage and supply, and to adopt such local reservoir operating instructions as may be necessary to ensure that water from the main source is distributed equitably among the three project areas in System H. The System H Coordinating Panel also had to provide guidelines for the operation of the system operational units.

System H Flow Monitoring Unit

The System H Flow Monitoring Unit was set up to monitor the main system operation, and it maintains the records necessary for the System H Coordinating Panel. The engineer-in-charge of the System H Flow Monitoring Unit served as the secretary for the Panel. The Deputy Resident Project Manager (Water Management) Galnewa served as Chairman of the Panel. The daily issues of water from each sluice at the headworks reservoir were to be monitored by the head of the Unit, or his staff, according to requests received from the respective Resident-Project-Manager offices. However, if the head of the Unit at any time believed that an order did not conform to the operating guidelines issued by the WMS, MEA, or the System H Coordinating Panel, he would either seek guidance from the Chairman, System H Coordinating Panel or as an interim measure, issue the quantity of water he thought was appropriate and then consult the Chairman, System H Coordinating Panel. The head of the System H Flow Monitoring Unit was to furnish daily, weekly, and monthly reports of operation to the WMS, MEA and the System H Coordinating Panel.

System H Main Canal Operating Units

The System H Main Canal Operating Units were organized to operate each of the three main canals taking off from Kalawewa. The main canal operating unit was an independent management unit, and ensured consistency in main canal operation and record-keeping.

ALLOCATION OF WATER

Maha (Wet Season). The consultants emphasized that farmers and officers in each block should be encouraged to use irrigation water as efficiently as possible during *maha*, because the manner of use in *maha* would affect the supply available in *yala*. Farmers were expected to use irrigation water only to supplement utilizable rainfall.

It was also stressed that farmers should adhere to the Seasonal Operating Plan issued by the WMS and the MEA indicating the amount of water expected to be available for the season, the extent that can be cultivated, and general policies such as cultivation dates, crops to be grown, etc.

Yala. In the dry season it was even more important that farmers conformed to the guidelines of the Seasonal Operating Plan. Based on the water allocation forecasts, farmers and officials should decide on the extends and locations of land that can be cultivated in each block. The farmers, with advice from the officers should decide how they can best use the limited supply of water.

FARMER ORGANIZATIONS

The advisors emphasized that water management functions should not be merged with community development functions. But it was important that the settlers themselves be the principal office-bearers in both water management committees and in community development societies. If turnout leaders operate and maintain their turnout efficiently and effectively, and if they cooperate to carry out similar activities at the distributary channel level, that would be a major step towards increasing farmer involvement.

CHAPTER 6

Coordinated Approach in Operational Planning

ENCOURAGING FARMER PARTICIPATION

It was recognized that an effective organization at the distributary level was essential for good coordination. On the advice of the General Manager, MEA, the distributary channel organizations were formed in H5 in 1986 to revitalize farmer organizations at field channel level, and to federate them at the distributary channel level, so that they could play a more active and responsible role in Operation and Maintenance (O&M) activities. The main objectives of the distributary channel organization were:

a) To establish continuous dialogue between farmer leaders and officers in all aspects of O&M along the distributary channel.
b) To help organize land preparation and other agricultural activities so that the water distribution program can be carried out smoothly.
c) To prevent farmers causing damage to structures and to make them attend to minor repairs whenever necessary.
d) To make arrangements to prevent wastage of water.
e) To get farmer organizations to maintain their field channels more conscientiously to enable a smooth flow of water throughout the channel.
f) To get the distributary organization itself to take on the contract to effect necessary maintenance work on the distributary channels. It was envisaged at the maintenance would be done better by the distributary channel organization since it was their own channel they were maintaining.
g) To involve farmers more and more in O&M activities of the irrigation system at distributary channel level and to reduce their dependency on officials.

OFFICERS' RESPONSIBILITIES AND FUNCTIONS

a) The Project Irrigation Engineer, in consultation with the Resident Project Manager, block managers, irrigation engineers, engineering assistants, and unit managers, is responsible for forming the distributary channel organizations. He should list out the objectives of forming this organization and they have to be clearly explained to farmer leaders. He has to list out the functions and obligations of the members of a distributary channel organization.
b) The Project Irrigation Engineer has to prepare the inventory of distributary channel organizations giving all the details of each organization.
c) The Project Irrigation Engineer and the block manager should convene meetings with the irrigation engineer, engineering assistant, unit managers, and field assistants to form the distributary channel organizations. A turnout leader should be elected as the distributary channel organization leader.
d) The block irrigation engineer and the engineering assistant should play an important role in the organization and function of the distributary channel organization.
e) The engineering assistant and the unit manager should only play an advisory role in the association. The engineering assistant of the distributary channel should record the minutes of distributary channel organization meetings, and keep all records related to the functions of the organization.
f) The unit manager, along with his field assistant, must participate in all activities of the distributary channel organization.

TURNOUT LEADERS' FUNCTIONS AND OBLIGATIONS

a) Turnout leaders must attend all meetings of the distributary channel organization. They should keep notes of the important decisions taken at the meetings.
b) They should keep all the other farmers in their turnout fully informed of what happens at these distributary channel organization meetings and the decisions taken there. Using this information the turnout leaders should try and improve the work of the turnout organization, especially in the areas of water distribution and maintenance of the field channel.
c) Farmer leaders should maintain a good relationship with officials of the MEA and strive to assist them actively in their work at this stage so that in future they could take over some of the officers' functions.

FORMATION OF THE DISTRIBUTARY CHANNEL ORGANIZATION

The Project Irrigation Engineer was of the opinion that the formation of these organizations should be launched with the total understanding of officers and farmer leaders, and that involving the new organization in the planning and operation of a cultivation season, on a trial basis, would be a good exercise for both officers and farmers. Hence, the following series of meetings was held to form the distributary channel organization in H5 with a view to obtaining the total involvement of farmers in the planning and operation of the 1986/87 *maha* cultivation season.

Meeting No. 1 (Project Level)

Participation: Resident Project Manager, Project Irrigation Engineer and all other project functionaries, block managers and all block functionaries.
Purpose: To discuss the main objectives and functions of the distributary channel organization.
This meeting was held in mid-June 1986 at the project office.

Meeting No. 2 (Administrative Block Level)

Participation: Resident Project Manager, Project Irrigation Engineer, block managers, block functionaries, engineering assistants, unit managers and field assistants.
Purpose: To explain and discuss the objectives and functions of the distributary channel organization, and the obligations of officers and farmer leaders.
These meetings were held at the end of June 1986 at the respective block offices.

Meeting No. 3 (Irrigation Block Level)

Participation: Project Irrigation Engineer, block manager, block functionaries, engineering assistants, unit managers, field assistants and all farmers.
Purpose: To explain and discuss the objectives and functions of the distributary channel organization and the obligations of farmers and farmer leaders; instruct the farmers to re-elect, if necessary, the leadership in the field channel organization, with the concurrence of the block manager and the unit manager. This is because the field

channel organization, as the core of the whole process, should have active leadership, and at this stage the farmers should have the option to elect a new leader if they need to do so.
These meetings were held in mid-July at the respective irrigation blocks.

Meeting No. 4 (Distributary Channel Level)

Participation: Project Irrigation Engineer, block manager, engineering assistants, unit managers, field assistants and field channel organization leaders (members of distributary channel organization).
Purpose: To form the distributary channel organization by electing a leader, discuss the objectives and functions in detail, and discuss the planning and operation of the 1986/87 *maha* cultivation season. This meeting was also used to discuss details of how to carry out any maintenance work that was urgently required. Farmer leaders gave their views on tentative time schedules proposed by the Chief Irrigation Engineer and the agronomist of the MEA, and they were asked to convey the proposals to all their fellow farmers and obtain their views, which could be presented at the precultivation meetings.

After the precultivation meeting, the Chief Irrigation Engineer's time schedule, along with the views of the farmer leaders, are forwarded to the MEA as project proposals for the Seasonal Operating Plan. The Water Management Secretariat examines the project proposals against the availability of water for the system and forecast the possible Seasonal Operating Plan. The project seasonal agricultural committee, on receipt of the Plan, inform the field channel organization leaders of the exact time frame of the cultivation season, water availability, extent, and types of crops recommended, so that the leaders can discuss them with their fellow farmers.

PLANNING THE 1986/87 *MAHA* (WET SEASON) CULTIVATION SEASON

Precultivation Meeting

Participation: Resident Project Manager in chair, project functionaries, block manager, block functionaries, engineering assistants, unit managers, field assistants and farmer leaders.
Purpose: To explain the recommendations and specifications of the Seasonal Operating Plan to farmer leaders and give them guidance to plan the cultivation season within their field channels.
This precultivation meeting was held six weeks ahead of the commencement of the cultivation season at irrigation block level.

Cultivation Meeting

Participation: Resident Project Manager/block manager in chair, project functionaries, block functionaries, engineering assistants, unit managers, field assistants and all farmers.
Purpose: To make common decisions within the framework of the Seasonal Operating Plan recommendations and specifications - the permitted total extent to be cultivated, the percentages of different crops, the total recommended extent at block and unit levels, the overall land preparation periods, and last dates of water issues for different crops, are major issues decided on at this meeting. Other factors that affect the cultivation season are also discussed, and decisions are taken.
This meeting was held four weeks before the start of the season, at irrigation block level.

EVOLVING A SEMIFLEXIBLE IRRIGATION SCHEDULE THROUGH PARTICIPATION

Based on the observations and indications made so far, the rotational method of water distribution has been found to be an economical method. What is important is that water distribution to different units or areas is followed under a strict schedule, and that it should ensure the correct volume of water reaching the user as and when it is required.

The operation of an irrigation scheme which involves a vast number of units is indeed a complex one. Depending on the efficiency standards desired, the schedule for a rotational supply of water could be one of three different types - (rigid) fixed schedule, fully flexible schedule, and semiflexible schedule.

Fixed Schedule

A fixed volume of water is fed to each irrigable unit at fixed intervals on a fixed rotational basis. How far this method meets the requirements, and what its effects are, have to be investigated individually because an assumed predetermined demand schedule will not be effective where diverse conditions are involved. The fixed schedule followed in H5 had shown its deficiencies, as explained earlier. The physical condition of the fields, crops and their growth stages, the behavior pattern of farmers themselves, and availability of farm power, are factors that vary from farm to farm. Therefore, to ensure an effective irrigation schedule which works smoothly and efficiently, it is very important to evolve a system of monitoring the actual needs of the farmers and field level information feedback.

Fully Flexible Schedule

The fully flexible schedule, on the other hand, is a system which takes all these aspects into consideration, but the operation requires the presence of night storage reservoirs in the canal system. As an alternative, storage should be maintained in the distributary channel so that farmers have the option of drawing water whenever necessary. The successful operation of this system depends on the attitude and temperament of the farmer. Unless he has a sense of discipline, awareness, collective responsibility, and a high degree of knowledge of crop-water relationships, there would be excessive use and wastage of water. A volumetric fee would have to be levied to make this method economically viable.

Semiflexible Schedule

This method, found to be the most desirable, has to be launched with full rapport between farmers and officers. They should meet and discuss the best method of water distribution with due consideration given to problems and circumstances. Water would be issued according to the outcome of this discussion. To overcome the numerous problems arising from the implementation of a totally rigid or a totally flexible schedule, and in order to arrive at the solution that is most beneficial to the farmer, and the most efficient in the use of water, the semiflexible schedule was introduced experimentally, with coordination of officers and farmers via the distributary channel organization and the field channel organization in H5, during the 1986/87 *maha* season.

PLANNING FOR DELIVERY OPERATION AT DISTRIBUTARY CHANNEL LEVEL

The Project Irrigation Engineer felt that the methods adopted in scheduling the existing system of water distribution could be re-organized and implemented in a more realistic and flexible manner with the help of the distributary channel organization through dialogue between the officers and farmer representatives from the very beginning to the completion of the season. Water requirements for land preparation, for example, vary within field channel areas, and even within distributary channel areas, and it would be difficult for the engineering assistant and the unit manager in charge of water distribution to make any decisions unless they know the characteristics of the land, and also the problems that farmers face. It was considered that the distributary channel organization could meet the actual demands of the field and provide the feedback necessary to prepare a realistic water distribution schedule. In this setup the field channel area is clearly identified as a rotational unit and the distributary channel area as a rotational area.

The water management officers meet the distributary channel organization at every important stage of the cultivation season and discuss the current situation in the cultivation operation in respect of the individual field channel.

Distributary Channel Organization Meeting No. 1

Participation: Project Irrigation Engineer or representative, engineering assistant, agricultural officer, unit managers, field assistants and all members of the distributary channel organization.

Purpose: The overall decisions taken at the irrigation block cultivation meeting were rediscussed in detail. This discussion enabled the officers to convey more details that were important to organize the cultivation process. Depending on the total extent of cultivation and the percentage of different crops recommended by the Seasonal Operating Plan, the extent of each crop that could be recommended for the distributary channel and field channel areas were clearly identified. For more accuracy, a soil map prepared by the engineering assistants with the concurrence of the unit managers and farmers for the distributary channel area giving the three major classes of soil types identified for individual irrigable allotments was tabled at this meeting (Figure 10). The extent of crops that could be cultivated in each field channel area and finally up to the distributary channel area were explained to the distributary channel organization. The equity in water distribution among allotments was discussed in detail at this meeting. The possibility of staggered land preparation within field channel and distributary channel areas within the overall land preparation period decided at the cultivation meeting was also discussed. The farmer leaders were free to express their views about the period required to complete the land preparation operation. Consideration of various factors such as labor, farm power and financial capabilities governing the duration of land preparation was very important at this stage. The 15-day period allocated for land preparation was generally accepted by the farmers. Accordingly, the field channel leaders in the distributary channel organization were thoroughly familiar with the specifications regarding crop extent, and possible flexibility available for an intermittent land preparation operation within their field channels.

The progress of irrigation and drainage channel maintenance, and canal and structure repairs that were decided on at the previous distributary channel organization meeting was also reviewed, and suitable dates for completion of such work were determined. Water allocations that could be made for land preparation and crop growth and the different application methods were also explained to the farmer leaders.

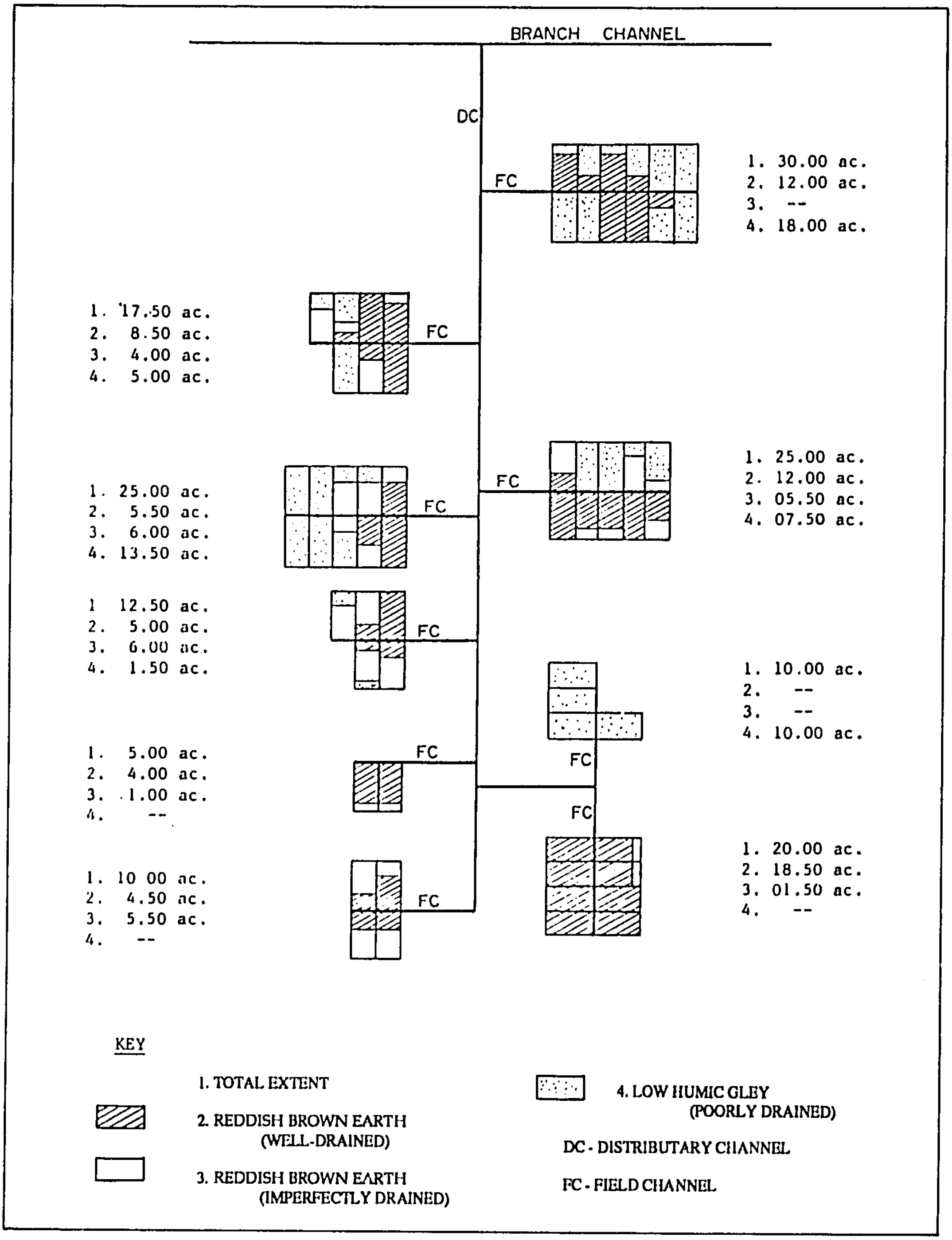
The farmer leaders of the distributary channel organization were then asked to inform all the other farmers in their turnout of the matters discussed and the decisions taken, and discuss with them the cultivation plan.

Distributary Channel Organization Meeting No. 2

Participation: engineering assistant, unit managers, field assistants, and all members of the distributary channel organization.

Purpose: One or two weeks before the first water issue the distributary channel organization met again with the

Figure 10. Schematic diagram of two different soil types identified for each irrigable plot in a rotational area.



engineering assistant, unit managers and field assistants to report the outcome of their discussion with their fellow farmers in respect of individual field channel areas. At this stage the individual farmer leader was competent to furnish the following information in respect of his unit:
a) the extent of different crops planned for cultivation
b) the staggered dates of commencement of land preparation and the respective crop extent
c) the farmers' views about the proposed equitable water allocations for land preparation and crop growth for a turnout area and the application logistics.

Officers tried to ensure that the farmers' suggestions conformed to the overall specifications of the Seasonal Operating Plan and final decisions were taken for a demand-oriented water distribution schedule for the land preparation period of 30-45 days permitted by the Seasonal Operating Plan.

DISTRIBUTARY CHANNEL ORGANIZATION PERIODICAL MEETINGS

Frequency: Once a fortnight during land preparation and ripening periods and at the discretion of the engineering assistant and distributary channel organization leaders during the growth period.
Purpose: To compare the actual response from the field with the cultivation plan. The main purpose of these meetings was to encourage the farmer population to keep their cultivation operation according to plan. Further, the distributary channel organization meetings at the ripening stage provide information on the actual situation of the field, and this enables officers to cut off excess issues and limit field channel discharges to satisfying demands without wasting any water. The distributary channel organization also met occasionally at the discretion of the leader or the engineering assistant, to discuss any important issue relating to water delivery, such as any deviation from the agreed schedule of delivery due to unexpected water shortages in the main source, inadequacy of water due to unexpected dry weather, etc. These discussions helped both officers and farmers to understand the constraints in both supply and demand and thus take appropriate measures.

CHAPTER 7

Operational Mechanism

DISTRIBUTARY AND FIELD CHANNEL OPERATION UNIT

THE DISTRIBUTARY AND field channel operation unit comprises the engineering assistant, the unit managers and the field assistants attached to the particular irrigation block. The engineering assistant is the technical officer-in-charge of preparing irrigation schedules and implementing them. The engineering assistant of the Unit is assisted by a number of distributary channel irrigation watchers to carry out the operation according to instructions. It is the engineering assistant's responsibility to prepare the field channel delivery schedule in keeping with field demands based on the agricultural implementation program set up by the distributary channel organization and the field channel organization for each rotational distributary channel area. These schedules are also based on the recommended water allocations for different soil conditions.

In preparing this schedule, the data related to the exact cultivation program planned for each rotational week will be entered by the engineering assistant in the field channel delivery schedule given in Annex II. The information provided in this includes the total extent recommended for the season, extent ready for land preparation, extent planted, and the extent ready for harvest under different crops for each field channel unit of a distributary channel.

The recommended water allocation is amended according to the stages of cultivation - land preparation, initial crop growth, and crop maturity. This allocation is further adjusted for the drainage type of the soil. The water requirement for well-drained Reddish Brown Earth (RBE) is assumed to be 1.75 times that for poorly drained Low Humic Gley (LHG). The ratio of the two soil types RBE:LHG is 60:40. The ratio remains the same down to block areas and sometimes to distributary channel areas. However, the ratio of soil groups among field channels varies considerably. Hence the water requirements of individual field channel areas are different. However, the recommended mean water allocation, periodically conveyed to the engineering assistant by the Project Irrigation Engineer, is dependent on the availability of water in the system.

The time required to issue this recommended volume of water at a given discharge rate is then decided. Once the schedule for the entire number of field channel units is prepared, the total daily water requirement at the entry to the distributary channel is calculated, making an allowance for canal losses (distributary channel loss factor is 1.1 as in Annex II).

These delivery schedules for each distributary channel area are submitted in triplicate to the Project Irrigation Engineer at least five days prior to the date of commencement of each rotational issue.

DATA PROCESSING UNIT

A group of officers formed the data processing unit to help the Project Irrigation Engineer to gather and process information related to the cultivation operation, planned and actual water distribution, and rainfall. The unit was headed by the engineering assistant (flow monitoring) who was already carrying out the discharge measurement activities in the project area. The technical officers and laborers assisting the engineering assistant (flow monitoring) acted as weather and flow delivery data collectors and messengers, respectively, in addition to their routine work on measuring devices. The data processing was done by a draftsman. The data processing unit was housed in the Project Irrigation Engineer's office.

MAIN CANAL OPERATION UNIT - H5

The main canal operation unit-H5 was organized to operate the main system within H5 down to the delivery to the distributary channel turnouts and its responsibilities were different from those of the distributary and field channel operation unit. The main canal operation unit-H5 acted as an independent service unit for the project area and it operated under the guidance of the data processing unit.

The main canal operation unit-H5 was headed by an engineering assistant who was assisted by a number of technical officers in charge of water distribution in different reaches of the main system. The technical officers supervised the main canal irrigation watchers who were responsible for the O&M of the main canal structures.

EFFECTIVE USE OF RAINFALL AND REVIEW OF ISSUES ON PREVIOUS DAY

To measure the rainfall in various parts of the area, six rain gauge stations were established in suitable locations, and each distributary channel was tied to the closest station. The distributary channel areas tied to each station were identified and demarcated (Figure 11).

In the H5 area a method, described below, was adopted to reduce a percentage of the irrigation water allocation by taking into account the available rain stored in the field on a particular day.

It was assumed that a rainfall of less than 0.2 inches/day (5.08 mm/day) was negligible in terms of contribution to the irrigation water allocation, and an amount of more than 2.0-5.0 inches/day (50.8-127.0 mm/day) was taken as the upper limit of 'effective' rainfall depending upon the acceptable ponding in the rice field at various stages of cultivation. Acceptable maximum pondage in the field was as follows:

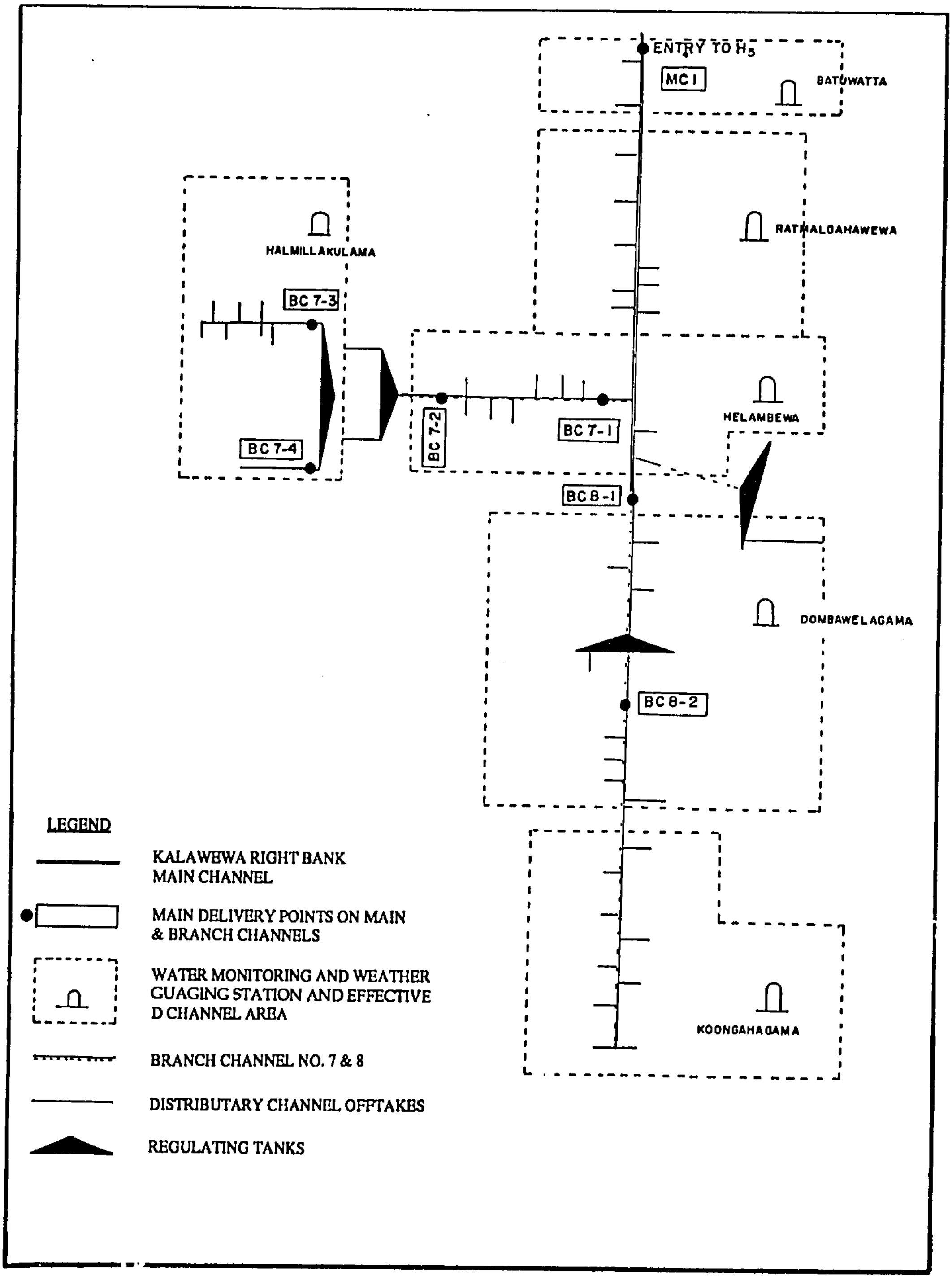
	Inches	Millimeters
Soaking and preparation of land for rice	5	127.0
Transplanting to tillering	2	50.8
Active tillering to dough stage	3	76.2

Daily 'effective' rainfall was recorded, starting with the season, in the form given in Annex III. Based on the assumed daily depletion rate, a cumulative depth of effective storage of water in the soil was calculated. (This effective storage may be visualized as the depth of water in the field.) However, the cumulative effective storage was not allowed to exceed the assumed pondage. The percentage of water depth to be added to the effective storage - the theoretical amount of water to be supplied to the field - was then calculated.

The percentage of water depth to be added to the effective storage was modified to arrive at the percentage of water allocation that was entered in the final column of Annex III. Conveyance of small quantities of water in long channels was not practical because of the low head in the channel, and the reduction of flow in distributary channels had to be kept at a practical level. After a few seasons it was decided to fix the minimum reduction possible common to all distributary channels at 40 percent of the full irrigation allocation.

Daily irrigation issues were carried out according to Annex IV, which uses the percentage of irrigation allocation computed in Annex III and compensates for the previous day's issues. On each day gate adjustments were recorded and at the end of the day irrigation issues were compared with the irrigation expected, and variations were recorded as excess or deficit in the next to last column of Annex IV.

Figure 11: Distributary turnouts, flow monitoring and weather-gauging stations in the H5 area.



DAILY OPERATIONAL GUIDANCE

The 24 hour rainfall experienced up to 06:00 hours and the actual discharges to distributary channels calculated by the TO are taken by messengers to the data processing unit before 07:00 hours every day. The discharge to distributary channels is calculated by averaging the hourly gauge readings recorded by the measuring devices at distributary channel heads by the main canal irrigation watcher from the six water monitoring and rain gauging stations. The processing of the data is done at the data processing unit and the final operational instructions for the current day, recorded in the form given in Annex IV, is carried by messenger to the main canal operation unit-H5, monitoring stations, and the distributary and field channel operation unit. Any changes that need to be made to the discharge rate are made at 11:00 hours every day by the main canal operation unit-H5. This leaves sufficient time for data to be reported to the data processing unit, processed there, and the day's operational instructions issued to the respective units.

The water monitoring and weather gauging stations function under the engineering assistant (flow monitoring) of the data processing unit. The main canal operation unit-H5 functions centrally to operate the main system, thereby maintaining the correct discharge of water to the distributary channels according to the daily instructions issued by the data processing unit. Water entering the distributary channels is distributed to the field channels by the distributary and field channel operation unit. The engineering assistant of the Unit is informed of the daily operational guidance instructions. Adjustments made to the computed schedule for the turnouts in distributary channels against rainfall have to be identified by the engineering assistant of the Unit who should quickly inform the distributary channel irrigation watchers and farmer leaders. The necessary alterations have to be effected by reducing the one cusec discharge from the individual field channel by a percentage equivalent to the percentage reduced at the distributary channel. The data processing unit uses the form given in Annex V to calculate the daily total water requirement at the main delivery points in the system and finally to calculate the total requirement for the project area. The daily total water allocation for H5 has to be supplied by the main canal operation unit in H4 according to the water orders of the Project Irrigation Engineer-H5.

CHAPTER 8

Results and Discussion

IMPLEMENTING THE COORDINATED approach with a Semiflexible Irrigation Schedule, effective utilization of rainfall, and improvement in water deliveries with intensive monitoring and daily assessing has resulted in satisfying the needs of farmers and reducing water requirements for successful cultivation, as shown by improved field water use efficiency. Along with these improvements it was expected to achieve equity of water distribution in the three administrative Blocks within the H5 area.

SATISFYING THE NEEDS OF FARMERS

The dialogue between farmers and water management officers in planning and implementing the distribution of water throughout the season has resulted in an increase in the sense of responsibility of both farmers and officers towards each other. The emphasis placed on the preparation of an efficient irrigation schedule by giving due consideration to the problems, circumstances, and actual needs of the farms has resulted in the smooth operation of the system.

Table 1 gives a comparison of the number of complaints received from the users under an average sized rotational distributary channel area during two *maha* (wet season) cultivation seasons. The number of complaints received when the coordinated approach was used is seen to be far lower than before it was implemented. However, inadequacy of time and water for land preparation may be corrected further.

WATER DUTY

In *maha*, the total area in the three projects is usually planted to rice. The mean rainfall received in the three project areas differs from one another. Table 2 indicates the rainfall received, and the actual water duty during the three *maha* seasons of 1984/85, 1985/86, and 1986/87 in the three project areas commanded by the Kalawewa Left Bank and Right Bank canals. It also shows that the water duty for H5 in *maha* 1986/87 is less than in the two previous seasons, even though rainfall received was lower.

Table 1. Complaints received during two maha cultivation seasons in an average-sized distributary channel area in H5.

Nature of complaint	*Number of complaints in* 1985/86 *maha* (wet season) (Initial)	1986/7 *maha* (Coordinated)	Complaint recorded at
Inadequacy of time and water for land preparation	63	10	DFCOU[a] office
Delays in water reaching tail-end turnouts station	06	None	Water monitoring
Illicit tapping of water by farmers in upper turnouts	03	None	DFCOU office
Inequitable allocation of water within field channel areas	08	01	DFCOU office
Unsatisfactory performance of distributary channel irrigation watchers	09	01	DFCOU office
Complaints against water management officers	07	None	PIE[b] office

[a]Distributary and field channel operation unit.
[b]Project irrigation engineer.
Size of the distributary channel area: total number of farm allotments = 160; total number of field channels = 15; location in relation to the main system - tail end.

Table 2. Total rainfall and water duty during *maha* (wet season) 1984/85, 1985/86 and 1986/87 in three project areas fed by the Kalawewa Tank.

Project	Units	Season					
		maha 1984/85 Rainfall	*maha* 1984/85 Water duty	*maha* 1985/86 Rainfall	*maha* 1985/86 Water duty	*maha* 1986/87 Rainfall	*maha* 1986/87 Water duty
H1, H2	(feet)	1.9	4.1	2.7	4.1	1.1	4.3
	(cm)	58.0	126.0	81.0	126.0	32.0	132.0
H4	(feet)	2.2	4.4	2.4	4.8	0.8	4.6
	(cm)	67.0	134.0	74.0	145.0	25.0	140.0
H5	(feet)	1.9	4.0	2.3	4.2	1.1	3.8
	(cm)	59.0	121.0[a]	69.0	128.0[a]	33.0	116.0[b]

[a]Initial approach
[b]Coordinated approach*Source:* Flow Monitoring Unit - System H.

FIELD WATER USE EFFICIENCY

Field water use efficiency, or the yield per unit of water (in bushels per acre-foot, bu/ac.ft; 1 bu/ac.ft = 169 kilograms/hectare-meter) is an indicator of the efficiency of water use. If irrigation is practiced with minimal waste of water, while not lowering the yield, field water use efficiency will be high.

Table 3 shows field water use efficiency in three areas during the three *maha* seasons. An improvement of field water use efficiency was shown in the 1986/87 *maha* season in the H5 area compared to other seasons and areas. This may be due to an increase in yield of rice associated with better crop management practices, or due to less wastage of irrigation water. Across the seasons, *maha* 1986/87 shows an increase in rice yield in all three areas. However, H5 area had the lowest water duty reflected by the highest field water use efficiency among the three areas, as seen in Table 3.

Table 3. Rice yield and water use efficiency in three project areas fed by the Kalawewa tank.

	Seasons											
Area	*maha* 1984/85				*maha* 1985/86				*maha* 1986/87			
	Yield		Field water *use efficiency*		Yield		Field water *use efficiency*		Yield		Field water *use efficiency*	
	(kg)	(bu)	(kg/ha-m)	(bu/ac.ft)	(kg)	(bu)	(kg/ha-m)	(bu/ac.ft)	(kg)	(bu)	(kg/ha-m)	(bu/ac.ft)
H1, H2	1941	93	3890	23	1962	94	3890	23	2129	102	4059	24
H4	1857	89	3382	20	1837	88	3213	19	2150	103	3890	23
H5	1899	91	3890	23[a]	1983	95	3890	23[a]	2108	101	4566	27[b]

[a]Initial approach
[b]Coordinated approach
Sources: Flow Monitoring Unit - System H; Statistical Unit - Mahaweli Economic Agency.

Table 4 shows the field water use efficiency in the H5 area for three *maha* seasons with water duty and rainfall. During *maha* 1986/87 with the high field water use efficiency, water duty has been reduced. There was high field water use efficiency as a result of low water duty and high rice yield during *maha* 1986/87.

EQUITY OF WATER DISTRIBUTION

Equity of water distribution has been considered at the three administrative blocks of the H5 area. The soil map of H5 shows that 60 percent of the irrigable area is made up of Reddish Brown Earth (RBE) and 40 percent of Low Humic Gley (LHG). To calculate the actual equivalent utilization of irrigation water it was assumed that the water requirements of RBE soils for rice cultivation is 1.75 greater than that of LHG soils.

Table 4. Total rainfall received, water duty, and field water use efficiency during *maha* 1984/85, 1985/86 and 1986/87 in H5 area.

Season	Rainfall	Water duty	Field water (kg/ha-m)	use efficiency (bu/ac.ft)
1984/85[a]	(feet) 1.9 (cm) 59.0	4.0 121.0	3890	23
1985/86[a]	(feet) 2.3 (cm) 69.0	4.2 128.0	3890	23
1986/87[b]	(feet) 1.1 (cm) 33.0	3.8 116.0	4566	27

[a]Initial approach
[b]Coordinated approach
Sources: Flow Monitoring Unit - System H; Statistical Unit - Mahaweli Economic Agency.

The equation used to calculate Actual Equivalent Water Duty was:

$$\text{Actual Equivalent Water Duty} = \frac{\text{Total water supplied}}{\text{Total area cultivated X [(\%RBE x 1.75) + \%LHG]}}$$

Table 5 shows the comparison between the Actual Equivalent Water Duty and rainfall for the three blocks during three *maha* seasons. Within a season, the variation among blocks was presented as the range of given values. The interblock variation was minimal for *maha* 1986/87, when the coordinated approach was used, showing equitability in water supply (rainfall plus water duty).

WATER DUTY AND RICE YIELD DURING *YALA* (DRY SEASON)

Rice yield, water duty and field water use efficiency during the past few years are presented in Table 6. Water use efficiency during *yala* was about half of that in *maha*. This low water use efficiency in *yala* was due to the low rice yield associated with that season.

To achieve a *yala* rice yield comparable with that in *maha*, the water duty supplied during *yala* should be higher than in *maha*. This higher water demand may be associated with a low groundwater table and high evapotranspiration. It has been recommended that there be a diversification during *yala* towards crops that have low percolation requirements because lowland rice cultivation requires flood irrigation and its water requirement therefore includes both evapotranspiration and percolation. It is not possible to analyze this situation further using the available data because the water duty presented includes rice and other field crops together.

Table 5. Actual equivalent water duty and rainfall in three blocks of the H5 area during the *maha* (wet season) seasons of 1984/85, 1985/86, and 1986/87.

Block		Season								
		1984/85			1985/86			1986/87		
		A	B	A+B	A	B	A+B	A	B	A+B
Talawa	(cm)	83.2	44.2	127.4	93.3	49.4	142.6	78.9	26.8	105.8
	(feet)	2.73	1.45	4.18	3.06	1.62	4.68	2.59	0.88	3.47
Helambewa	(cm)	80.5	42.7	123.0	79.2	51.5	130.8	83.5	24.7	108.2
	(feet)	2.64	1.40	4.04	2.60	1.69	4.29	2.74	0.81	3.55
Ipalogama	(cm)	86.6	47.2	133.8	92.0	53.7	146.0	84.7	23.1	107.9
	(feet)	2.84	1.55	4.39	3.02	1.77	4.79	2.78	0.76	3.54
Range	(feet)			0.35		0.5		0.08		
	(cm)			10.5		15.0		2.4		

A = Total water duty
B = Total rainfall

Table 6. Rice yield, water duty and field water use efficiency in H5 area during the past few seasons.

Season	1984 *yala*	1984/85 *maha*	1985 *yala*	1985/86 *maha*	1986 *yala*	1986/87 *maha*	1987 *yala**
Rice yield							
(kg/ha)	2526	4692	3042	4898	3196	5207	2217
(bushels/ac)	49	91	59	95	62	101	43
Water duty							
(cm)	131	122	134	128	165	116	76
(feet)	4.3	4.0	4.4	4.2	5.4	3.8	2.5
Field water use efficiency							
(kg/ha-m)	2029	3890	2368	3890	1860	4566	2875
(bu/ac.ft)	12	23	14	23	11	27	17

*Crop suffered from stress conditions due to short supply of irrigation water.
Sources: Flow Monitoring Unit - System H; Statistical Unit - Mahaweli Economic Agency.

CHAPTER 9

Summary and Recommendations

CANAL SYSTEM

THE NEW SETTLEMENT, projects under the Mahaweli Development Programme have been provided with adequate facilities in irrigation and social infrastructure. As far as irrigation is concerned, such facilities include a comprehensive system down to the individual farm allotment. The distributary system has been designed and constructed with small irrigation turnouts which provide the core for small and viable agricultural communities.

The experiments carried out in H5 have proved that a well-coordinated farmer/officer relationship combined with carefully innovated planning and operational approaches in a manually operated open canal system can achieve very good results. The system covers water delivery from the headworks down to the farm allotment. Observations made so far indicate that infrastructure facilities have been successfully utilized by the organization for equitable distribution of water.

WATER USE

Full cultivation each year of all the land in System H, in both *maha* and *yala*, is a desirable objective. However, the water supply available for System H is limited, and it appears that in some years there is insufficient water for full cultivation, with shortages occurring principally in *yala*. Adherence to the recommended cropping patterns each season and saving water, especially in *maha*, is therefore highly desirable.

FARMER PARTICIPATION IN OPERATION AND MAINTENANCE

The success of water management at the tertiary level depends mainly on the efficiency of farmer organizations. The responsibility of distributing water equitably at the field level has to be shared by these organizations. The irrigation infrastructure has also helped the farmer in this regard. The irrigable area has been carved into rotational units of 12-15 ha commanded by a turnout offtake (field channel), with several such units falling within a rotational area commanded by a distributary offtake (distributary channel) which takes off from a main or a branch channel. The two levels of farmer organizations set up in the project area, the field channel organization and the distributary channel organization, are a special feature of participatory Operation and Maintenance (O&M) management. The field channel organization is responsible for the O&M of the rotational unit, while the distributary channel organization has to oversee the O&M in the distribution area.

The MEA's responsibility for maintenance does not include the field channels and farm drainage within the rotational unit. The field channel organization is expected to enlist the farmers in the unit to carry out maintenance work, although there are occasions when some farmers do not participate in maintenance work.

Farmers on their own will not always join in group activity. Frequent follow-up and encouragement will lead to satisfactory results in respect of both operation and maintenance. It is also imperative that the project administration tries to involve the farmer organizations in the planning and implementation of programs and make the farmers feel that they are active partners in the project. Increasing the farmer's sense of responsibility towards the system will also lead to decreasing his dependence on the government agency.

TECHNICAL IMPROVEMENT

Recommended water allocation down to distributaries has been provided as a depth per time period, for land preparation and the subsequent crop growth periods. Estimates of channel losses and soil variability have also been taken into consideration when deciding recommended water allocations. However, the recommended water allocation may be further adjusted according to the availability of water in the system.

A cumulative possible storage (ponding) of water in the field has been determined throughout the season, allowing for an assumed daily depletion rate. Therefore, on a given day, knowing the estimated amount of water in the field, the recommended water allocation was adjusted to arrive at the irrigation requirement.

A communication system has been developed to correct a deficiency or an excess of irrigation water supplied during a day due to system failure/inadequacies, by an adjustment of the irrigation requirement.

Using the coordinated approach combined with an effective use of rainfall and a system of monitoring, evaluating, and communicating within the H5 area of Mahaweli System H, it has been possible to reduce the water duty and, at the same time, obtain a higher rice yield in *maha* 1986/87.

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Annex I: System H Training Manual (Jayewardene, 1983)

FUNCTIONS AND DUTIES

Manager, Community Services - with the Assistance of UNICEF Consultant.

(1) Overall supervision of the training program in System 'H'.

(2) Identification of the training needs for each sub system with the assistance of the Training Council.

(3) Formulation and implementation of the training program through the Training Committee.

(4) Organization of research in the field of rural settlements encompassing settlement planning, water management, agriculture extension, community development etc.

(5) Carrying out continuing education by undertaking new projects with new technique of rural development and by organizing seminars, conferences and off campus courses as well as action research programs.

Director (Training)

(1) Organize training programs on the directions of the Training Committee.

(2) Coordinate the activities of the different training wings and give clear cut directions to training audio-visual and documentation wings for smooth functioning.

(3) Liaison with RPM (K), RPM (T) and RPM (N) for regular and proper conduct of training courses.

(4) Organize farmer leaders training programs in different areas.

(5) Arrange production of instruction sheets for Project Officers as well as Farmer Leaders.

(6) Evaluate training programs and assess their impact.

Training Officer

(1) Draw up detailed training schedule for Project Officers as well as Farmer Leaders for different areas.

(2) Make all necessary arrangements for conduct of the training courses in different areas including physical arrangements such as accommodation, food, tea, etc.

(3) Provisions, duplication, distribution etc. of all training material including recording of the proceedings of the training courses.

(4) Keeping attendance records at training courses.

(5) Contact lectures, speakers scheduled at training sessions to ensure their timely participation.

(6) Any other functions which the Director (Training) may assign.

Annex II. Field channel delivery schedule.

Rotational issue: from .... to ....
Intended water allocation (inches/acre) for

	RBE	LHG	
1	....	....	for rice land preparation
2	....	....	for OFC land preparation
3	....	....	for rice growth
4	....	....	for OFC growth

Irrigation block : ....

DC : ....

5 Recommended conveyance and seepage loss factor for DC, e.g. 1.10.

6		7	8		9		10=9x1 or 2		11		12		13=11-12	
Canal numbers		Total extent under specifications (acres)	Extent recommended for season (acres)		Extent ready for land preparation (acres) during the rotational period from........... to..........		Water requirement for land preparation based on factors 1 & 2 (acre-inches)		Extent planted (acres)		Extent full ripe (acres) (acres)		Extent requiri irrigation for growth	
FCS	DC		Rice	OFC	Rice	OFC	Rice	OFC	Rice	OFC	Rice	OFC	Rice	OFC
Total for DC														

Legend
cusec = cubic feet per second
RBE = reddish brown earth
DC = distributary channel
LHG = low humic gley
FC = field channel
OFC = other food crops

14=13x3 or 4		15=10+14		16	17											
Water Requirement for growth based on factors 3&4 (acre-inches)		Total water requirement (acre-inches)		Desired FC discharge 0.5/1.0/1.5 (cusec)	Field channel delivery schedule (time of opening and closing) 1acre-inch = (approximately) 1 cusec for 1 hour Date											
Rice	OFC	Rice	OFC		Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time	Time

18 = Computed daily total water requirement for Distributary channel x loss factor 5 ____________________

Annex III. Utilization of rainfall.

Weather pauging station*..............................

Effective DCs* ....
....
....

19	20	21	22	23	24	25
Date	Daily effective rainfall 6.00 a.m-6.00 a.m. (inches)	(For general information) cumulative effective rainfall from the beginning of the season (inches)	Intended overall field water allocation per day = daily depletion rate of effective rainfall (assumed) (inches per day)	Accumulated depth of effective storage in the field (inches)	Water requirement as percentage of intended allocation	Recommended percentage of intended allocation

* *See figure 11*

Annex IV. Distributary channel (DC) delivery schedule.

26	27		28	29	30	3
DC number	Variations in issues on previous 24 hours (brought forward) (cusec)		Computed water requirement to DC based on intended allocation (cusec)	Corrected discharge to DC for next 24 hours (cusec)	(Utilization of effective rainfall) water requirement as percentage of allocation (brought forward from annex iii)	Irrigatio to DC fo
	Excess −	Deficit +				Discharge (cusec)

		32		33		34
equirement next 24 hours		Actual discharge to DC (average of hourly reading at DC Head)		Variation in issue during 24 hours concerned (cusec)		Remarks
	Gauge height (feet)	Discharge (cusec)	Gauge height (feet)	Excess –	Deficit +	

Annex V. Main channel delivery schedule.

Line number	Irrigation block	Delivery point	1	2	3	4	5	6	7	8	9
1	413	DC 1									
2		DC 2									
3		DC 3									
4		DC 4									
5 = 1+2+3+4		Total 413									
6	414	DC 1									
7		DC 2									
8		DC 3									
9		DC 4									
10		DC 6									
11 = 6+7+8+9+10+11		Total 414									
12	415	FC 14									
13		FC 38 A									
14		DC 3									
15	412	DC 3									
16 = (5+11+12+13+14+15) 1.05		BC 8-2									
17	412	DC 1									
18		DC 1A									
19		Total 412									
20	415	DC 1									
21		DC 2									
22 = 12+13+20+21+14		Total 415									
23 = (16+17+18+20+21)1.025		BC 8 - 1									

Season Month

Date																						*Total for month
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	(acre-feet)
Discharge (cusec)																						

Annex V. Main channel delivery schedule.

Line number	Irrigation block	Delivery point	1	2	3	4	5	6	7	8
24	417	DC 1								
25		DC 2								
26		DC 3								
27		DC 4								
28		DC 5								
29		DC 6								
30		DC 7								
31 = (24+25+26+27+28+29+30) 1.05		BC 7 - 3								
32		BC 7 - 4								
33 = 31+32		Total 417								
34	418	FC 21								
35 = 33+34		BC 7 - 2								
36	418	DC 3								
37		DC 2								
38		DC 1								
39		DC 4								
40		DC 5								
41		DC 6								
42		DC 7								
43=34+36+37+38+39+40+41+42		Total 418								
44 (35+43) 1.05		BC 7 - 1								
45	411	DC 3								
46		DC 4								

Season **Month**

Date																					*Total for month (acre-feet)
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Discharge (cusec)																					

Annex V. Main channel delivery schedule.

Line number	Irrigation block	Delivery point									
			1	2	3	4	5	6	7	8	9
47	419	DC 2									
48		DC 1									
49 = 47+48		Total 419									
50	411	DC 2									
51		DC 1									
52 = 45+46+50+51		Total 411									
53	420	DC 1									
54		DC 2									
55 = 53+54		Total 420									
56	421	DC 4									
57		DC 3									
58		DC 1									
59 = 56+57+58		Total 421									
60 = (23+44+49+52+55+59) 1.10		MC -1 Total requirementt									

* 1 cusec for 1 day = (approximately) 2 acre-feet.

Season Month

Date																						*Total for month (acre-feet)
)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Discharge (cusec)																						