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Irrigation Management Processes and Conditions

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A Case Study of Sri Lanka's Walawe Irrigation Improvement Project

Charles Nijman

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

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Cover photograph by Douglas J. Merrey: A broken field channel of the Uda Walawe system.

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Weights And Measures

1 meter (m)	=	3.28 feet
1 millimeter (mm)	=	0.039 inches
1 kilometer (km)	=	0.62 miles
1 hectare (ha)	=	2.47 acres
1 million cubic meters (mcm)	=	810 acre-feet
1 ton (t)	=	1,000 kilograms (kg)
1 cubic meter per second (m^3/sec)	=	35.3 cubic feet per second (cusec)
1 square kilometer (km^2)	=	0.39 square miles

Abbreviations

ADB	Asian Development Bank
CECB	Central Engineering Consultancy Bureau
CHO	Constant Head Orifice
CPO	Controlled Pipe Outlet
EIRR	Economic Internal Rate of Return
IIMI	International Irrigation Management Institute
MASL	Mahaweli Authority of Sri Lanka
MEA	Mahaweli Economic Agency
MMP	Sir M. MacDonald & Partners Ltd.
msl	mean sea level
O&M	operation and maintenance
PRC	Planning Research Corporation/Engineering Consultants International
RVDB	River Valley Development Board
WIIP	Walawe Irrigation Improvement Project

Glossary

anicut	dam or weir to direct water into a canal
bethma	sharing of certain irrigated areas during dry seasons
kanna	cultivation
maha season	main wet season
paddy	rice
purana	old or ancestral village as distinct from new village or settlement
tank	reservoir
yala season	secondary wet season

Foreword

Introducing a management perspective in all stages of irrigation development is one of the crucial challenges we are faced with in improving the performance of irrigation systems. Economists, engineers, sociologists and other disciplinary specialists working in the irrigation field all contribute certain diagnostic approaches and tools, but these cover only some of the issues relevant to irrigation managers. The organizational analysis presented in this paper is an effort by IIMI to look at irrigation in a more integral manner.

The analysis presented is unique in its focus on the functionality of different disciplinary approaches in actual decision-making processes during planning, design and operation of an irrigation system. It also takes an integrative perspective of how different management conditions as human resources, their motivation and incentives, management information systems, organizational structure and other management control systems influence these decision-making processes, and ultimately the performance of the irrigation system.

Internal and external reviews of this paper have stressed the importance of the systematic and integrated approach taken in the analysis, its high quality, and the wider applicability of the findings and recommendations. Given the systematic performance problems in the irrigated sector, it is not surprising that some of the findings presented in this report are rather sensitive to the involved actors, the agency and national government, as well as the consultant and donor. However, this management analysis presents systematic flaws of the irrigation sector rather than performance of individual staff members or organizations, and we have attempted to present the text as such, as far as this is really possible for such a detailed case study. We sincerely hope that all who read this book will do so in this spirit, and will distill its significant contributions to irrigated agriculture.

Indeed, the book is an important effort towards a better problem definition of the widespread underperformance in irrigated agriculture.

Khalid Mohtadullah
Director for Research
International Irrigation Management Institute

Preface

THE DETAILED STUDY of irrigation management processes and managerial conditions presented in this paper is part of IIMI's effort to integrate a management perspective into the assessment of irrigation performance. This management perspective requires an amalgamation of two key disciplines involved in irrigation management, irrigation engineering and management science, into an analytical framework for irrigation management. Irrigation engineering approaches are thereby evaluated by their contribution to the actual decision-making processes during system planning and design, and system operation. Yet, in the analysis of the most relevant decision-making processes, conceptual contributions of other disciplines such as economics, sociology and agronomy have to be considered as well.

Developing such a management perspective requires inputs from practitioners, researchers and specialists of all these disciplines. The development of a management perspective is therefore initially done through case studies, of which this paper is one. This case study deals with a rehabilitation project while the other deals with the development of a new irrigation-cum-settlement system, the Kirindi Oya system in South Sri Lanka (Nijman 1991b).

Apart from available data in the form of reports, files, and studies on Uda Walawe, the case study presented in this paper is based to a large extent on interviews with a wide range of actors involved; from farmers and gate tenders of the Uda Walawe system to top officials of the involved managing agency, the responsible ministries, and the donor. Moreover, external consultants, researchers, former decision makers, and an involved ex-Member of Parliament have been interviewed.

The analysis given in this paper is based on this multitude of opinions from interviewees and available written data. Even while supported by the analytical framework, and its "objective" management perspective, the story represents the author's distillation of the "true" picture of irrigation management in Uda Walawe. Thus, only the author is responsible for this paper; the views expressed are his own.

It is certainly not the objective of the analysis in this paper to blame individuals in agencies, government, consultancy firms, or donor regarding their involvement in Uda Walawe. Instead, the paper tries to provide a picture of the systematics in certain bottlenecks in irrigation management; most reviewers have explicitly remarked that the validity of the "system" described in this picture goes beyond Uda Walawe or Sri Lanka. Findings of the other case study on Kirindi Oya were largely the same. Many of the findings and recommendations apply to a certain degree to other government agencies and other donors involved in irrigation in other developing countries as well. As far as individuals can be identified at all in the paper, they should certainly not be criticized, because this paper is about the performance of the "system" of irrigation development and management in developing countries, and definitely not about individual performance.

Much of the data collection for this case study was carried out during maha 1987/88 and yala 1988. Interviews were conducted from maha 1987/88 to maha 1989/90. However, the study does not cover the major changes in the management of the rehabilitation project in Uda Walawe which have occurred since maha 1989/1990, because these would have required a separate description and analysis.

Given the dependence of this study on the interaction with irrigation practitioners and researchers, I am very grateful to the large number of people who gave me of their time for interviews, often iteratively. I hope that most of them can recognize their contributions in the analysis and recommendations given in this paper. Moreover, I am very grateful for the cooperation and assistance I received from the staff of the Mahaweli Economic Agency, particularly Mr. A.S. de Silva (then Project Director), the late Col. Raja Wijesinghe (then Resident Project Manager), the late Mr. A.F. Dias Abeysinghe (then Deputy Resident Project Manager O&M), Mr. N. Wijewarnasuriya (Deputy Resident Project Manager Agriculture) and Mr. Peiris (Acting Resident Project Manager O&M). In addition, I would like to thank Mr. Jayantha Jayewardene (then Managing Director) for providing the necessary support to carry out this study. I am also grateful to staff of the Central Engineering and Construction Bureau, particularly, Mr. H.L. Domingo (Chief Resident Engineer), and staff of Sir M. MacDonald and Partners Ltd. and the Asian Development Bank for their cooperation in this research.

Useful comments on a draft of this paper were provided by a number of agency staff and by the foreign consultant. In particular, I would like to thank

Mr. Ananda Herath, Acting Managing Director of the Mahaweli Economic Agency, Mr. H.A. Wickremaratne, Chief Irrigation Engineer of the same agency, and Mr. Alan Beadle of Sir M. MacDonald and Partners Ltd. for comments and suggestions, which I have tried to accommodate as much as possible in the final text.

This study would not have been possible without the valuable interaction with a number of IIMI staff in Embilipitiya and Colombo. In particular, I would like to thank Dr. Douglas J. Merrey, Dr. P.S. Rao, Dr. Masao Kikuchi, and Mr. K. Jinapala for the many discussions we had on Uda Walawe, and Prof. Drs. A.A. Kampfraath, Dr. Douglas J. Merrey, Dr. C.M. Wijayaratna, Dr. R. Saktivadivel, Prof. Khin Maung Kyi and Ms. Inge Jungeling for the valuable comments they have given on earlier drafts of this paper. I wish to thank also Dr. Chris Panabokke and Mr. Ranjith Ratnayake for discussions we had on irrigation management in Sri Lanka in general. Special thanks are due to Mr. Adriza for assisting in preparing some of the figures in this paper.

The research was supported by the Research and Technology Department (DPO/OT) of the Ministry of Foreign Affairs of the Netherlands through my secondment to IIMI for a period of 4 years. Additional research and publication costs have been funded out of IIMI's unrestricted core funds for which I am very grateful to IIMI.

Last, but certainly not least, I would like to thank Prof. Drs. A.A. Kampfraath for the indispensable technical guidance in the development of the analytical framework and its application to this case study. Also, I would like to thank Dr. P.S. Rao for the support and technical supervision provided in an early stage of this study, and Mr. Charles Abernethy for support and supervision at later stages of this case study.

Reading Advice

Readers with very limited time, but who want to grasp the main messages in the paper, are advised to read the Executive Summary and Chapter 11, containing the overall picture, conclusions and recommendations.

Readers with limited time, but who in addition to the above, are also interested in the opportunities for improvement of the key decision-making processes and managerial conditions rather than in their detailed description and analysis should also read chapters 6 and 10.

Charles Nijman
Management Specialist
1991

Executive Summary

THIS REPORT PROVIDES a management perspective on decision-making processes concerning system utilization and system rehabilitation. This management perspective is based primarily on a large number of interviews with irrigation managers and external consultants in Uda Walawe, a major irrigation system in Sri Lanka, and in the head office of the managing agency from March 1988 to the end of 1989. It is also based on reports, files, and records of the managing agency and on interaction of the author with IIMI research staff residing in the project area and based at its Colombo office working on a parallel IIMI research project in the Uda Walawe system. The paper focuses on both the management of a major donor-funded rehabilitation program, and the operation of the system at present, i.e., prior to its improvement. The report does not, however, cover the recent changes in the organizational setup of the rehabilitation project, because these were initiated and implemented essentially at the final stages of this study.

PROCESS-BASED ANALYTICAL IRRIGATION MANAGEMENT FRAMEWORK

This study uses an analytical irrigation management framework which has been derived from a general management framework of the Department of Management Studies of the Wageningen Agricultural University, the Netherlands. This framework classifies the decisions which are made in an organization according to their contributions to the overall performance of the organization, instead of looking at the performance of structural appearances of the organization (e.g., persons, divisions). This means that a process orientation rather than a structure orientation is adopted to evaluate the effectiveness of the decision-making processes themselves. For example, a primary factor in evaluating client participation in this paper is its impact on, for example, the water-allocation processes.

Management of water is considered the primary irrigation activity. To evaluate the internal management processes in any irrigation system, key decisions with respect to water delivery should be defined. In system utilization, the decisions on seasonal allocation, in-seasonal allocation, and water flow regulation have been recognized as key decisions. For the evaluation of system rehabilitation the desired system objectives, feasible system objectives, and functional system requirements have been taken as the most relevant areas of key decisions-making.

The organizational analysis of Uda Walawe, in this paper, starts with a description and analysis of the technical and managerial aspects of these key decision-making processes and their mutual adaptation. Indicators are established for the management performance in Uda Walawe for these key decisions. Opportunities for improvement of the management performance for each key decision are indicated in terms of requirements from the processes and managerial conditions (i.e., people, provision of information, systems and methods, provision of knowledge, and organizational rules). The following section gives a short summary of the most significant findings and recommendations for the management of system utilization and system rehabilitation in the Uda Walawe system. These are applicable to a large degree to the managing agency as a whole, and to other irrigation management agencies.

SYSTEM UTILIZATION: OPERATIONAL ACTIVITIES

Seasonal and In-seasonal Allocation

Seasonal demand assessment at the lowest level, the unit, focuses on the cropping pattern and agricultural input requirements. At the next level, the block, the demand assessment takes place in the seasonal cultivation meeting when the cultivation calendar is discussed with the water users. No demand assessment at unit or distributary-channel levels exists regarding the starting and completion dates of the cultivation season. Allocation decisions and actual implementation of the seasonal allocation decisions bear no relation to any of these demand assessments.

The background for this approach to seasonal planning is the almost complete lack of control on these processes by the River Valley Development Board (RVDB) management before 1982; head enders could cultivate the whole year through at the expense of the tail enders. After the Mahaweli Economic Agency (MEA) took over by early 1982, it wanted to demonstrate its better management capacity to the Asian Development Bank (ADB), the potential donor for a rehabilitation project. Therefore, it improved adherence to its seasonal allocation plan to a certain extent by adopting a uniform cultivation calendar for the whole command area, while refusing any official form of staggered cultivation. This approach required minimal management inputs of its staff for interaction with water users and politicians, and effectively enforced some adherence to the cultivation calendar. It has led to savings of at least 12 percent in annual water issues from the reservoir.

However, because of this lack of interaction with water users, there is little control over actual water use within the blocks and branch canals; head-end water users start the cultivation whenever they like, grow the varieties they like, and use as much water as they want at the expense of many tail enders in these subsystems and in the overall system. The tail enders can often start their cultivation only one month later, if at all. Without exception, the cultivation season is extended for these tail enders.

Except for the agricultural extension which has certainly contributed to the increased use of improved varieties and fertilizers, the input and credit provision by MEA itself and thus, also its role in this aspect of improving adherence to the cultivation calendar, have played a marginal role in Uda Walawe. Moreover, the physical and managerial control over water allocation and flow regulation by MEA to improve the coordination of the implementation of the land preparation with other input supplies appears to be absent in Uda Walawe. Therefore, the major argument for the Mahaweli "authority" structure appears to be unjustified for Uda Walawe.

Demand assessment also does not take place during the cultivation season. Rotational allocations had been introduced in 1982 to enable the earlier water delivery to tail-end canals and to improve adherence to the cultivation calendar.

However, contrary to common belief, these rotations do not necessarily limit excessive water consumption by head-end water users.

Allocation processes seem to be dominated at all hierarchical levels by a desire to minimize management input combined with a desire to minimize the complaints by water users and politicians to agency staff.

Main recommendations. Improvement of the present seasonal and in-seasonal allocation seems possible only if more interaction with the water users is pursued, because presently the influence of MEA on the decisions by the water users is limited; it is the water users who presently really decide the starting and completion dates of the cultivation, their water consumption, and the varieties grown. Demand assessment for effective and efficient staggered cultivation between and within blocks is required, and rotational allocation plans should try to become more consistent with the actual requirements of the water users. Such improvements will require more management inputs in interactions between different staff levels and between the MEA staff and the water users. Because of the large number of water users in a smallholder system like Uda Walawe, water users will have to be organized into viable groups with representative group leaders.

Such improvements in management inputs, managerial attitudes, interaction with water users and subordinates, information flows, and allocation strategies all seem to depend on the more basic precondition of more commitment and accountability of all staff levels to the seasonal performance. Priority for improvement lies thus with building up such an overall institutional support to the seasonal and in-seasonal allocation performance. This will have to be initiated and developed by the MEA head office rather than at project level only.

Potential performance indicators for the allocation concern are, for example, the scheduled and realized water duties, cropped areas and yields for the different main canal, branch canal, and distributary channel subsystems which could be monitored on a regular basis. The related contribution or accountability of different staff to these performance indicators can be developed over time by gaining experience in using these indicators. Without seriously introducing these performance indicators, especially the water-related indicators, improvements in the allocation seem very unlikely, for assessment of staff performance.

Water Flow Regulation

The potential flexibility in water flow regulation provided in the tail end of the Right Bank main canal and the branch canals through gated cross-regulators has not been used in Uda Walawe. The MEA management preferred the traditional invariable water flow regulation with rotational allocations to the different offtakes, which requires less management input from all involved staff levels. Given the motivation and willingness of different staff levels this type of water flow regulation indeed seems the most appropriate.

Main recommendations. Starting with the existing physical infrastructure, improved management performance can only be reached by replacing the present "approximate" water flow regulation with more accurate water level assessments at important points along the main and branch canals and at the heads of the distributary channels. After discharge variations at the heads of these canals occur, these have to be reported faster to higher-staff levels to be used for water flow regulation purposes in the main and branch canals. These more accurate water level assessments will require regular calibration of staff gauges or measuring structures at the measurement points.

With the gated cross-regulators presently being constructed by the rehabilitation project in the main canal, improved management performance of the water flow regulation will require a tremendous and therefore probably an unfeasible increase in management inputs by all staff levels. The reason is that the stable water flow in the main canal will be replaced by continuously fluctuating water levels between the Uda Walawe and Chandrikawewa reservoirs, and between Chandrikawewa Reservoir and the tail end of the Right Bank main canal, unless the gated cross-regulators are used as fixed weirs like in the pre-rehabilitation situation. (The provision of intermediate reservoirs at regular intervals along the main canal [e.g., the existing Chandrikawewa Reservoir, and potential others downstream of Chandrikawewa] would have reduced the required management inputs for improved management performance considerably.)

Improved management performance of the water flow regulation will require a simultaneous improvement of the in-seasonal allocation decision making as well, otherwise localized allocation processes due to pressures of water users on the MEA staff will interfere with the water flow regulation decision-making processes.

With or without gated cross-regulators, an increased management performance of the water flow regulation seems unlikely without any overall institutional support and accountability for the water flow regulation performance of the MEA staff. As for the seasonal and in-seasonal allocation concerns, this accountability will have to be initiated and developed by the MEA head office or the highest-level policymakers rather than by project-level management only.

SYSTEM REHABILITATION: PLANNING, INVESTIGATIONS, AND DESIGN

Desired System Objectives

The Walawe Irrigation Improvement Project (WIIP) has been initiated by the donor. The donor used the leverage of other potential loans to convince the Government of Sri Lanka to agree with this originally low-priority investment, which allowed the donor to upgrade the low Economic Internal Rate of Return (EIRR) of 7 percent from its involvement in the earlier investments and to allow further development of the Left Bank area. Consequently, the project has been considered a donor project rather than an agency project, with very little commitment, accountability, or responsibility of the managing agency and water users towards the achievement of project objectives.

Main recommendations. To develop more commitment and accountability of the national agency, the government, and the beneficiaries towards the project objectives, the donor should not play an influential role anymore in this decision making. The EIRR should not be used for determining the desirability of a project (component), but rather for assessing its feasibility.

Feasible Objectives for Rehabilitation

After the initiation of the formal loan request by the Government of Sri Lanka, the donor staff and the consultants as well as the government and the agency staff did not adequately assess the actual feasibility of the WIIP. The feasibility and appraisal assessments for the project were more oriented toward developing a feasible plan in terms of the EIRR (i.e., project justification), rather than on assessing the feasibility of the project objectives in terms of the underlying assumed water duties, cropping intensities, irrigated extents, project-implementation schedule, and related water delivery concepts and management inputs. As a result, the actual feasibility of the rehabilitation concept has remained vague. Major bottlenecks such as the excessive water use by head-end reaches of systems or subsystems have not been dealt with in the feasibility assessments due to little motivation and willingness of staff and water users to increase their management efforts. In addition, a tendency towards capital-intensive irrigation investments led to overly optimistic assumptions about the benefits of rehabilitation. These benefits were fixed at the start of the project in line with the benefits and related EIRR envisaged for the original project. They were justified with scientific criteria, which consequently had to be applied rigidly during project design and implementation to reach these objectives, at least theoretically. The resulting inflexibility and time pressures during system design and implementation were major factors contributing to the problems in the project.

Main recommendations. More accurate determination of feasible objectives for system rehabilitation will have to be done necessarily by the managing agency itself instead of by the outside donor staff or consultants. The donor staff and the consultants should only be involved in the feasibility assessment of a plan already developed by the managing agency. Past experiences and achievements by the managing agency instead of theoretical scientific simulations of opportunities, should play an important role in this feasibility assessment. The donor staff and the consultants should be objective in this assessment, and be able to pronounce as unfeasible a project proposal that is unsound. Implications for their internal performance assessment and loan targets should not be allowed to influence project feasibility and appraisal.

Functional Requirements for Rehabilitation

Functional requirements for system rehabilitation were also based to a large extent on theoretical simulations of water requirements and a rationalized but rigid turnout area concept, with little or no reference to real-life and location-specific problems. Most functional system requirements were not made explicit in the operation and maintenance manual and design criteria.

Unrealistically high managerial requirements were implicitly assumed at an early stage by the foreign consultants. In the absence of any effective interaction with local consultants and the managing agency staff, the feasibility and actual functionality of these requirements have not been assessed. Given the interests of the different parties involved, and the leverage used by the donor to push a project concept which it perceived as feasible, at least theoretically, such effective interaction was very difficult.

MEA relied heavily on foreign consultants for the determination of functional system requirements. In the absence of any managerial strategy to reduce the water waste by head enders, the consultants adopted unrealistic low peak irrigation capacities to enforce the 40 percent water saving required by the feasibility-level decision of the donor to extend the command area from 8,000 ha to 12,000 ha, i.e., an engineering solution to a management problem. While most involved actors were aware of the theoretical and inconsistent nature of the above approach, especially in view of the unfeasible managerial requirements, none of them were really made responsible for solving this problem. The resulting accountability gap was considered the donor's problem mainly and all parties kept themselves strictly to their terms of references.

Main recommendations. More appropriate determination of functional system requirements and opportunities for system rehabilitation will have to be done by the system managers themselves instead of by the outside donor staff or the consultants. A less rigid and more appropriate design concept is required for Sri Lankan irrigation systems which better fits the general local functional requirements (e.g., management inputs, control over water flow). The development of such a design concept by the Sri Lankan agencies (i.e., development of their own professionalism in this direction) seems unlikely if foreign funds continue to be available without any requirements imposed by the Government of Sri Lanka or the donor agencies to make the managing and construction agencies accountable for their design assumptions and evolving system performance. The development of appropriate functional system requirements for new or existing irrigation systems will only be possible if the government and the donors will allow appropriate time and funds for the required managerial processes — for example, through gradual development or rehabilitation from head end to tail end of command areas and catchments without predetermined (peak) irrigation requirements and related irrigable areas evolving from the feasibility-level decision making.

PRIORITIES FOR IMPROVEMENT OF IRRIGATION MANAGEMENT

Prioritizing among the areas of management concern and the opportunities for improvement should evolve from internal decision-making processes, strategic exercises or the like within and between MEA, the Mahaweli Authority of Sri Lanka (MASL) and the Government of Sri Lanka rather than from outside. In addition, the donors could derive some opportunities for improvement from the related suggestions in this paper on their role in these decision-making processes.

A comparison of the different key decision-making processes and their managerial conditions shows inconsistencies between the different key decisions in irrigation management. The determination of desired system objectives was focused on the initiation of loan acquisition by the Government of Sri Lanka. The consequent feasibility assessment was focused on loan justification, while the functional requirements were kept implicit and approached only theoretically. The actual real-life desirability, feasibility and functionality of the project objectives and requirements have not been assessed at all, unless by the donor staff and the consultants, and as perceived at top levels in the agencies and the government. Overall, the system rehabilitation decisions ignore the management issues occurring during system utilization, while all system utilization decisions are oriented on a combination of minimizing management inputs and maintaining a "no-complaint" situation.

The lack of accountability and responsibility in system rehabilitation and utilization towards the water delivery performance is the crux of the whole irrigation management problem; it dominates all key decision making with respect to the water delivery. The lack of motivation and willingness of agency staff to increase its management efforts in water delivery aspects of the system utilization and rehabilitation is ultimately due to a lack of accountability and responsibility of the managing agency as a whole for its water delivery performance.

The political and agency-wide priorities for construction activities and related funding make the system creation and rehabilitation processes the most likely starting point for building such accountability through the leverage provided by these funds. A more objective assessment of the potential or feasible irrigation management performance during the system creation and rehabilitation processes can be a first step in giving more value to the only resource which is presently not attributed any value in irrigation, i.e., water.

CHAPTER 1

Introduction

FOCUS OF THE STUDY

UDA WALAWE IS a large-scale gravity irrigation system in an intermediate to dry-zone environment in southern Sri Lanka, where irrigated cultivation is done by smallholders who settled in the early sixties and who originated from the overpopulated wet zone. This report describes and analyzes the decision-making processes by the managing agency, the donor, the consultants, and the water users. All these actors were involved in system management and in the planning and design for rehabilitation of the system, i.e., the Walawe Irrigation Improvement Project.

The focus in this paper is on the management of water as the primary irrigation activity. Activities like agricultural production or organizing the water users are considered processes complementary to the management of water. Other activities like maintenance, improvement or construction processes do not necessarily involve irrigation and are therefore considered derived processes. Decisions concerning water are made during the irrigation system rehabilitation as well as during system utilization; both categories of decision making are considered in this paper.

In this paper, "system" refers to the physical infrastructure (i.e., canals and structures); staffing, people who influence the decision-making processes; and to the other facilities (e.g., communication equipment, vehicles, computers, forms, etc.) needed to deliver water to the water users. Thus, the water users are considered part of the system to the extent that they influence the decision-making processes about water delivery, but they are its client with respect to the actual service delivery.

Utilization of water by the water users is considered to be managed by the water users themselves. The analysis will not go into these decision-making processes at tertiary and on-farm levels. Neither will the analysis go into details of differences in interest of water users, or ways by which the water users individually or in small groups can influence the decision-making processes. The analysis will focus on the agency processes and the ways that the agencies provide for participation by different groups.

By looking at all decision-making processes that relate to water it is envisaged to obtain a "management perspective" in terms of an overall view of all activities that have to be dealt with by the managers, and of the interests and biases of the managers involved.

The specific result of looking at the decision-making processes by means of an analytical management framework is that the analysis becomes less dependent on opinions and feelings that people have about the organization, and will be less distracted by conflicts among the different managers. Naturally, such conflicts occur in the Uda Walawe system as they do in all other organizations. If described in this paper they are not meant to point a finger at any individual but are only used to show the systematic picture of biases and interests in the institutions and how they influence the management processes.

The analysis of the decision-making processes in the Uda Walawe system is done by means of an analytical irrigation management framework based on an existing general management framework developed by Professor Kampfraath and his colleagues of the Department of Management Studies of the Wageningen Agricultural University, the Netherlands (Kampfraath and Marcelis 1981).

OBJECTIVES OF THE STUDY

The International Irrigation Management Institute (IIMI) envisaged two primary objectives for this case study. The first was an objective of the Consultative Committee of IIMI and the Government of Sri Lanka to have an organizational analysis of Uda Walawe — and thereby also of the managing agency, the Mahaweli Economic Agency (MEA) as a whole with respect to its influence on water delivery in Uda Walawe — by means of an analytical management framework. This paper gives the outcome of this organizational analysis.

The second objective of IIMI was to develop an analytical irrigation management framework on the basis of the aforementioned general management framework. The development of this analytical framework occurred concurrent with the organizational analysis of the Uda Walawe case study, and that of a parallel case study of the Kirindi Oya system in southern Sri Lanka (Nijman 1991b). A generic paper on the analytical irrigation management framework which will generalize the irrigation management processes beyond the Sri Lankan case studies will be published in the near future. In addition, the analytical framework is envisaged to be used for comparative management research of different Sri Lankan systems, and also irrigation systems in different countries.

The analytical irrigation management framework will translate different categories of decision-making processes that occur in all organizations into irrigation management decision-making processes. For example, production planning will be translated into processes of seasonal and in-seasonal allocation of water to different irrigated extents for cultivation of different crops.

The analytical framework can be used to identify possible directions and ways for the better harmonization of all efforts in an irrigation organization toward a common interest. A limitation, however, is that such an analysis by itself does not guarantee the better harmonization of efforts as this is a gradual process, which requires the willingness and cooperation of a sufficient number of involved actors if it is to succeed.

RESEARCH METHODOLOGY

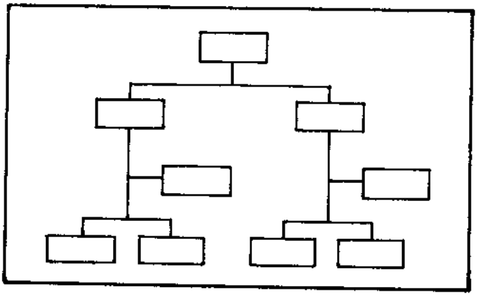
A Short Introduction to the Analytical Irrigation Management Framework

In this analytical framework, decision making is considered to be the major force determining the performance of irrigation systems. To develop a management perspective of the organization this paper first identifies key decisions in regard to water delivery. These key decisions are classified according to their potential contributions to the water delivery performance of the organization, not according to the subject involved (e.g., participation, communication, resource mobilization, crop diversification, sustainability, involved staff time, or financial inputs). The evolving classifications are defined as management concerns. The different management concerns thus cover those key decisions that have to be taken by an organization as a whole to reach a certain performance. Performance evaluation of management is done by evaluating the contributions of the different key decision-making processes to the water delivery performance. Thus, key decisions become components of the whole or overall system performance.

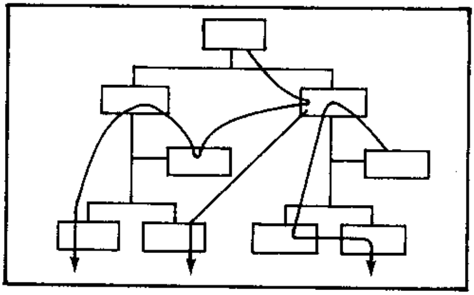
In this context, focusing on decision-making processes means moving away from the hierarchical and structural appearance of the organization. The structural appearance represents individual units with functions, tasks and responsibilities. However, an organizational structure evolves over time. Structural changes in the past originated not only from requirements of processes, but also from the internal dynamics of the organization — the evolution of existing hierarchical levels, the presence and influence of certain leading officers at a given moment, or the division of the organization into historically determined departments. The internal dynamics of the organization gradually "bias" the structure with respect to the effectiveness of the processes. Thus, to evaluate the performance of the different key decision-making processes it is necessary to temporarily omit this structural appearance. The importance of structures is not denied but is looked upon as a mediating force with respect to its influence on decision-making processes and is thus considered of secondary relevance.

Figure 1 presents a schematic look at orientations of the decision-making process and structure in management.

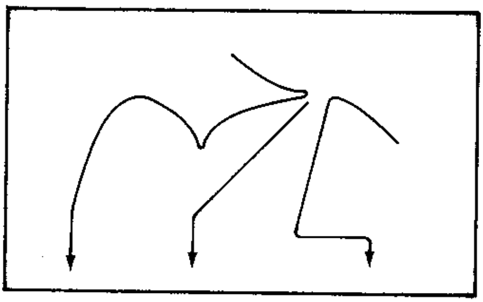
Figure 1. Orientations of the decision-making process and structure in management.



Structure orientation



Structure and process orientation



Process orientation

Two main categories of decision-making activities and their related management concerns can be recognized on the following lines:

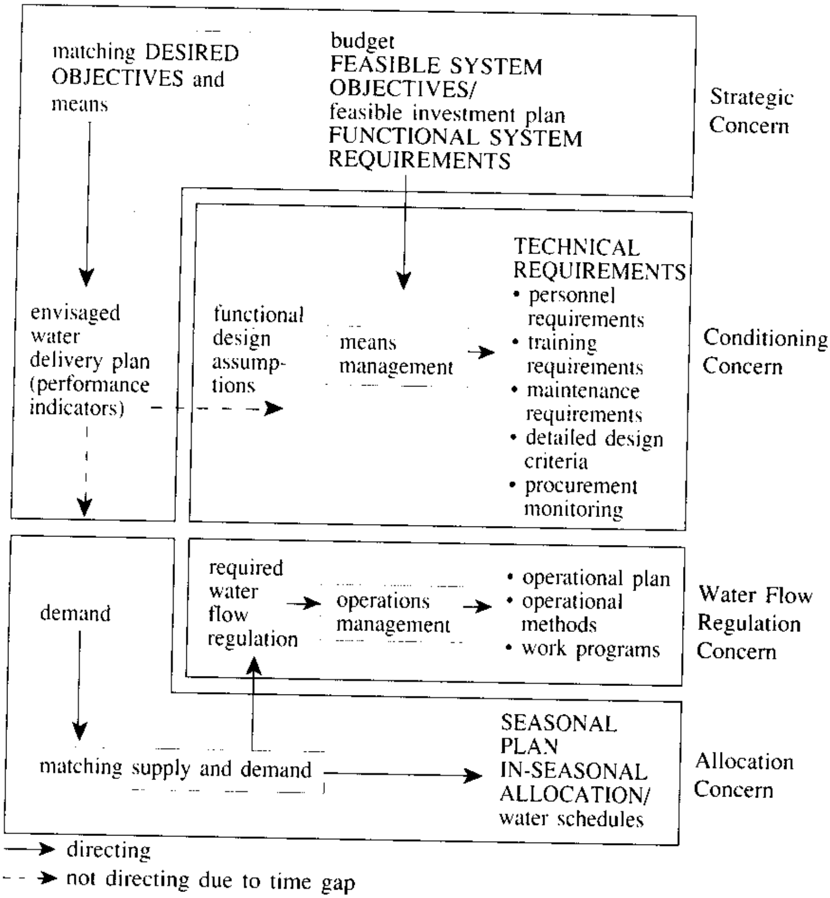
1. Irrigation system creation, rehabilitation and maintenance

This group comprises the decision-making processes for the determination of the requirements (i.e., physical infrastructure, staff, cars, information systems, etc.) for irrigation capacities. These capacities must be available for the achievement of the required decision-making processes (for allocation of water and water flow regulation as well as the de facto gate operations and consequent water flows) and results (i.e., water delivery performance). Because the WIIP deals only with system rehabilitation this category will be referred to as "system rehabilitation" in this paper. Kampfraath has divided this group into the so-called "strategic concern" and the "conditioning concern" (ibid., 33).

The strategic concern covers the decision-making processes with respect to the determination of desired system objectives, feasible system objectives, and functional system requirements. Short descriptions of these different key decision-making processes of the strategic concern are given below, and also in the introductions of chapters 7 to 9.

Desired system objectives. These are desirable objectives that are set for the intended irrigation investments, without considering their feasibility as such. These objectives evolve from the related objectives of the national government, the politicians, the donors, the local community and the beneficiaries. Such objectives, whether implicitly or explicitly stated may be the reduction of cultivation risks through more control over water in certain areas at a certain point in time. Related to this are other objectives such as a desired increase of agricultural production, alleviation of poverty, reduction of unemployment, settlement of landless people, appeasement of political supporters or geopolitically sensitive areas, saving of foreign exchange through increased exports or reduction of imports, sustainability of the environment, etc.

Figure 2. Irrigation management concerns.



Feasible system objectives. Matching desired system objectives with available resources (financial, staffing capabilities, future staffing, and maintenance budgets) evolves into the determination of feasible objectives such as planning the area to be commanded by irrigation water at a certain point in time, the different crops to be grown, the cropping intensities, the acceptable cultivation risks, the predicted water delivery performance, etc.

Functional system requirements. Given the feasible system objectives and the available resources, the functional system requirements can be specified. These in turn can be divided into component requirements such as the physical infrastructure, staffing, communications and possibly the organization of water users into groups.

The functional infrastructure requirements refer to the determination of, among others, the following: required water levels to command certain areas, canals to maintain these water levels, structures to control water flows and levels, storages to collect and store water from the catchment, and intermediate storages to collect runoff or reuse drainage water or increase responsiveness at those locations.

The functional staffing requirements refer to the number and quality of staff required for the utilization of the irrigation infrastructure at the envisaged water delivery performance. The functional communications requirements refer to the quantity and quality of communication and related facilities and staffing requirements needed to reach the envisaged water delivery performance. Similarly, it can be considered a requirement to organize water users into groups to share water in view of other assumptions regarding the functional requirements.

The conditioning concern covers the decision-making processes regarding the technical requirements of these irrigation capacities while considering the functional requirements as have been decided upon by the strategic concern. The technical infrastructure requirements refer, among others, to the technical standards to be used: densities of engineering materials, coefficients of expansion and shrinkage, permissible concrete stresses, seepage gradients and uplift or protection. The technical staffing requirements refer, for example, to the selection criteria or professional development programs. The tendering of construction, rehabilitation, and maintenance contracts and the monitoring and control of the actual acquisition of the irrigation capacities are also technical requirements.

2. Irrigation system utilization

This group comprises the decision-making processes for the determination of the utilization of the available irrigation capacities (i.e., decision making on priorities, timing, quantities and methods of achieving required water deliveries) in order to get the water really delivered. This group can be split up into the "allocation concern" and "water flow regulation concern."

Allocation concern. The allocation concern comprises the decisions regarding how much water will be allocated, when and where: matching of supply and demand. It also deals with the quality — in line with the requirements of the allocation strategy — of the water delivery in terms of timeliness, adequacy, equity, reliability, responsiveness, predictability, efficiency, variability, etc. In Sri Lanka, it entails the following two key decisions:

> *Seasonal allocation plan.* At the beginning of each season, the matching of the available supply to the existing demand and allocating water to subsystems for irrigation and other purposes, possibly leads to a plan which incorporates the cropping pattern, cultivation calendar and related cultivation risks.
>
> *In-seasonal allocation.* Similarly, during the season, the matching of the available supply to the existing demand and allocating water to subsystems for irrigation and other purposes, possibly leads to a more or less regular in-seasonal allocation schedule which also incorporates the cropping pattern, cultivation calendar and related cultivation risks. These allocations are expressed as operational targets for the capture of water from a source, for storage in (intermediate) reservoirs and canals, for conveyance along canals, and for distribution through offtakes.

Water flow regulation concern. To realize these allocations, structures have to be operated to capture water from a source, to store it, to convey it through canals, and to distribute it through offtakes in line with operational targets. This means that managers must determine operational methods for the actual gate operations of different structures and, depending on the required water delivery performance, possibly develop a plan for the coordination of the operational methods of the different structures in the system to regulate water flows and levels.

A mutual adjustment of the allocation and water flow regulation concerns will always be necessary. The operational practices of the water flow regulation concern provide the starting points for the allocation concern. On the other hand, the allocation concern determines the operational targets for the water flow regulation. In all situations, it will be the water flow regulation that deals with the final decisions with respect to the realization of water deliveries and thus of the allocation plans.

This paper deals with all the above concerns except the conditioning concern, which is considered to be of secondary relevance with respect to the problem of water delivery performance. Moreover, describing actual technical system requirements would require the incorporation of issues like interference by politicians in staff selection, and the more "informal" procedures during construction. While not irrelevant, these reasons have made the conditioning concern a lower priority compared to the other concerns in the case studies and the development of the analytical framework.

In this paper, the decision-making activities will be described in terms of their *outcomes* (i.e., decisions) and in terms of processes that lead to these decisions; the steps in the decision preparation and decision making and the information necessary for the management control of these processes.

The situation in which the decision-making activities takes place will be described in terms of managerial conditions. These managerial conditions are considered to influence — not to determine — the decision making and thus its outcome; changes in these managerial conditions and their actual functioning can be used to influence the decision making and the performance of the organization, i.e., conditioning of the decision making. Kampfraath has classified the managerial conditions into the following five groups (Kampfraath and Marcelis 1981, 47):

* People (involved as individuals and as groups)
* Organizational rules
* Provision of information
* Provision of knowledge
* Systems and methods (i.e., the material and nonmaterial means, such as spatial division, simulation models, budgeting forms, checklists, etc.)

The description of the existing decision-making activities for each aforementioned management concern or key decision will allow the analysis of the existing situation and identification of opportunities for improvement —

an improvement, if the existing managerial conditions do not provide sufficiently for requirements which allow a good execution of the management and management control activities. The ultimate approach of this analytical framework towards the irrigation decision-making activities is indicating opportunities for the improvement of this management control with respect to these decision-making processes.

In the analysis and conditioning of a decision-making process two different aspects of the process are taken into account:

1. The *technical* (or substantive) aspect which refers to alternative technical approaches for seasonal planning, operational plans, operational methods etc.; the assumptions made and data used in the decision making as well as the clarification of priorities.

2. The *managerial* aspect which refers to the method of making that choice; the process or, the different ways of processing the decision making. For example, water users and staff of different agencies can be involved at different phases of the processes dealing with the seasonal planning, operational plan, operational methods, etc., with different levels of authority, responsibilities and information. In general, management analysis focuses on this managerial dimension of the decision-making processes, which however cannot be seen separately from its technical aspects.

In the description and analysis of the actual situation in the Uda Walawe system, one of the points of analysis will be the mutual adjustment of these technical and managerial dimensions. This will be done for all the aforementioned key decisions in chapters 3 to 5 and 7 to 9. In the conditioning of the decision-making processes the mutual adaptation of the decision-making processes and their managerial conditions will be taken into account as well. Marcelis (1984, 93) suggests that if there is a lack of balance between these two, the proper outcome of the decision making is less possible. To facilitate the mutual adaptation of processes and their managerial conditions, the concept of the level of perfection of the decision making has been introduced by Kampfraath and Marcelis (1981, 35). The level of perfection is a performance indicator for decision-making processes which is determined quantitatively by means of four criteria: feedback, foreseeing, integration, and systematics (see Table 1 and the Annex). In this paper this concept will be utilized as a means for analysis of the actual decision-making processes. The levels of perfection for the different irrigation management concerns and key decisions used in this paper are listed in the Annex, which also elaborates further on the rationale behind this classification. This concept of the level of perfection of a decision-making process will be used in future for comparative research with respect to the managerial performance of different irrigation systems. Although a correct evaluation of the present level of perfection of the decision making with respect to the Uda Walawe system is only possible in comparison with other systems, it is used in this paper to indicate opportunities for improvement in case the present outcomes of the decision making require such improvement.

Sustainability

Irrigated agriculture usually pursues multiple objectives, e.g., increased agricultural production, increased equity of water delivery within systems, and increased welfare for its beneficiaries. During the last decade, the development jargon has been enriched with the concept of "sustainability." Apart from the environmental sustainability, this concept is not usually applied in management analysis in developed countries. A lower level of political and organizational development of the society as a whole, typical of less-developed countries, has made this concept more necessary in less-developed countries.

In this paper, the concept of "sustainability" will refer to the degree that the objectives pursued in the different management concerns, or key decisions, are better mutually attuned to each other. Practically, this means that a system is considered more sustainable if the objectives during planning and design, like envisaged water-delivery performance, lifetime of investments, increased incomes, and envisaged maintenance levels are well in line with the actual or most likely achievements of the same managing agency during the future system utilization in the same country, region or system. Simultaneously, it refers to the degree to which the actual objectives during

Table 1. The levels of perfection on a scale of 0-100 percent (after Kampfraath and Marcelis 1981, 39).

Level of perfection (%)	SYSTEMATICS: To what degree are decisions made according to a more or less fixed pattern?	FEEDBACK: To what degree are the decisions made tested continuously for appropriateness?	FORESEEING: To what degree does decision making foresee the scope of the decision?	INTEGRATION: To what degree are problems seen on a wider context before the decision is made?
Very low (0-20)	no rules: a certain routine exists	never: unless unconsciously	hardly: ad hoc decision making	no: problems are examined myopically
Low (20-40)	"rules of thumb" broad rules form the basis of decision making	sometimes: obvious experiences are proposed	somewhat: necessities are considered	somewhat: convincing subsidiary influences are incorporated
Average (40-60)	rules: important decision-making processes are supported with rules	regularly: the most important information is considered	reasonable: priorities are considered	in a broad context: directly related plans are considered
High (60-80)	procedures: combinations of mutually attuned rules	often: most information from the past is considered	far: foreseen developments are considered	in a broad context: important influencing factors are incorporated
Very high (80-100)	systems: balanced systems of mutually attuned procedures	always: all relevant information from the past is considered	very far: expected developments are reviewed and considered	in the entire context all influencing factors are incorporated

system utilization conform to the assumptions during the planning and design. In addition, the concept of "environmental sustainability" will be used now and then to refer to the degree to which the system does affect the short- or long-term environmental ecosystem in which the system is situated.

Data Collection and Analytical Procedures

The data that underlie this study were collected primarily through interviews with the decision makers as well as through observation of the decision-making processes and physical processes. A first round of interviews with all relevant decision makers helped the author to become familiar with functions, tasks, responsibilities and entitlements and evolving decision-making processes. Further rounds of interviews served the purpose of being more specific on questions most relevant to the analytical framework. In addition, reports, files, records, etc. were studied to gather important facts and figures. These data were collected mainly during *maha* 1987/88 and *yala* 1988. For the management processes within the block the study focused on the Chandrikawewa block of the Right Bank of the Uda Walawe system as this facilitated interaction with other IIMI research at distributary channel level in that area[1]. Several rounds of interviews with the most relevant decision makers, also in the MEA head office, continued however up to maha 1989/1990. Opinions of the different decision makers about the organization and their role in these processes helped to obtain a better understanding of the actual decision making. Cross-checking of opinions, and repetitive and iterative questioning were necessary to obtain a more balanced view of formal and informal processes. Balanced evaluation of opinions became possible gradually through increased familiarity with the organization and the actual processes. This familiarity reinforced itself more and more making it possible to raise more specific questions and obtain more specific answers. Of course, the framework itself provided a guideline

[1] Extensive research has been done by IIMI on the Walawe Irrigation Improvement Project on a variety of subjects: performance of irrigation management in terms of distribution of water at distributory- and field-channel levels and economics of different crops, irrigation institutions, and rehabilitation processes (Merrey and Jinapala 1988, IIMI 1988, 1989a, 1989b, 1990).

in prioritizing among the enormous mass of issues, information, and opinions and focusing on the important issues and facts.

Important additional background information, especially regarding the interface between water user organizations and agencies and regarding the water flow regulation of the Right Bank main canal, was obtained from the involved IIMI research staff in Colombo and in Embilipitiya.

ORGANIZATION OF THE PAPER

A description of the history, organizational setup, and physical infrastructure of the Uda Walawe system and the improvement project is given in Chapter 2. Description and analysis of the different key decision-making processes in regard to the seasonal allocation plan, the in-seasonal allocation, the water flow regulation, the desired and feasible system objectives and functional system requirements in the Uda Walawe schemes are covered in chapters 3, 4, 5, 7, 8 and 9, respectively. An assessment of the present management performance and opportunities for improvement for the system utilization and system rehabilitation is given in chapters 6 and 10, respectively. An overall picture of the decision-making processes and managerial conditions of all these key decisions is given in Chapter 11. The conclusions and recommendations for all key decisions are also given in Chapter 11.

CHAPTER 2

Walawe Irrigation Improvement Project

HISTORY OF THE WALAWE RIVER BASIN

THE MAP OF the basins of the Kirindi Oya, Menik Oya, and Walawe rivers show the highest intensity of existing and abandoned ancient village tanks of Sri Lanka, i.e., approximately one tank for every two square kilometers (Mendis 1967, 24).

On the Left Bank, is the Mahagama tank, also known as the Pandikulama tank, believed to have been built by King Udaya II (887-898 AD). Brohier recorded that "there is a local tradition which asserts that Pandikulama tank held the waters of a thousand small tanks....As a matter of fact 440 tanks were found in the drainage area of <366 square kilometers>[2]...The drainage area from this area is sufficient to fill the largest tank in the island" (Brohier 1934, III.18). This tank dammed the Mau Ara, a major tributary of the Walawe River, and received also water through a 22.4-kilometer-long canal which carried water from an anicut in the Walawe River at Thenketiya (which is close to the present site of the Walawe dam). The present sluice of the Mahagama tank, which is a very small tank in the Left Bank command area of the present Uda Walawe Reservoir is believed to have been part of this Pandikulama tank.

In more recent times, four major works were undertaken in the Walawe River Basin. About 60 years ago, the Liyagastota Anicut was constructed.

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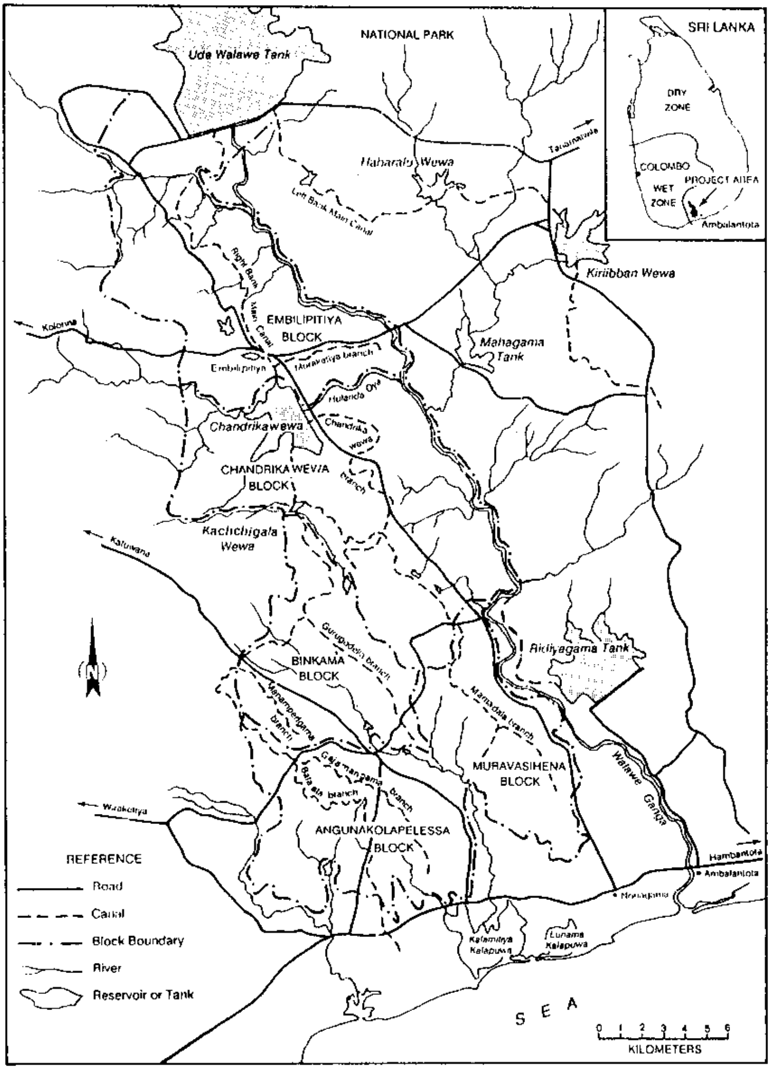
[2] In quotations included in this paper, contents within angle brackets, < >, are explanatory notes or equivalent values in other units of measurement introduced by the author.

It diverted water from the Walawe River into the then newly built Ridiyagama tank situated immediately downstream of the Left Bank command area of the present Uda Walawe Reservoir. The Ridiyagama tank has a storage capacity of 27.1 million cubic meters (mcm) and commands 5,010 ha (Figure 3). About 90 years ago the Ukgalkaltota Anicut was constructed upstream of the present Uda Walawe Reservoir to divert water directly into Left Bank and Right Bank canals with a command area of 670 ha.

Mendis describes that "one of the first acts of the Government in 1948 <i.e., after independence> was to study detailed Plans and Specifications prepared by the International Engineering Company, (who were also responsible for the design of the Gal Oya Project) for the Walawe Dam and Power Plant, situated at Embilipitiya about 30 miles from the mouth of the river. These proposals were not implemented, however, but further investigations and feasibility studies for the development of the Walawe basin were undertaken by the Irrigation Department. Under the Colombo Plan, the Canadian Government in 1954 supported an Aerial Survey of the land and water resources of Ceylon. Consequent to this survey a Report on a Reconnaissance Survey of the Resources of the Walawe Ganga Basin, Ceylon, was published in July 1960" (Mendis 1967, 26). These investigations provided "the basic factual information that planners and policy-makers require before the development plans can be formulated" (Photographic Survey Corporation Ltd. et al. 1960, 194), but it also contained a "plan for the development of a large part of the lowland plain of the Walawe Basin" (ibid., 192).

This plan included "the Uda Walawe Reservoir at the present site some <seven> miles upstream of the Embilipitiya site, and the Upper Walawe or Samanala <reservoir> which together with a forebay reservoir, the Katupath Oya Reservoir, constitute the Samanala <reservoir> project primarily meant for power production. There were also several smaller reservoirs on tributaries of the main river, namely Chandrikawewa Reservoir on Hulanda Oya, the Mau Ara Reservoir and the Weli Oya Reservoir. Of these, the Chandrikawewa Reservoir with a storage of <17.8 mcm> and commanding <2020 ha> was completed in 1964 by the Irrigation Department" (Mendis 1967, 27).

Figure 3. Location map: Uda Walawe system.



Source: IIMI 1990, 7.

The Uda Walawe Reservoir itself would provide for "adequate balancing storage...in order to re-distribute surplus flow and upstream releases and also return flow from irrigated lands upstream." (Photographic Survey Corporation Ltd. et al. 1960,189). This Uda Walawe Reservoir would be the last development phase of the development of the water resources of the Walawe Basin (ibid.).

All the abovementioned proposed reservoirs have been constructed by now, except for the Samanala Reservoir which is still under construction. It seems that this development plan has been followed to a large extent in actual practice, apart from the Samanala Reservoir being constructed last instead of first. The reason for this is that priority was given to "immediate and easy development of vast extents of land for colonization under the compulsive urge of growth in population" (Discussion on Mendis 1968, 121).

Design of the proposed Uda Walawe Reservoir was done from 1960 to 1962 by the Engineering Consultants Inc. During the tendering for the actual construction in 1964, another firm, Technoexport, submitted an alternative proposal for the dam which was much cheaper and provided for more power generation. Their proposal was accepted with some amendments. The reservoir was completed in "record time in 1968" and at very low costs (Mendis 1989b, 35).

At the time of construction of the Uda Walawe Reservoir at the present site, arguments were raised that if this storage reservoir had been built at an upstream location, more area could have been commanded in the long term, also in view of the then proposed transbasin diversion of excess runoff from the wet zone, i.e., the Southern Area Plan (Mendis 1968, 132). Mendis argued that "the policy argument should have been the optimum utilization of the land and water resources of South-East Ceylon and not of the Walawe basin alone" (ibid., 123). The discussion of this plan which is still ongoing (e.g., Mendis 1988a, 1988b, 1989a, 1989b, Fernando 1990) has been described in another case study by the author in connection with the dam sites for the Kirindi Oya Irrigation and Settlement Project (Nijman 1991b) and will not be repeated in this paper.

Table 2. Chronological list of events in Uda Walawe Basin development.

Year	Event	Command area (ha)	Storage (mcm)
Around 1900	Construction of Ukgalkaltota Anicut (Irrigation Department)	670	-
1930s	Construction of Liyagastota Anicut & Ridiyagama Tank (Irrigation Department)	5010	27.1
1948	Plans and specifications for Walawe Dam and power plant (Engineering Consultants Inc.)		
1960	Reconnaissance survey of the resources of the Walawe Ganga Basin (Photographic Survey Corporation Ltd.)		
1960-1962	Design of Uda Walawe Reservoir (Engineering Consultants Inc.)		
1964	Completion of Chandrikawewa Reservoir (Irrigation Department)	2020	27 (active, 10)
1964	Tendering for dam with alternative dam plan (Technoexport)		
1967	Feasibility study of downstream development (Hunting Technical Services)		
1968	Completing of dam		268 (active, 240)
1969	Appraisal of downstream development (ADB)	32724[1]	
1979	Project Completion Report (ADB)	13288[3]	
1982	Project Performance Audit Report (ADB)		
1984	Feasibility study of rehabilitation (SOGREAH)		
1984	Appraisal of rehabilitation (ADB)	31606[1] 23106[2] 16238[3]	
1986	Inception report on rehabilitation (MMP)		

[1]Potential [2]Planned [3]Actual

BACKGROUND TO THE REHABILITATION PROJECT

At the time of construction of the Uda Walawe Reservoir and parallel with it, downstream development had been done by a local contractor but was "extremely slow and fraught with problems. The original plan was to acquire all private lands and block them out together with crown lands lying within the irrigable command. An element of anarchy crept in however, and prevented this" (Mendis 1989b, 35). To demonstrate this Mendis quotes one of the several studies that have reported on this: "In fact, the official land distribution never occurred. Once the land had been leveled and prepared, purana villagers <i.e., villagers from original or ancestral villages as distinct from new villages or settlements>, infuriated by the coming of outsiders, forcefully and disorderly occupied the land. Thus, distribution occurred in an unorganized manner, with each family, whether purana or not, taking land where an opportunity was present and in as big a quantity as possible. Sometimes settlers were chosen from the land in which they first settled. The political context of the time did not allow radical measures to be taken to correct this situation and restart from scratch. Thus the status quo remained" (De Vroey and Shanmugaratnam 1984, 85 ibid.). In addition, the quality of construction itself at this stage was low, due "mostly to hurried construction, in the absence of adequate design and construction supervision" (ADB 1979, 3).

In 1967, Hunting Technical Services was "commissioned" by the Ministry of Overseas Development in London "at the request by the Ceylon Government under the Colombo Plan Technical Cooperation Scheme" (Hunting Technical Services 1968, I:1) to develop an outline integrated development plan for both banks of the Walawe River commanded by the Uda Walawe Reservoir "excluding those areas already settled by colonists" (ibid.). By this time, in the Right Bank "about <810 ha> of new land had been cleared in tracts[3] 2-7, various housing and infrastructure facilities had

[3] A "block" is an adminstrative division of the command area. A "tract" is a different division used during the original construction. A "unit" is a hydrological and administrative division at field level.

been completed; detailed project plans had been prepared; 38.4 km of main canal were already functioning; some basic settlement infrastructure constructed; and settlement underway" (ADB 1979, 15).

In 1969, due to financial constraints the government requested and obtained the assistance from the Asian Development Bank (ADB). At the time of Appraisal, the completion of the project was envisaged for the end of 1972. Actual completion occurred in 1979. Already by that time, the ADB's Project Completion Report (ADB 1979) and the Project Performance Audit Report (ADB 1982) had concluded that various structural and operational aspects of the project were unsatisfactory. Recommendations of the latter report led to an understanding between the Government of Sri Lanka and the ADB to undertake a rehabilitation of the Right Bank of the Walawe system. The processes involved in this decision making are described more extensively in chapters 7 and 8.

THE ORGANIZATIONAL SETUP

The agencies most directly related to the system utilization and rehabilitation decision-making processes in the Uda Walawe system are the managing agency and the consultants. Their organizational setup and main coordination structures are described below.

The Organizational Setup of the Managing Agency

Till the end of 1981, the responsibility for the construction and operation of the Uda Walawe system rested with the River Valleys Development Board (RVDB). The organizational setup at that time consisted of a project manager (a regional general manager), who was assisted by three deputy general managers, one each for water management, agriculture, and land. All three deputy general managers did have a hierarchy of subordinates.

In early 1982, the Mahaweli Authority of Sri Lanka (MASL) took over the responsibility for the system. MASL, under the Ministry of Mahaweli

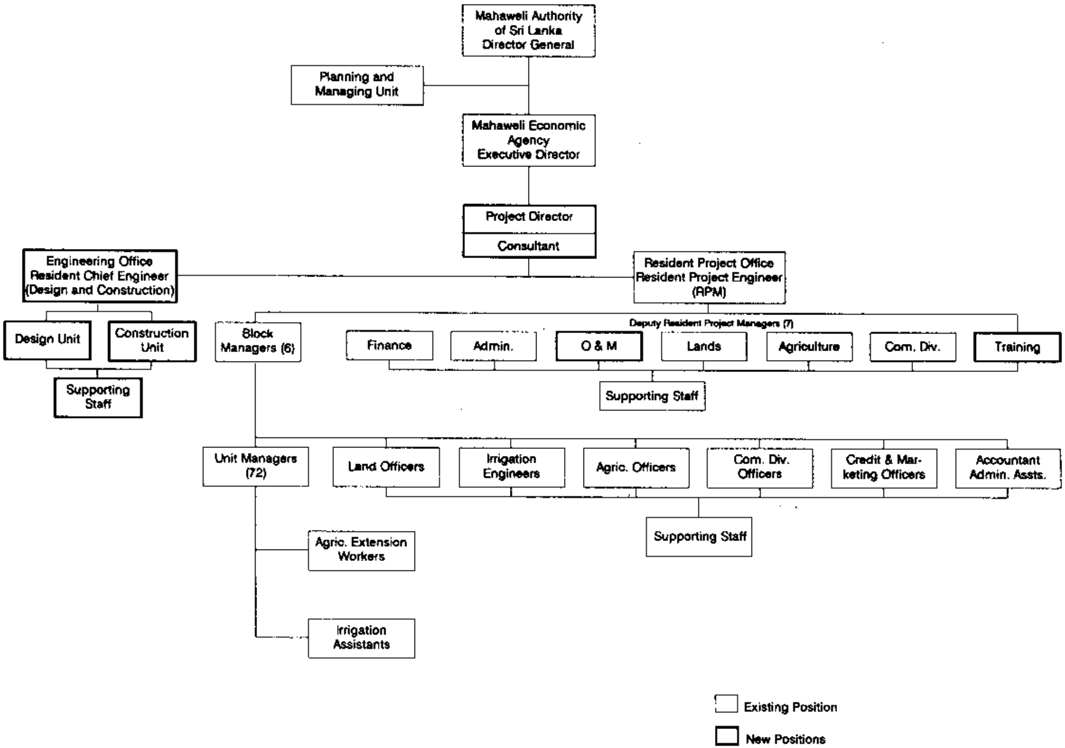
Development, was established in April 1979 under the Mahaweli Authority Act No. 23 as an umbrella organization statutorily responsible for planning, implementation, and coordination of the entire Mahaweli Ganga Development Scheme and any other resource-development project in any river basin declared as a "Special Area." In April 1981, the Walawe River Basin was declared a Special Area. The decision to charge MASL with the management of Uda Walawe instead of the Irrigation Department has been taken at the highest political levels and the exact reasons are unclear.

MASL has charged one of its operational agencies, the Mahaweli Economic Agency (MEA) with the management of the Walawe scheme. MEA introduced to Walawe a type of matrix management which it practices in other Mahaweli systems as well. In this setup the Resident Project Manager manages the project assisted by the deputy resident project managers, one each, for agriculture, water management, community services, lands, marketing, finance and administration (Figure 4).

The Deputy Resident Project Manager, Water Management or Chief Irrigation Engineer is assisted by four Irrigation Engineers, one Technical Officer and a number of gate tenders. Apart from maintenance, this water management section is responsible for main system management in the Right Bank and Left Bank main canals and the Mamadala branch canal. It has no involvement at all in the water management within the different blocks apart from allocating their maintenance budgets.

The Deputy Resident Project Manager, Agriculture is assisted by several subject matter specialists for rice, plant protection, animal husbandry, subsidiary field crops, and administration. The function of his section is to provide agricultural and on-farm water management extension (i.e., farmer training classes) and input supply, to liaise with the research station in Angunakolapelessa, and provide in-service training of Unit Managers, Field Assistants and Agricultural Officers. The same staff gets an annual training also in the aforementioned research station. The Deputy Resident Project Manager, Lands is responsible for legalization of encroached land — a big issue in Walawe — acquisition of crown land, collection of service fees, land settlement, and forest works. For the Walawe Irrigation Improvement Project they were responsible for the provision of reliable Final Village Plans indicating the legal boundaries of canals and the different allotments to be used for the Blocking Out Plans by the system improvement consultants.

Figure 4. Organizational Setup of the Walawe Irrigation and Improvement Project.



Source: ADB 1984a, 101.

The Deputy Resident Project Manager, Marketing is responsible for liaison between buyers and suppliers of agricultural products and between the banks and farmers with respect to the credit services to farmers. To improve the marketing of the products, they provide daily market information to the head office of MEA and they have built several market places spread over the project area.

The Deputy Resident Project Manager, Community Development is responsible for training of farm women (e.g., in food preparation, beekeeping, family help, nutrition, food values, inoculation, handicrafts), and organization of officer training classes, health care, housing loans, sporting activities, library services, and cultural activities.

The project area is divided into 7 blocks, 5 on the Right Bank and 2 on the Left Bank, each containing approximately 2,000 farm households, which are headed by Block Managers. These Block Managers are assisted by officers for administration, lands, agriculture, community development and marketing, and irrigation engineers. At field level the block is subdivided into units of about 250 farm households for which the agency services are coordinated by a Unit Manager.

All the aforementioned technical sections at project level have technical authority over the support staff of the same discipline in the Block Office and through them over the Unit Managers. The Block Manager on the other hand has administrative authority over the same staff at block and unit levels. This separation of technical and administrative lines of authority provides for a matrix organizational structure (Figure 4).

The Irrigation Engineer at block level is assisted by two Engineering Assistants, who are involved in maintenance and operation of the system. For the supervision of the operation of specific canals the Engineering Assistants are again assisted by Technical Officers, Field Assistants and gate tenders. Field Assistants are involved in maintenance activities as well. The Agricultural, Community, and Marketing Officers at block level are responsible for the same duties as the related offices at project level so far as they take place in their block.

The Unit Managers are mainly responsible for the agricultural extension functions and feedback of field-level information to higher-staff levels. The Unit Managers in Walawe are not responsible for water management which is an important difference between the organizational setup of Uda Walawe compared to the other Mahaweli systems. The Unit Manager thus does have a technical relation with the water management divisions of the Block Office. In Uda Walawe the water management is done by the Field Assistants. Consequently, there is no hierarchical relation between the Unit Manager and Field Assistants as is the case in other Mahaweli systems.

This difference originated in early 1982 when MEA took over system management including the existing staff of RVDB. Most of the present Unit Managers were at the time employed as extension workers and their job descriptions and duties have not been changed since the takeover. The Field Assistants were mostly gate tenders at the time of the takeover. Their responsibilities were not changed under MEA, but after one and a half years they were redesignated as Field Assistants. Their work supervisors during RVDB management were redesignated as Technical Officers. Thus, at field level, few changes occurred after MEA took over from RVDB.

The Organizational Setup of the Walawe Irrigation Improvement Project

The Walawe Irrigation Improvement Project is headed by a Project Director who is based at the head office of MEA in Colombo. In case of specific needs he can request technical support from one of the two Chief Irrigation Engineers based in the same office.

At project level, a new Engineering office has been opened in addition to the existing Resident Project Manager's office. The latter is responsible for "present and post-project <operation and maintenance>, agricultural development and settlement activities. The Engineering Office will be responsible for the improvement and rehabilitation of the irrigation system, service roads, and water supply works" (ADB 1984a, 29).

The Engineering office is headed by the Chief Resident Engineer of the Central Engineering Consultancy Bureau (CECB) which is responsible for detailed designs and supervision of the actual execution of the rehabilitation works. For that purpose it has a large staff which is temporarily based at the new Engineering office. They are assisted by another consultant, Sir M. MacDonald and Partners Ltd. (MMP), responsible for defining appropriate design criteria for the rehabilitation.

Coordination

Coordination during the normal management of the system is the responsibility of the Resident Project Manager and of Block Managers. To that end the following meetings are held: a monthly Staff Conference at project level and a weekly Block Meeting for all officers in the block. These meetings are meant for interaction between the different disciplinary officers together with the different line managers, i.e., the Resident Project Manager and Block Managers in the Staff Conference and the Block and Unit Managers in the Block Meeting. In the head office of the MEA a monthly meeting is held with the Resident Project Managers of all the MEA projects.

For the Walawe Irrigation Improvement Project a monthly Progress Meeting was held during the design phase at project level which was attended by MEA, CECB and MMP project-level staff and the Project Director and Managing Director of the MEA head office. In addition, a monthly Management Brief was held by the MASL to discuss the progress of a number of ongoing construction or rehabilitation projects.

PHYSICAL FACILITIES

Water resources for the Uda Walawe Reservoir are the catchment areas of the Walawe River and its main tributaries. Annual average runoff of the Walawe River at the Uda Walawe dam site is 1,057 mcm, of the Hulanda Oya River at Chandrikawewa Reservoir 45 mcm, and of the Mau Ara River at Mahagama tank 54 mcm (SOGREAH 1984, 6). The storage capacities are 268 mcm for Uda Walawe (i.e., about 25 percent of the annual inflow only) and 27 mcm for Chandrikawewa Reservoir.

Annual rainfall and run-off regimes of the catchments are characterized by high rainfall and inflow in the months of October to January followed by the comparatively drier month of February, then a second wet season from March to May, and a pronounced dry period from June to September. "A study of 40 years inflow data of the reservoir shows an average annual inflow of 1093 mcm with a reliability of 850 mcm in 80 percent of the years. The average monthly inflow varies from 36 mcm in August to 173 mcm in November. The June to September dry season inflow varies from 44 mcm to 482 mcmc with an average of 175 mcm. One in five year low dry season inflow is 125 mcm." (ADB 1984a, 75)

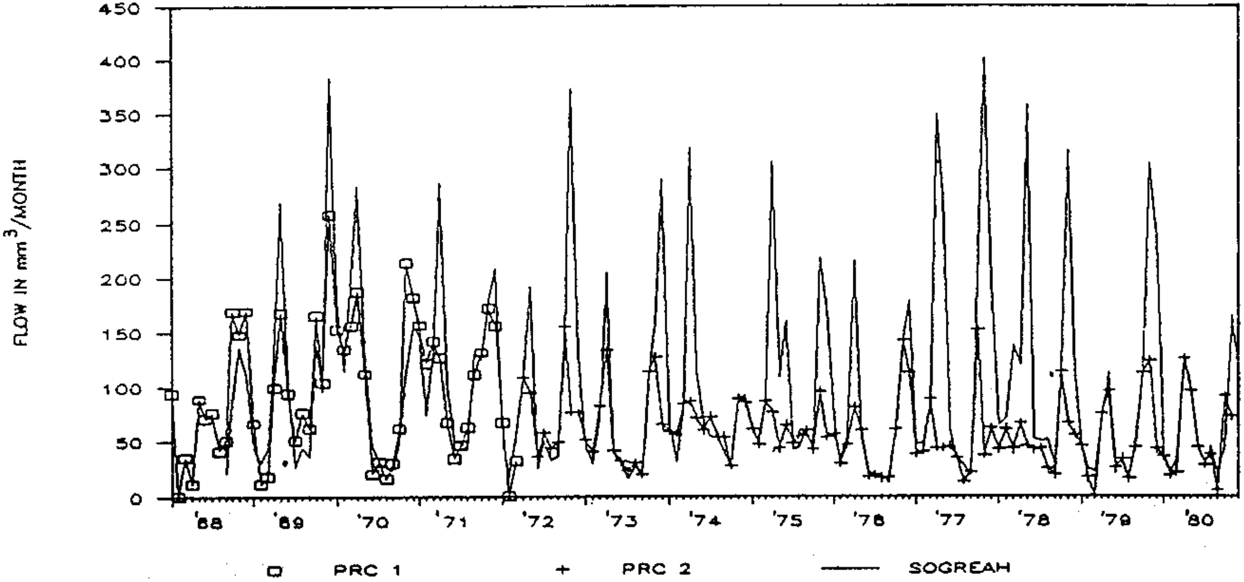
Table 3. Effective rainfall in the Uda Walawe catchment area.

Month	Irrigation Department Illupalama[1] (mm)	Wolf[2] (mm)	Proposed[3] (mm)
a) *Maha Season*			
September x 1/2	0	16	28
October	46	139	58
November	104	185	192
December	31	147	124
January	8	78	14
February x 1/2	0	27	13
TOTAL	189	592	429
b) *Yala Season*			
April x 1/2	24	65	57
May	6	82	93
June	0	34	24
July	0	32	15
August x 1/2	0	13	8
TOTAL	30	226	197

[1]Effective rainfall = 0.67 (R_{75} –25) mm
[2]Using SDS Method effective rainfall varies between 40% and 80% R mean
[3]Constant 70% R_{80} effective rainfall;
where R_{75} = 75% probability rainfall
R_{80} = 80% probability rainfall

Source. MMP 1986a, A2-12.

Figure 5. Uda Walawe inflow: Comparison of 1968-80 data.



Source: MMP 1986a, A2-23.

The complete inflow from the Uda Walawe catchment area upstream of the system, however, is stored in the main Uda Walawe Reservoir of which, under the existing cultivation practices and calendar in the command area, on average, about 665 mcm were regulated annually by the Uda Walawe Reservoir until 1983 (SOGREAH 1984, A2-12). The remainder is spilled to the river. Because of the (relative) large annual runoff compared to the available storage capacity the short-term water-level fluctuations in the reservoir can be relatively large. However, as long as enough water is available in the reservoir, the supply of water to the main canals can be rather reliable. Water is issued to the main canals by operating the turbines in the dam or the spray valves in the head sluices. This operation allows, in principle, for a supply which is independent of an upstream conveyance system.

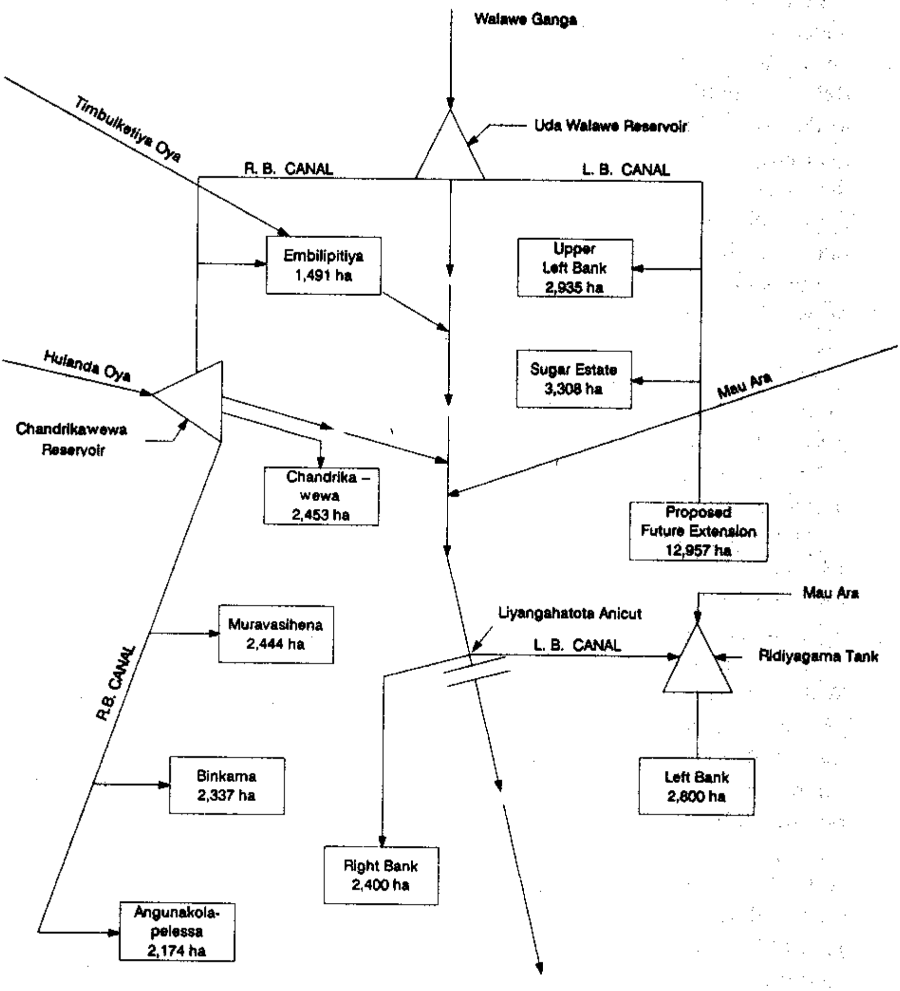
One power unit issues to the Right Bank main canal, and two such units to the Left Bank canal. The water issues for irrigation purposes are given priority towards power production. The turbines can produce power up to 5.3 m above the sill level of the Right Bank head sluice which is at 73.1 m above mean sea level (msl).

The design discharge through the power units and for the main canal is 18.4 cumecs while two bypass outlets are available for the Left Bank to issue the total required discharge if the minimum required discharge cannot be obtained through the power units.

The schematic layout of the main irrigation system below the Uda Walawe Reservoir is given in Figure 5. The main design characteristics and envisaged hydraulic functions of the original design are given below. A more elaborate description of the system's functions envisaged after system improvement is given in Chapter 9 under "functional system requirements," but the following short description is meant to give some preliminary insights for a better understanding of chapters 3 to 5 on the allocation and water flow regulation concerns.

The Right Bank main canal of 40 km has been designed to command an area of 12,000 ha. It is a single bank canal which was originally planned to follow a contour upstream of Chandrikawewa Reservoir. Pressure from several sources at the time of construction led to rerouting of this canal into the Chandrikawewa Reservoir. From Chandrikawewa Reservoir it continues to the small Kachchigala Reservoir. The rerouting of the Right Bank

Figure 6. Schematic layout of the Uda Walawe main system.



Note: The area (ha) indicated is the official developed service area, not the actual cultivated area.

Source: PRC 1982.

main canal led to a considerable reduction of the effective storage capacity because the sill level of the sluice to the Kachchigala Reservoir had to be constructed at 56.6 m above msl, while for Chandrikawewa branch canal it was at a height of 52.65 m above msl. The full supply level is 61.0 m above msl. From Kachchigala Reservoir the Right Bank main canal goes straight to the tail-end blocks where no further intermediate storages on the main system are available.

A total of seven branch canals exist on the Right Bank representing 65 km of canal, i.e., Moraketiya, Chandrikawewa, Mamadala, Gurugodella, branch canal No. 6, Gajamangama, and Bata Ata. These branch canals convey water to five blocks: Embilipitiya, Chandrikawewa, Muravasihena, Binkama, and Angunakolapelessa. In addition, there is approximately 700 km of distributary and field channels. Distributary channels convey water from the branch canals, and in the case of the northern tracts 2 to 7, from the main canals, to the field channels. Field channels convey water from the distributary channels to the individual farmers' plots with an average size of 1.1 ha.

The offtakes along the main canals have been provided with constant head orifice (CHO) structures. Another 1,100 offtakes in the system are of the controlled pipe outlet (CPO) type. Other control structures in the system are fall structures, bifurcations, regulators, and ungated farm turnouts on field channels. No measuring structures as such are provided.

Many of the aforementioned structures are in a dilapidated state: "Many gates from branch to distributary canals and about 40% from distributaries to field channels have been broken by farmers, essentially in upper tracts. Many farm turnouts along distributaries have been considerably widened or dug-out to allow higher discharges with turnouts in upper portions of distributaries supplying about twice as much water as those in the lower ends" (ADB 1979, 54).

While the upper part of the Right Bank main canal was designed for a peak requirement of 19.3 cumecs, insufficient excavation during construction and siltation afterwards led to the situation in 1983 when at "18.4 cumecs, several locations along <Right Bank> main canal <had> only 15 to 20 centimeters of operational freeboard" (Wolf 1983, 9).

A SHORT NOTE ON THE PRESENT PERFORMANCE OF WALAWE

The original investments in Uda Walawe were very disappointing for the donor as compared to the assumptions made during their appraisal assessment. Water duties and cropping intensities were extremely low in the early years, because the head sluice was fully opened without any management downstream by the RVDB. This led to extreme water use by head-end reaches at the expense of approximately two thirds of the command area which did not receive any water at all by the time of project completion. System-wide seasonal water duties have been as extreme as 7 meters during the initial stages (Visvalingam 1986, 7). By 1981, these efficiencies were still only one-fifth of the original appraisal estimates, as shown in Table 4. The large differences between the cropping intensities of different blocks are shown in Table 5, which also shows appraisal estimates of 200 percent (ADB 1979, 49). The well-drained soils with steep slopes in the head reaches (tracts 2 to 7) require more water, but to a large extent the excessive water use is a managerial problem. Available data on gross water issues and areas cultivated as given in tables 6 and 7 are not very reliable, but they indicate the trend that the performance of these indicators has been improving gradually over time under RVDB and MEA governance.

This gradual improvement is due to an almost "natural" system development and improvement. From 1970 onwards the same maximum discharge has almost always been issued through the head sluices, whereby the irrigable area has been extended gradually over the years. This led to improved water duties and cropping intensities without reducing the annual water issues from the reservoir till 1982. In addition, since yala 1982 MEA enforced stricter adherence to seasonal cultivation along the main system than did RVDB and this might have led to a maximum of some 12 percent reduction of the annual water issues (assuming, optimistically, a three-month intermediate season introduced by MEA during which only one sixth of the maximum discharge is issued for domestic purposes, and assuming that there is no intermediate season at all during the RVDB period, but a three-month period instead, with only half of the maximum possible discharge being issued through the head sluice).

Table 4. Right Bank System irrigation efficiency[a].

	Maha			Yala		
	1978/1979	1979/1980	1980/1981	1979	1980	1981
Irrigated area (acres)	17,350	17,998	19,717	14,909	17,259	18,125
Diversion (acre-feet)	193,500	194,800	196,634	214,930	214,560	191,200
Effective precipitation (acre-feet)	17,523	17,695	23,078	6,560	14,955	34,068
Total water[b] (acre-feet)	211,023	212,495	219,712	220,490	229,515	225,268
Water acre (acre-feet/acre)	12.16	11.81	11.14	14.86	13.30	12.43
Project efficiency[c] (2.38 feet/acre = 100%)	20%	20%	21%			
Project efficiency[c] (3.22 feet/acre = 100%)				22%	24%	26%

[a]Total project efficiency using flow from the headworks. Losses include all canal and on-farm losses.
[b]This does not include natural inflows to the main canal because records are not available. If natural inflows are included in the calculation, the irrigation efficiency will be lower than the values given here.
[c]The basis used in the ADB Appraisal Report of 1969.

Source: ADB 1982, 38

Table 5. Cropped area, cropping intensity and yield, 1979-1981.

	Embilipitiya (Tracts 2-7)		Chandrikawewa		Binkama (Tracts 12-14)		Muravasihena (Tracts 9-11)		Angunakolapelessa (Tracts 15-19)		Total	
	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala
I. Cropped area (acres)												
(1) 1979/1980												
- rice on rice land	3,544	3,647	5,675	5,590	3,226	3,533	365	336	1,485	1,004	14,295	14,110
- rice on subsidiary land	—	—	37	10	757	847	867	766	920	984	2,581	2,607
- other crops[a]	128	107	318	58	158	64	272	172	246	141	1,122	542
(2) 1980/1981												
- rice on rice land	3,660	3,662	5,813	5,632	3,758	3,736	476	463	1,087	1,349	14,794	14,842
- rice on subsidiary land	—	—	36	21	1,407	789	1,122	1,111	1,004	1,043	3,569	2,964
- other crops[a]	141	43	336	64	175	52	291	39	411	121	1,354	319
II. Uncultivated area												
(1) 1979/1980												
- acre	55	—	102	474	1,701	1,398	4,607	4,837	2,495	3,017	8,960	9,699
- % of total service area	1.5	—	1.7	7.7	29.1	23.9	75.4	79.2	48.5	58.6	33.2	36.0
(2) 1980/1981												
- acre	—	22	—	415	502	1,265	4,222	4,498	2,644	2,633	7,368	8,833
- % of total service area	—	0.6	—	6.8	8.6	21.7	69.1	73.6	51.4	51.2	27.3	32.8

(Continued on p.37)

Table 5(continued).

	Embilipitiya (Tracts 2-7)		Chandrikawewa		Binkama (Tracts 12-14)		Muravasihena (Tracts 9-11)		Angunakolapelessa (Tracts 15-19)		Total	
	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala	Maha	Yala
III. Cropping intensity (%)												
(1) 1979/1980	199.2		190.6		147.0		45.5		75.4		130.8	
(2) 1980/1981	201.4		199.1		169.8		40.9		95.5		140.4	
IV. Rice yield (metric tons per acre)												
(1) 1979/1980	1.67	1.87	1.72	1.54	1.62	1.46	n.a.	1.17	1.12	0.88	1.54	1.47
(2) 1980/1981	1.78	1.77	1.73	1.59	1.52	1.55	1.18	1.26	1.36	1.12	1.56	1.48
V. Percentage of rice to total cultivated area												
(1) 1979/1980	96.5	97.1	94.7	98.9	96.2	98.6	81.9	86.5	90.7	93.4	93.8	96.9
(2) 1980/1981	96.3	98.8	94.6	98.9	96.7	98.9	84.6	97.5	83.6	95.2	93.1	98.2

[a]Chili, vegetables, and cotton.

Source: MEA in ADB 1982, 35

The MEA data represent a reduction in annual water issues from approximately 600 mcm during 1973-77 and 1978-82 to 450 mcm during 1985-89, i.e., a reduction of 25 percent (IIMI 1990, 137). The MEA data demonstrate the unreliability of the present or past data of the water issues with a factor two of the improvements perceived as likely in the discussion above. While the cultivated areas and cropping intensities have probably

Table 6. Cultivated areas under irrigation in the Walawe system, 1973-1989.

	Maha[a]			Yala			Total			Cropping intensity
Year	Rice	OFC[b]	Total	Rice	OFC[b] 1000 ha	Total	Rice	OFC[b]	Total	
1973	4.51	0.04	4.55	4.48	0.13	4.61	8.99	0.17	9.16	0.52
1974	6.56	0.29	6.85	6.52	0.45	6.97	13.08	0.74	13.82	0.78
1975	6.74	0.34	7.08	6.25	0.35	6.60	12.99	0.69	13.68	0.78
1976	8.35	0.52	8.87	7.28	0.25	7.53	15.63	0.77	16.40	0.93
1977	7.37	0.37	7.74	3.94	0.22	4.16	11.31	0.59	11.90	0.68
1978	7.84	0.24	8.08	7.73	0.14	7.87	15.57	0.38	15.95	0.91
1979	8.69	0.24	8.92	7.02	0.16	7.18	15.71	0.40	16.11	0.91
1980	8.70	0.12	8.82	8.68	0.18	8.86	17.38	0.30	17.68	1.00
1981	9.47	0.35	9.82	9.59	0.14	9.73	19.06	0.49	19.55	1.11
1982	10.04	0.15	10.19	10.49	0.05	10.54	20.53	0.20	20.73	1.18
1983	11.13	0.73	11.86	10.38	0.38	10.76	21.51	1.11	22.62	1.28
1984	11.16	0.48	11.64	11.18	0.45	11.63	22.34	0.93	23.27	1.32
1985	10.56	0.60	11.16	11.15	0.75	11.90	21.71	1.35	23.06	1.31
1986	11.03	0.62	11.56	11.47	0.58	12.05	22.50	1.20	23.70	1.35
1987	11.47	0.52	11.99	10.59	0.65	11.24	22.06	1.17	23.23	1.32
1988	10.36	0.67	11.03	10.38	0.72	11.10	20.74	1.39	22.13	1.26
1989	10.59	0.66	11.25	na	na	na	—	—	—	—

[a]The maha season is recorded in the year when the crop is harvested; eg., 1972/73 maha in 1973.

[b]OFC stands for "Other Field Crops"; crops other than rice.

[c]Computed against the total system command area of 17,615 ha; 11,940 ha for the Right Bank and 5,675 ha for the Left Bank, the data of which is from SOGREAH (1984, 41).

Source: Original data are from MEA, quoted in IIMI 1990, 154.

improved over time, the increase in the 1980-1983 period from 100 percent to approximately 130 percent seems unlikely large. More specific performance figures are provided in chapters 7 and 8.

Since 1983/84, MEA did not attempt to further improve water duties and cropping intensities, because: a) the rehabilitation project had started, b) water was abundantly available from the Uda Walawe Reservoir during almost all the years given the low cultivation risks for the existing cultivated areas, and c) crop failed only during one season since 1986. However, at least one third of the originally constructed command area is still without

Table 7. Average rice yield per hectare, water duty, and productivity in the Walawe system.

Year	Maha			Yala			Average[a]		
	Yield (t/ha)	Water duty (m/ha)	Water productivity (kg/m^3)	Yield (t/ha)	Water duty (m/ha)	Water productivity (kg/m^3)	Yield (t/ha)	Water duty (m/ha)	Water productivity (kg/m^3)
1973	3.11	7.07	0.044	2.90	7.24	0.040	3.01	7.16	0.042
1974	3 86	4.12	0.094	3.36	5.73	0.059	3.61	4.93	0.073
1975	3.89	3.81	0.102	3.40	4.42	0.077	3.65	4.10	0.089
1976	4 26	3.14	0.136	2.71	4.18	0.065	3.55	3.62	0.098
1977	3.75	2.80	0.134	3.44	4.21	0.082	3.66	3.29	0.111
1978	3.65	3.26	0.112	3.89	3.99	0.097	3.77	3.62	0.104
1979	4.00	3.75	0.107	4.00	5.10	0.078	4.00	4.35	0.092
1980	4.35	3.20	0.136	4.42	3.81	0.116	4.39	3.51	0.125
1981	4.67	2.56	0.182	4.29	2.77	0.155	4.48	2.67	0.168
1982	4.91	2.73	0.180	4.55	2.43	0.187	4.73	2.58	0.183
1983	5.41	1.63	0.332	5.26	2.21	0.238	5.34	1.91	0.280
1984	4.19	0.93	0.451	3.36	1.82	0.185	3.78	1.38	0.274
1985	4.66	1.64	0.284	3.88	2.00	0.194	4.26	1.83	0.250
1986	5.13	1.70	0.302	4.19	2.01	0.208	4.65	1.86	0.250
1987	6.01	1.76	0.341	4.63	2.10	0.220	5.34	1.92	0.278
1988	5.14	2.06	0.250	4.67	2.18	0.214	4.91	2.12	0.232
1989	6.01	2.09	0.288	na	na	-	-	-	-

[a]Weighted average using the area planted in each season as weight.

Source: Original data are from MEA, quoted in IIMI 1990, 155.

any irrigation water. Motivation to increase management inputs for further water savings was low in view of the rehabilitation project, which was aiming specifically to improve these aspects. Thus, from the point of view of the MEA staff further water saving by management improvements were not necessary, while from the point of view of the donor, further improvements were still required to increase the cropping intensity in line with their appraisal assumptions of 1970. The latter arguments were the main reasons for the US$12 million investment in the rehabilitation of the system. Overall, while considering the present system utilization processes in chapters 3 to 6, the present water delivery performance should still be considered insufficient, and needing improvement.

CHAPTER 3

Allocation Concern: Seasonal Allocation Plan

THE ALLOCATION CONCERN in Sri Lankan irrigation systems refers to seasonal and in-seasonal decisions. The seasonal allocation plan is discussed in this chapter, and the in-seasonal decision-making processes in the next.

Seasonal allocation requires an assessment of the supply to the system as a whole and the supply to different subsystems. This supply assessment can incorporate supply parameters as rainfall in the catchment area, hydrological simulations, actual inflow, and storage in reservoirs. Seasonal allocation also requires an assessment of demand of the overall system and different subsystems. Assessment of demand for the season refers to the requirements for irrigation and nonirrigation purposes of water users, politicians, and staff of involved agencies. These requirements may refer to demand parameters as the areas to be irrigated, the water duties, the cropping pattern, the cultivation calendar, and the related cultivation risks for the different subsystems. Implicitly or explicitly, this water duty refers to the water-delivery performance — whether required by water users or envisaged by the agency during the season — in terms of adequacy, timeliness, responsiveness, predictability, delivery-performance ratio, operation efficiency, and equity. Requirements with respect to water duty, cropping pattern (e.g., short-term and long-term varieties), and cultivation calendar and related cultivation risks may also implicitly represent demand preferences with respect to the input of labor in irrigation and agricultural practices (i.e., potential and preferred farm power), factor substitution (e.g., water for insecticides), and related agricultural productivity. On the other hand, the expected water delivery performance may implicitly incorporate the preferences of the agency staff (e.g., minimization of management input, minimization of accountability towards or interaction with water users and politicians).

Allocation decisions have to be preceded by a matching of supply and demand. If demand is larger than supply for the overall system or for the different subsystems prioritizing may be required among the abovementioned parameters that determine the explicit and implicit demand requirements of the different subsystems. It may also require prioritizing among the different subsystems.

THE DECISION-MAKING PROCESSES

Supply Assessment

Technical aspects. Seasonal assessment of supply to the overall command area of Uda Walawe takes into account the storage in the reservoir. The inflow into the reservoir or rainfall in the catchment area is not considered, not even if the supply to the system is tight at the beginning of the season. At the start of yala 1987, while water supply was tight, only the rise of the water level in the reservoir was measured and used for assessing the likely supply.

The storage is estimated daily on the basis of the water level in the reservoir and an existing rating curve that indicates the related stored water in the reservoir. This rating curve has been established before the original construction on the basis of topographic maps. Supply to the different subsystems (e.g., branch canal, blocks, or tracts) is not assessed separately on a seasonal basis. The influence of, for example, Chandrikawewa Reservoir on the water availability is considered negligible because most of its storage capacity cannot be effectively utilized anyway due to the high level of the sluice sill to Kachchigala Reservoir (see page 31).

Managerial aspects. The assessment of the reservoir water level itself is done by the Technical Overseer in charge of the headworks on behalf of the Headworks Administration.[4] This Technical Overseer informs the O&M

[4] The Headworks Adminstration is a separate division of MASL which manages all its headworks in the country.

division of the Resident Project Manager's office about this water level, daily, by telephone.

Demand Assessment

Technical aspects. In principle, the annual requirements with respect to the area to be cultivated, cropping patterns, seed and fertilizer are assessed for every individual farmer, and aggregated at block and project level into a crop planning summary. The demand with respect to the starting dates for the cultivation are assessed at block level. Apart from the starting and completion dates for the cultivation season, this demand assessment does not change for tight or short water availability situations.

The requirements of different subsystems with respect to the water duties for the season are not assessed for the coming season. Based on experience, the O&M division prepares a water utilization budget for the overall system which includes gross figures for nonagricultural demands as well. The data of the aforementioned crop planning summary are not used for the calculation of the water utilization budget, because the area cultivated has little influence on the actual water issues and because the data of the crop planning summary are considered unreliable.

Managerial aspects. The water utilization budget is a standard list of the perceived water requirements based on previous gross water duties. No interaction takes place between O&M division and any of the water users or field-level staff to evaluate the validity of this assessment for a particular season.

The Unit Managers are responsible for collecting data, by May of each year, on the annual requirements of seeds and fertilizer, cropping patterns and areas to be cultivated by the farmers in a unit. For this data collection the Unit Manager is expected to interact with all the farmers in his unit area. In actual practice, however, the reliability of the data appears to be rather low, because the Unit Managers in Uda Walawe as in the other Mahaweli systems (see, for example, Raby and Merrey 1989, 72) are not very motivated to put much effort into this data collection. Therefore, these data can be considered indicative only.

The data forwarded by the Unit Managers are used by the Agricultural Officer of the Block Office to make an agricultural implementation program at block level. By July of each year, the agricultural implementation programs of the different blocks are evaluated in the Agricultural division of the Resident Project Manager's office and amalgamated into a project-level agricultural implementation program. This report has to be discussed with officials of the Ministry of Agriculture for their comments after which the final report is published in August, each year.

Matching of Supply and Demand into a Seasonal Allocation Plan

Technical aspects. The rule of thumb is that if the Uda Walawe Reservoir contains 60 percent of its total storage capacity of 269 mcm, the supply is considered sufficient to start the cultivation in the whole command area. If the available supply is less than this 60 percent, the start of the cultivation for the whole command area is postponed if rainfall is expected soon, or cancelled if the supply does not come above or close to this limit. Cultivation of part of the command area or staggered cultivation is not practiced in Uda Walawe; it is either everybody or nobody.

The cultivation calendar gives the authorized dates for the start and completion of the land preparation and the authorized date of the last water issue. The land preparation and the overall cultivation season end exactly one month, and three and a half months, after the officially agreed starting date, respectively. These dates are the same for all subsystems even if certain tail-end areas receive their first water issues only one month after the officially agreed date.

The authorized starting date for the cultivation is influenced by the time required for minor repair works to the physical infrastructure and for cleaning and desilting of the canals between the cultivation seasons. In addition, the optimum period for flowering of the rice crop and cultural events like the Sinhala and Tamil New Year influence the authorized starting dates. The actual dates are influenced by spilling reservoirs as well. The potential utilization of rainfall for land soaking and further land preparation does not influence this decision.

Implicitly, these starting dates represent an authorization to grow three-and-a-half-month rice varieties if farmers have finished the land preparation within 20 days after the agreed date for the first water issue. If farmers finish their land preparation beyond this date, they are supposed to grow three-month varieties to limit the total duration of the cultivation season, and thereby the seasonal water use. Within these dates farmers are advised and allowed to grow subsidiary field crops, but there are no official decisions in this respect. The authorized cropping pattern is entirely independent of the water availability at the start of the season.

Managerial aspects. The first step in the seasonal matching of supply and demand is the aforementioned assessment of the available supply by the O&M division. If supply is considered sufficient, or a rising water level in the reservoir raises expectations that the rainy season has started and further rainfall will render it sufficient in the near future, the Resident Project Manager convenes a meeting with the Agricultural and O&M divisions. The O&M division briefs the other staff on the water availability. After these discussions the Agricultural division prepares a tentative cultivation calendar and program and the O&M division prepares a program for the holding of cultivation meetings. Farmer training classes are held at unit level to inform the water users about the proposed cultivation calendar and agricultural practices.

It is a legal requirement that the seasonal plan is authorized by the water users at the cultivation meeting. In Uda Walawe these meetings are held at block level. The Block Managers preside at these meetings on behalf of the Resident Project Manager. The Resident Project Manager himself is authorized by the Irrigation Ordinance (Government of Ceylon 1968, 7) to make all decisions with respect to the seasonal plan, because he has the same authority as a Government Agent for the Walawe Special Area.

The Block Manager has no authority to make the final decisions with respect to the cultivation calendar. Instead, he has to obtain the agreement of the water users with the proposed cultivation calendar. If farmers do not agree, he has to inform the Resident Project Manager of their requirements. In all cases, the Resident Project Manager makes the final decision.

The reason that the Block Manager is not authorized to make the final decision with respect to the starting date is that this date has to be matched with water issues of the other blocks. An additional reason is that the staff of the Resident Project Manager's office is of the opinion that these starting dates have to be the same for the whole system, i.e., that no staggering between the different subsystems should be allowed. The normal starting dates of the cultivation are 20 September for maha and 20 April for yala.

At the time of the cultivation meetings for maha 1986/87, yala 1987 and maha 1987/88 the reservoir was filled 14 percent, 32 percent, and 6 percent, respectively. Justification for holding the cultivation meetings in these seasons was the occurrence of rainfall or the rising of the water level in the Uda Walawe Reservoir. Still, in these instances, the cultivation of the whole command area was proposed and authorized, and reduction of the irrigable area in case of limited water availability or staggered cultivation was never considered. In these seasons, different starting dates (i.e., tentative calendars) were proposed for different rainfall situations; only if the 60 percent level was reached was the cultivation actually started.

One overall starting date is an explicit management strategy in Uda Walawe. It is considered to facilitate the timing of the flowering period in the optimal period (i.e., January for maha) for the whole system. Also, one overall starting date is considered to stimulate discipline among farmers to adhere to the cultivation calendar. This discipline is a sensitive issue for the responsible officers given the fact that under the RVDB management the lack of discipline in this respect led to perennial cultivation in the head-end reaches at the expense of the cultivation by tail enders. The project-level top management of MEA considers it one of their major achievements that the water users adhere more to the cultivation calendar nowadays. This practice indeed may have saved up to 12 percent of the annual water issues from the reservoir, as mentioned earlier (page 28). However, apart from the reduced cultivation risks this saved water has not been used so far in Walawe due to the limiting capacity of the Right Bank main canal, due to no or very little reductions of water duties per period of time, and due to MEA's unwillingness to stagger the cultivation along the main system.

In practice, it appears that water users never agree with the proposed cultivation calendar (see, for example, IIMI 1988, 97, 1990, 28). The cultivation meetings are sometimes "very lively affairs, with angry exchanges and accusations" (IIMI 1990, 28). The water users disagree mainly because they feel that the cultivation meetings are held to fulfill the legal requirement of the Irrigation Ordinance only, without allowing any discussion or flexibility in the proposed cultivation calendar.

In certain instances, they disagree because they really prefer another cultivation calendar. This occurred, for example, at the start of the yala 1988 cultivation. The Uda Walawe and Chandrikawewa reservoirs were already spilling during the cultivation meeting so the water users preferred to start the cultivation before mid-April instead of the normal date of 20 April. The top management of Walawe did not accept their proposal, because harvesting was still going on in certain areas and thus too little time would be left for the preseasonal maintenance works. Moreover, they reasoned that the water users would celebrate the Sinhala and Tamil New Year during that period. Thus, they decided to authorize the first water issues for 20 April only, and allowed some water to be issued for domestic purposes.

After the cultivation meeting the O&M division prepares the final cultivation calendar. It also prepares the schedules for rotational issues to the different branch canals and distributary channels which are managed by it. In addition, it formally approves — but does not evaluate or amend — the proposed rotations within the different blocks as proposed by the block officials themselves. These schedules will be dealt with more extensively in the next chapter on in-seasonal allocation processes.

Implementation of the Seasonal Allocation Plan

Technical aspects. The dates of the cultivation calendar as determined by the Resident Project Manager are the targets for the implementation of the seasonal allocation plan. Five days before these target dates water issues are started to fill up the canal system. However, if the reservoirs are spilling the water issues sometimes start even earlier than the agreed dates. The actual starting dates at the heads of the different branch canals along the main canals are approximately the same. However, due to limited canal capacities combined with limited staff interventions the starting dates to the tail ends of the Chandrikawewa, Muravasihena, Binkama and Angunukolapelessa blocks mostly come approximately one month later. These limited staff interventions relate to the progress of implementation of a rotation during land preparation which allows water to reach these tail enders earlier; such a rotation is implemented only after farmers in the head-end reaches have completed their land preparation and it is only then that the tail-enders can start their land preparation.

In principle, the supply of fertilizers, pesticides, and seeds can be provided directly to farmers by the MEA staff at block level. If not, the provision by the private traders is facilitated by the block-level staff. Also, the Marketing Branch facilitates the provision of credits by the banks, because the banks do not have enough staff for this purpose. In actual practice, however, the role of MEA in these services is rather limited in Uda Walawe.

No accurate data are available in this respect, and the following figures are therefore rough estimates only. Approximately 25 percent of the seeds necessary is provided by MEA, because MEA cannot obtain more seeds from the Department of Agriculture. Instead, many farmers buy their seeds directly from the seed rice producing farmers in their direct neighborhood (thus, before their produce is certified by the Department of Agriculture). Fertilizer provision through MEA is limited to approximately 5 percent of requirement. Credit provision through the banks is not higher than 10 percent of demand, because most farmers have defaulted in the repayment of loans provided earlier.

Managerial aspects. The setting of the starting dates for issues to the branch canals is done by the project-level O&M division staff. The starting dates within the branch canals are fixed by the respective block offices except for the Mamadala branch canal, which is operated directly by the O&M division because it serves two blocks, Chandrikawewa and Muravasihena.

Because the land preparation consumes a lot of water at a time, especially in the well-drained soils with steep slopes, the actual starting dates for the different distributary and field channels depend to a large extent on the preferences of the water users in the head-end canals. The general picture is that during the first two weeks a continuous issue is given to a branch canal, whereby the head enders can start their land preparation. After that period the O&M staff of the Block Office starts to intervene and rotate water issues among distributary channels to permit more downstream channels to start their land preparation as well, without water reaching the tail-end channels during the first month however. In contrast to the discipline required by the top management of the different blocks to adhere to the enforced starting date for all blocks, the discipline exercised within the different blocks appears to be minimal.

According to an IIMI research report on irrigation difficulties and the lack of discipline within the blocks,

> though continuous issues are the normal expectation <of the water users> at the initial stage of land preparation, rotational issues usually have to be started after two weeks. In addition, additional water-issue days are added to head-end distributaries in the rotation schedule for land preparation, to ensure they do not disrupt deliveries to the tail. If the branch canal deliveries are not increased to compensate for this, more delays result in the tail. Further, the farmers, particularly at the head end, usually take extra days to finish land preparation since they know the cultivation calendar is flexible. In fact, the delay in land preparation in the head-end distributaries can be attributed to some extent to the abundance of water. There is no reason to hurry. Most of the farmers who delay land preparation in <distributary channel 8 of Chandrikawewa block> are leased-in farmers who feel no obligation or commitment to follow Mahaweli Economic Agency decisions. Some other reasons for the delay include difficulty in obtaining hired tractors, lack of initial capital to pay for hired tractors, and personal problems such as death of relatives, or illness (IIMI 1990, 29).

The irrigation difficulties and the lack of discipline of head-end farmers and block-level staff in Uda Walawe are more due to the nonadherence to the starting dates than to the farm power constraints and the lack of input supplies to the farmers. A lack of agreement and interaction between agency staff and water users about actual required water quantities, feasible rotations, and starting dates for the different distributary channels is apparent. In addition, the possible physical control of stopping the water issues at the completion date for the season authorized by the Resident Project Manager, is not exercised because water users can usually enforce extension through politicians. Also, its implementation by MEA is difficult with a single bank main canal. MEA usually preempts such interventions by issuing water till the end of the cultivation in the tail-end canals. Given the low management inputs of the MEA staff aimed at an earlier cultivation by tail-end canals, a refusal of such extension cannot be justified.

It is not the Agricultural or O&M division that really decides the starting dates for these different distributary channels but the individual farmers themselves, in conjunction with other farmers and possibly the gate tenders. "Eventually decisions on the commencement of land soaking and land plowing are taken by each individual farmer on day to day basis" (IIMI 1990, 114). Except for a gross starting date for the branch canal as a whole, very little guidance, monitoring, or evaluation of the starting dates within the branch canal takes place. The O&M division at block level collects information on weekly progress of the land preparation, but the data are unreliable and are not analyzed. Thus, they play no role in the decision making and control of the implementation of the seasonal allocation plan and related water issues to different subsystems.

The Agricultural division at project level prohibits water users to grow three-and-a-half month varieties if they have not finished their land preparation within 20 days. However, if the agency is not able to provide the water to the tail-end distributary channels to start the land preparation this ruling loses its validity and credibility. In actual practice, as for example during yala 1988, "100 percent of the farmers" completed their land preparation in excess of 20 days and still used three-and-a-half-month varieties (IIMI 1988, 98).

Mutual Adaptation of the Technical and Managerial Aspects

The collection of data for the crop planning summary by the Unit Managers does not effectively lead to an assessment of the requirements of the water users with respect to the cultivation calendar and water duties. However, even if it did, all individual requirements cannot be honored by system management because of the multitude and heterogeneity of individual requirements; but a better assessment of the aggregate requirements and related interaction could lead to an acceptable compromise. Presently, hardly any demand assessment takes place at all.

Similarly, matching of supply and demand requires interaction of MEA staff and water users before the cultivation meeting to assess the requirements of the water users, to brief them on the system-level opportunities and constraints, and to compromise on dates and water allocations. Presently, such interaction does not take place at all before the cultivation meeting. Even during the implementation of the seasonal plan such interaction seems to be limited, which actually means that the implementation of the seasonal allocation plan is not properly managed. In areas below the heads of the branch canals no planning of the starting dates seems to take place. As a result, water users feel justified and free to start and complete cultivation at any time they want, and use as much water as they like.

The top management of the Uda Walawe system considered it unfeasible to be flexible over the overall starting dates and staggering between different subsystems. They feared that this would soon lead to no cultivation calendar at all at the expense of tail enders. They may be correct in that the present discipline could not have been introduced in Walawe given the overall motivation of the staff, and the established undisciplined behavior of the head enders during the RVDB management. However, without more interaction between the MEA staff and water users, improvement of the present seasonal allocation decision making seems impossible, even with a rehabilitated system. The MEA head office guides the other Mahaweli systems in the seasonal allocation planning and implementation to a certain degree through the guidelines provided by the Chief Irrigation Engineer. The Uda Walawe system is different from the other systems because it is not supplied from the Mahaweli River and is thus not covered by the overall Seasonal Operating Plan (SOP) for these interrelated systems. No other guidelines are provided for the Uda Walawe system. The project-level staff does not provide guidelines to block-level O&M staff in this respect either.

While some monitoring of the seasonal allocation planning and implementation by block-level and project-level staff takes place, the collected data are neither analyzed nor used for evaluation of the performance of the involved decision makers. The dilapidated physical infrastructure (i.e., the unavailability of required physical controls over water flows) is used as an excuse for nonadherence to the cultivation calendar, while in fact the managerial control for a better adherence to the cultivation calendar is not exercised very much. Without such improved managerial control the rehabilitated physical control structures will be of limited avail and may be broken again.

The head offices of the MEA and the MASL do some performance evaluation of the seasonal allocation planning and implementation through the monthly agricultural progress reports which are sent by the Unit Managers through the block- and project-level hierarchy to the Monitoring and Statistical Unit of the MEA and the Project Monitoring Unit of the MASL. These data focus on agricultural production targets and achievements. These reports are not used for assessing the performance of individuals in the organization with respect to the water delivery aspect of the seasonal plan; water duties are not monitored. And, the monitoring of monthly progress is not useful for assessing the implementation of the seasonal plan, which would require a weekly progress report. The data of the Project Monitoring Unit are used more to highlight certain aspects of different systems to MASL's top management than to monitor regular staff performance. The aforementioned data collection is important for public relations as well because they enable presentations of statistical data on Mahaweli achievements to the outside world.

The MEA head office leaves the responsibility for staff performance evaluation with respect to the seasonal allocation planning and implementation to the Resident Project Manager. The head office also argues that evaluation of adherence to allocated water duties and cultivation calendar is system-specific and difficult. If they do not monitor, analyze, and evaluate the different systems in this respect, an increased management input of the project-level staff is unlikely. As a result, staff is not stimulated to increase its managerial efforts to improve its own performance in this respect and that of its subordinates.

However, further reductions of the cultivation periods by better monitoring and evaluation of the land preparation could lead to additional annual water savings of approximately 9 percent for each week per season. For two weeks per season, the related benefit-cost ratio could be as high as 192, provided that the water saved would be used for additional cultivation (Kikuchi 1990, 2). The related benefits could be as high as "a 3-month-salary-worth bonus...to all employees, or a 12-month-salary-worth bonus to the water management related employees" (ibid., 3).

CHAPTER 4

Allocation Concern: The In-Seasonal Allocation

THE SEASONAL ALLOCATION decisions in terms of the area to be cultivated, cultivation calendar, cropping pattern, the envisaged water duties, and cultivation risks for different subsystems provide the starting points for the in-seasonal allocation decisions. The seasonal allocation decisions — which may be adjusted somewhat during its implementation, i.e., land preparation — are made only once a season, while the in-seasonal allocation decisions are, in principle, made more frequently during the season.

In-seasonal allocation requires assessment of the supply to the system as a whole as well as the supply for different subsystems. This supply assessment can incorporate supply parameters as rainfall in the catchment area, hydrological simulations, actual inflow, storage or level in reservoirs, and storage or level in upstream canals. The frequency of the supply assessment can vary from continuous to ad hoc, and this frequency may depend on the water availability (i.e., abundant, tight or short).

Demand during the season refers to the different requirements for irrigation and nonirrigation purposes of water users, politicians, and staff of involved agencies. These requirements may refer to demand parameters as the areas to be irrigated, the water duties, the cropping pattern, the cultivation calendar, and the related cultivation risks for the different subsystems.

The assessment of demand can be based on such parameters as cultivated area, on-farm vertical percolation and lateral seepage rates, canal seepage rates, expected and actual rainfall in the cultivated command area, canal operational losses, and evaporation from crops. Also, it can be based on the water level at the head of the concerned subsystem, or on requests of water users or politicians. This assessment can be done more or less frequently, which frequency may also vary with the water availability.

Implicitly or explicitly, the water duty refers to the required or expected water delivery performance by the agency during the season in terms of, for example, adequacy, timeliness, responsiveness, predictability, delivery-performance ratio, operation efficiency, and equity.

Requirements with respect to water duty, cropping pattern, cultivation calendar, and related cultivation risks may also implicitly or explicitly represent demand preferences with respect to the input of labor in irrigation and agricultural practices (i.e., potential and preferred farm power), factor substitution (e.g., water for insecticides), and related agricultural productivity. On the other hand, the expected water-delivery performance may implicitly or explicitly incorporate the preferences of the agency staff (e.g., minimization of management input, minimization of accountability towards or interaction with water users and politicians).

Allocation decisions have to be preceded by a matching of supply and demand. If demand is larger than supply for the overall system or for the different subsystems prioritizing may be required among the abovementioned parameters that determine the explicit and implicit demand requirements of the different subsystems. It may also require prioritizing among the different subsystems. The allocation decisions with respect to water duties may be done more or less frequently, which frequency may also vary with the water availability.

The allocation decisions in terms of operational targets for conveyance and distribution for the water flow regulation may be expressed in an explicit or implicit water schedule for the different subsystems, that may or may not incorporate the hydraulic and managerial responsiveness. The responsiveness used may be based on assumptions, experience, feedback, historical data, or a combination of these, possibly combined with some form of statistical analysis.

THE DECISION-MAKING PROCESSES

Supply Assessment

Technical aspects. In-seasonal assessment of the supply to the whole system is done in the same way as the seasonal assessment, and the same data are used. During the season, monitoring of the water level in the Uda Walawe Reservoir is done daily. No data on inflow into the Uda Walawe Reservoir or rainfall in the catchment area are collected.

If, during the season, runoff occurs from the catchment area of the Chandrikawewa Reservoir the water level in the reservoir will rise. If there is a threat that the reservoir will spill, the normally issued maximum discharge in the main canal of approximately 20 m^3/s is reduced. The minimum discharge from the head sluice to the Right Bank main canal in such cases is 11.3 m^3/s to maintain enough head to enable sufficient supply to some distributary channels that take off from the main canal just upstream of the Chandrikawewa Reservoir. If it rains for more than seven days and the irrigation issues to these distributary channels can be stopped, the discharge in the main canal is reduced below 11.3 m^3/s.

The supply available to the branch canal, and distributary and field channels is assessed by the water levels at the head of this canal or these channels. Because most main and branch canals are operated on an on-off basis, the water level upstream of these offtakes is assumed to be rather constant. According to staff involved in the in-seasonal allocation processes, the water level in certain canals appears to fluctuate, especially at the tail end of the canal, because of the frequent obstruction of water flows by farmers. (It should be noted that no measurements have been done in Uda Walawe by MEA or IIMI in this respect.) Because the water level fluctuates more at the tail end of the main and branch canals the assessment of the water level should also occur more often at the tail than at the head of the main canal. No data are available in this respect, however.

Managerial aspects. In-seasonal assessment of the supply to the overall system is done daily by the Technical Officer who is in charge of the headworks. He informs the project-level O&M division regularly about these water levels. He also calculates the daily water balance of the reservoir and thus derives the daily inflow into the reservoir.

If the supply from the reservoir to the main canals has to be changed at the request of the project-level O&M division, he implements these changes at fixed times of the day (at 08.00 hrs or at 16.00 hrs); fixed times are maintained because they make it easier to calculate the water balance of the reservoir.

Demand Assessment

Technical aspects. In-seasonal demand of the overall system and of the different subsystems is assessed mainly through feedback of realized water levels along the main and branch canals and distributary channels.

The demand of the field-channel subsystem is never really assessed, because involvement of agency staff at that level is very limited. The demand of the distributary-channel subsystem is assessed through the water levels along the distributary channel only after farmers complain. Monitoring of the water levels along distributary and field channels is irregular. No measurements of these water levels are done.

The demand of the branch canal or block subsystems is assessed by the water levels along the branch canal — too low water levels occur usually at the tail end of the branch canal — in combination with the requests for more or less water from the block office. The water levels along most branch canals and at the head of the offtaking distributary channels are monitored comparatively regularly. Cross-checking of the water level measurements is not done however. The assessment of demand of the Right Bank and Left Bank main canals is done by an assessment of the water levels along the main canals as well. This demand is thus the resultant of the localized demand assessments for the branch canal, and distributary- and field-channel subsystems. These demand assessments include nonirrigation demands as well (e.g., the demand for water for domestic use).

The demand assessment through water levels is not very accurate but gives some indications. Several reasons cause this inaccuracy. Many structures in the system are broken. The water levels at the head of the distributary and branch canals are often influenced by backwater effects.

Accurate assessments of the related discharge to the downstream subsystem are thus impossible. No calibrations of available staff gauges have taken place, and the theoretical formulae are used instead. This is the case even for the staff gauges at the head of the main canals.

Managerial aspects. After the land preparation has been started in a certain branch canal no assessment of the exact demand takes place within the branch canal. Usually, the head-end distributary channels receive continuous issues for one or two weeks. These continuous issues are considered necessary by the water users, field-level staff, and block-level staff to saturate the dry canal beds and the fields. The actual demand within these canals is not assessed by them however, unless serious irrigation problems are reported by the tail-end farmers.

Similarly, the actual demand of the field channels is usually to get a continuous flow in them because, among other reasons, continuous issues are automatic and require less labor input. Also, continuous issues reduce the need for weedicides, because the inundation impedes the growth of weeds to a large extent. However, because the capacities of the canals are often not sufficient for such continuous issues, rotational allocations have to be implemented, and demand assessment takes place within a framework of scheduled rotations.

After one, two or even four weeks — this varies with the branch canal — a rotation is started among the distributary channels. The actual demand in quantity and duration within the different distributary channels is not assessed during the period of water issue, but may be assessed during the time these channels are scheduled to be closed and complaints come from water users. Then these channels are kept open a little at the requests of individual farmers to issue extra water. These demand assessments are made by the responsible gate tenders (or, in Chandrikawewa block, in the absence of gate tenders, by the Field Assistants). Demand assessment does not take place within the distributaries unless tail-end farmers complain that they do not get enough water. In such instances, the gate tenders may intervene.

Five years ago, such requests by tail enders in longer distributary and field channels led to the development of rotational issues within these channels and these were mutually agreed upon by water users, gate tenders, Field Assistants, and the Technical Officer. Presently, demand assessment takes place only if water users complain.

Similarly, demand assessment for the branch canal as a whole occurs only if complaints of water users cannot be taken care of within the branch canal. For this reason the issues to the Chandrikawewa branch canal are increased for two days a week when water is to be issued to the tail-end distributaries; the duration of the increased discharge has gradually become longer during the past years at the request of water users and field staff.

Matching of Supply and Demand into In-seasonal Allocation Schedules

Technical aspects. The allocations to the branch canals along the main canal are also on a rotational basis during and after the land preparation, except for certain branch canals which receive continuous issues. Thus, the scheduled rotational allocations along the main canal are fixed for the whole season with or without rainfall.

The allocation to the Right Bank main canal is maximal during the whole season, and is reduced only after heavy rainfall (lasting more than seven days) or after the Chandrikawewa Reservoir threatens to spill. This maximum discharge also determines the maximum allocations to Embilipitiya and Chandrikawewa and tail-end blocks. Before the Right Bank main canal reaches the Chandrikawewa Reservoir, the Embilipitiya block has already consumed about 8.5 m^3/s. And the Chandrikawewa branch canal requires and is allocated 3.3 m^3/s which leaves approximately 9.3 m^3/s for the tail-end blocks. These maximum and fixed allocations are not changed frequently. The maximum allocation to the tail-end blocks is kept constant through regular adjustment of the radial gate from the Chandrikawewa Reservoir to the Kachchigala Reservoir for variations in the water level in the Chandrikawewa Reservoir.

However, the allocations to the different distributary channels along the main canal are continuous during the land preparation while after its completion the duration of water issues is reduced by some days. These rotational issues along the main canal are integrated with the rotations to the branch canals along the main canal. Allocations to distributary channels along the branch canals are usually on a continuous basis to the head-end canals at the start of the land preparation, and on a rotational basis after peak requirements of these head-end canals have been saturated, i.e., after 1 to 4 weeks. The duration of this period is different for the different branch canals and blocks. In the tail-end distributary channels of Chandrikawewa, Binkama, Muravasihena, and Angunukolapelessa blocks, the land preparation can be started only after the first month. Because the allocation to the branch canal is fixed over the whole season, this means that the tail enders are allocated water for land preparation only after the rotational deliveries are started.

The scheduled allocations to branch canals are specific in discharge (i.e., derived from the relation between water level and theoretical formulae) and duration, while for the distributary channels it is generally specific in duration only. On the other hand, approximate water levels have been developed over time for all canals (i.e., for branch canals and distributary channels the water levels are scheduled in an approximate way).

Managerial aspects. Some of the aforementioned scheduled rotational allocations (e.g., for Chandrikawewa branch canal) had already been introduced by the RVDB. However, most of them have been initiated and developed by the MEA since 1982. Initial rotations were based on the inaccurate data of the irrigable areas under the different distributary channels, and initiated by the project-level O&M office. These rotations were changed and improved upon over the years, mainly by the Technical Officers of the different blocks. These changes were not aimed so much at an equitable allocation of water over the command area but rather to allocate enough water earlier to the tail ends of the different branch canals and blocks within the allocation limitations set by the size of the Right Bank main canal and the rotational allocation set by the project-level O&M division to the branch canal and distributary channels taking off this main canal. These rotations were also a direct consequence of the enforcement of more adherence to the cultivation seasons and the creation of intermediate seasons in Uda Walawe; the rotational issues ensured that tail enders could start earlier with land preparation and thus could also complete the season earlier.

Every season, the project- and block-level O&M divisions determine the new schedules for rotations among the distributary channels in their areas, and submit these for approval to the Deputy Resident Project Manager, O&M. The latter's approval is only a formality, because these rotations are considered the block office's responsibility. The Technical Officer of the project-level O&M division prepares these rotation schedules for the main system as a whole and for the Mamadala branch canal (because the latter conveys water to different blocks). The rotation schedule for Mamadala branch canal is prepared with the help of the Field Assistant who is responsible for the implementation of the allocation and water flow regulation in this canal. In the different block offices the rotation schedules are prepared by the Technical Officers, who are responsible for the actual implementation under the supervision of the Irrigation Engineer of the block office.

In fact, these Technical Officers and sometimes the Field Assistants (e.g., Mamadala branch canal) of the project and block offices are the de facto system managers of Uda Walawe; they know all the ins and outs of allocation and water flow regulation in their canals, while the engineers usually have very limited knowledge about the related details.

The fixed rotational schedules are based not on organized interaction with the water users along the canal, but on the necessity to get water to the tail end of the canal. Head enders have agreed to these schedules only if they feel that they get ample water for their canal. If they feel that they get too little, they just take more by influencing the gate tenders, demolishing the structures, or blocking the canals. Rotational schedules that have been developed this way, necessarily accommodated the wishes of the head enders to a certain extent. Such processes can be recognized for main and branch canals and distributary and field channels.

The maximum allocations to the different subsystems set by the project-level O&M division have been developed over time, and are, in principle, rather fixed. However, in the past, if the Embilipitiya or the Chandrikawewa block office insisted that they could not deliver water to the tail-end areas with their allocations, the project-level O&M division generally did not refuse extra water to these blocks, because these internal rotations were the responsibility of the block office and they could not and did not want to intervene and thus become responsible for the water delivery within the block as well.

Scheduled rotations within distributary and field channels have been initiated and developed only if this was required to get water to their tail ends. In these canals, the rotations may have been organized by gate tenders (or

Field Assistants) or water users themselves. Water overconsumption by head enders was worsened by the dilapidated physical infrastructure: "Most of the head-end field channels on almost all the distributaries are damaged; equitable distribution is very difficult under these conditions" (IIMI 1990, 23).

These allocation schedules thus represent water allocations developed over time and represent a certain compromise between head-end and tail-end interests, but do not necessarily incorporate any water saving per se. Nobody is really responsible for reducing or limiting water waste within a distributary or field channel or on-farm. Gate tenders are probably involved to some degree in it to cope with the total allocation within their subsystems, but it is not their responsibility. Higher-level staff seldom intervene in the allocation at field level themselves, unless specific problems arise in which case the Field Assistant or Technical Officer may visit the field. However, reduction of water waste has never been their responsibility.

Implementation of the In-seasonal Allocation Schedules

Technical aspects. The scheduled rotational allocations are implemented quite rigidly in terms of duration — discharge or water level has been established in an approximate way anyway — whereby small deviations are possible. In certain branch canals, however, the rotational allocations are implemented less rigidly than in others. In the Chandrikawewa branch canal, for example, the dilapidated nature of the infrastructure, amongst others, has made it gradually more difficult to maintain a fixed rotation with the present discharge. However, in the Moraketiya branch canal, for example, a relatively rigid rotation can still be maintained despite the dilapidated nature of the infrastructure.

While, in general, the overall allocations to Embilipitiya and Chandrikawewa blocks are quite abundant, requests for extra water by these blocks are difficult for the project-level O&M office to refuse. If more water is requested for a branch canal or a distributary channel, the project level O&M office staff can make a field trip to the tail end of the particular canal or channel or they can send their own Field Assistants to operate the particular canal for some time. If they do this, it is done without considering the allocations to the other distributary channels. If such interventions to a particular canal do not lead to a more satisfactory water supply to the different field channels, the O&M division will have to acknowledge a need for an increased allocation.

During and after rainfall the same rotational allocations are pursued with a possible interruption or reduction of the allocation to a distributary, or a branch for some days. In principle, rainfall measuring gauges are available at all block offices. Apart from the Chandrikawewa block, which is equipped with a telephone, little information from the block offices about their requirements after rainfall becomes available. Reduction of the allocation to the branch canal as a whole is initiated by the project-level O&M division only after at least seven days of rainfall; it never happens on the request of a block office.

The allocation to the tail-end block (Angunukolapelessa), is never reduced because it is considered to be permanently water-short. And the issues from the head sluice to the Right Bank main canal are never completely stopped. Even after heavy rainfall the canal system will not be completely closed because of the issue of water for domestic purposes in the command area. The discharge to the tail-end blocks is never increased during higher water levels in the Chandrikawewa Reservoir or during spilling of the reservoirs, partly to protect the small Kachchigala Reservoir from spilling — which would happen because the stoplogs in its sluices are never operated — and partly to prevent claims or arguments for more permanent higher discharges from these tail-end blocks.

During periods of water shortage the duration of the rotational issues to all canals is reduced by one day, to spread the disadvantages in an equitable way. When this was done during the yala 1987 water shortage, it appeared that tail-end blocks were more affected by this measure because of the smaller margin in their usual water allocation.

Because few cross-regulators are provided in the main system, few operational targets for conveyance along the main and branch canals are necessary. For different discharges through the main system, the water levels at important points (e.g., at heads of branch canals, at a point in the Right Bank main canal just upstream of the Chandrikawewa Reservoir where a certain level is required to achieve the required supply to offtaking distributary channels, in the Chandrikawewa Reservoir, downstream of the

Chandrikawewa Reservoir in the Right Bank main canal) are, in principle, different. Feedback from these levels takes place on a daily basis. In addition, the water level in the main canal downstream of the Embilipitiya block is monitored to record its water consumption.

One such operational target for conveyance is the water level in the Chandrikawewa Reservoir. The required discharge for the Right Bank main canal downstream of the Chandrikawewa Reservoir can be issued only if the water level in the reservoir is kept between 61.0 m and 56.6 m above msl. During rainy periods (i.e., more during maha than during yala) a low water level is maintained to enable storage of runoff from the Chandrikawewa's catchment. If the Chandrikawewa Reservoir threatens to spill, the water issues from the head sluice are reduced. For the rest, the intention is to maintain, as much as possible, a constant water level in the reservoir by keeping the allocations from the reservoir (i.e., the outflow), in principle, equal to the inflow. Therefore, the period of three days that the issues to Chandrikawewa branch canal are increased coincides with the closure of the upstream Moraketiya branch canal and some distributary channels.

This constant level allows the storage of runoff from the Chandrikawewa Reservoir catchment "as long as it does not rain longer than two days, and if the inflow from the Uda Walawe Reservoir is not reduced," according to the O&M staff. After these two days, the extra runoff spills back to the Uda Walawe River. In practice, however, actual spillage from the Chandrikawewa Reservoir seldom occurs; it happened only once in the last three years. As indicated above, the operational target for conveyance in the Kachchigala Tank after rainfall is the normal level; no storage of rainfall runoff in the small Kachchigala Reservoir is envisaged.

In the absence of cross-regulators, operational targets for conveyance in other canals are mostly the minimum required head at the tail-end distributary channels during the time they receive water. These targets are more a part of the developed rotational schedule than a target by themselves.

Managerial aspects. The rigid implementation of the scheduled rotational allocations depends to a large extent on the management inputs of the responsible staff members. The individual motivations of higher-level staff play an important role in explaining the differences in implementation of the schedules between Chandrikawewa and Moraketiya. Also, in the tail-end Angunukolapelessa block, for example, an active and motivated Field Assistant of the project-level O&M division developed and implemented rotational allocations which improved the water situation considerably and even saved a large part of the crop during the drought of maha 1986/87 (Somaratne 1989). Presently, the responsibility for these allocations has been given back to the Angunukolapelessa block office which has led to degradation of the developed scheduled rotational allocations and excessive allocations for domestic use in the off-seasons; an approach of minimization of complaints by water users with the least possible management inputs.

Generally, the Technical Officers in Uda Walawe prefer rigid rotations; maintaining control while implementing the schedules in a flexible way requires more management inputs, because it may lead to problems in downstream water levels in the branch canals. This preference for rigidity itself demonstrates a problematic interaction of staff with the water users. This problematic interaction was confirmed by interviewed Technical Officers, who said water users were obstructing flows in the canals, were stealing water at night, etc. Many of them felt that the dilapidated nature of the system stimulated to a certain extent this behavior of the water users.

Despite the preferred rigid rotations, requests for extra water issues have to be accommodated regularly. Within the distributary and field-channel sub-systems the gate tenders and Field Assistants are free to change the rotational issues. Monitoring by them is infrequent; IIMI research found that this frequency varied from "never" to "three times a week." Their activities are limited to reacting to complaints by water users. Usually, Technical Officers do not actively monitor these rotations, but are aware of their existence. The Irrigation Engineer and Engineering Assistants of the block office are usually unaware of such rotations or of their nature.

Extra water issues to the distributary channel subsystems usually have to be approved by the Technical Officer or Field Assistant responsible for the scheduled rotations. In certain canals, the needed flexibility is realized by altering the quantity of the allocated discharge, while in others the duration of the allocation to a certain distributary channel is extended. The final allocation decisions in this respect are, in principle, made by the responsible Technical Officer or Field Assistants, but in practice the gate tenders often make the decisions. This also depends on the individual motivation of the involved staff.

The implementation of the allocation schedules along the main canals is quite fixed in terms of duration, but rather flexible in quantity; the responsible gate tenders usually make the final decisions in this respect.

At block level nobody cares for possible water saving at this time and it is up to the gate tenders to decide to close the gate or not. Only at the level of the main system does the project-level O&M division have a routine of reducing issues to branch canals if it rains longer than seven days. However, at project level there are no strong interests to try to improve water saving in this respect. The O&M division is keen in preventing spilling from the Chandrikawewa Reservoir as long as the Uda Walawe Reservoir itself is not spilling. They also take care in protecting Kachchigala and keeping the discharge to the tail-end blocks constant. The result is a rather successful storage of the runoff from the Chandrikawewa catchment area despite its limited effective storage capacity.

The operational targets for conveyance are established, monitored, and evaluated by the Technical Officer or Field Assistant responsible for conveyance along a specific canal. Conveyance to the tail end of the main system and in several of the branch canals requires regular checking of farmer made obstructions in canals, especially during water-short situations. However, the project-level O&M division corrects some of these farmer made obstructions only before the start of the season. The conveyance targets have become routinized over time and are fixed, i.e., they do not provide for any variations in water flow, as, for example, after rainfall.

A special gate tender is responsible for the daily realization of the operational targets for the Chandrikawewa Reservoir; he is responsible for the operation of the offtakes to the Chandrikawewa branch canal, Kachchigala Reservoir, and the offtakes from Kachchigala to Mamadala branch and the Right Bank main canal. Appointing one and the same gate tender in this respect guarantees a certain mutual adaptation of the different operational targets for conveyance. The performance of this gate tender and the operational targets are regularly monitored by the Technical Officer of the O&M division.

Mutual Adaptation of Technical and Managerial Aspects

Gate tenders along main and branch canals have no real responsibility for monitoring and evaluating the allocations from these canals. In principle, the gate tenders responsible for distributary and field channels are also responsible for realizing necessary internal rotations. However, they have no responsibility for the allocation within field channels and on-farm. If more water is required or requested it is allocated; this practice has been the same before and after 1982. Also, block-level staff have no responsibilities to save water; allocations to the overall branch canals enforce some limitations as, for example, in the rotations. These overall allocations are derived from the limitations in discharge capacity of the main canal, within which limits the project-level O&M division has successfully enforced some additional, but relatively minor limitations in duration of rotational allocations.

Requirements of the water users tend to be continuous and abundant discharges. Because the capacities of the canals are not sufficient to provide all distributary channels along the different branch canals with such continuous and abundant discharges, two things can happen. The head-end distributary channels can get such a preferred water service at the expense of the tail-end distributaries and blocks. The latter will receive too little water or no water at all. This is what basically happened during the RVDB management, and, to a certain extent, is still continuing in view of the tail ends that have never received water to date.

The agency can limit the water use by the head enders, and thus not comply completely with their preferred water requirements, and implement rotational allocations to the tail-end distributary channels to ensure a certain supply to these canals. RVDB started some rotational issues before 1982, but most of the rotational allocations have been introduced by MEA.

The rotational issues introduced by MEA were oriented at getting water to the tail-end distributary channels of branch canals, and less at realizing equitable allocation between distributary channels. A more refined demand assessment within these basic rotational allocations to reduce water wastage in the head-end canals, has never been actively pursued by MEA or RVDB staff, unless by some motivated individual staff members. Most staff members react only to complaints of the water users.

The MEA staff argue that the dilapidated physical infrastructure prevents further improvements in water duties and cropping intensities, and this is correct to a certain extent. To a large extent, however, the physical infrastructure is used as an excuse for minimizing their management input in further improvements to match supply and demand, i.e., to match the allocations better with the actual demand of the different subsystems. Especially, further refinements in demand assessment are neglected by all staff levels. While preferred water requirements may be continuous and abundant water issues, water users do not actually use the allocated quantities completely and opportunities for water savings do exist.This requires increased management inputs by the different staff levels to increase the interaction with water users and between different hierarchical staff levels. However, higher MEA staff do not perceive this as their responsibility.

Presently, very limited interaction takes place between O&M staff at project level and those at block level and between O&M staff at block level and those at field level; higher-level staff do not guide, monitor, or evaluate lower-level staff with respect to their job performance but they minimize the number of complaints to higher-level staff. Consequently, few incentives exist for lower-level staff to increase their performance in this respect and, to a large extent, the personal motivation and integrity of the involved individuals determine how well the rotational schedules match the actual requirements, or how much water is wasted. To a larger extent, improved performance depends on the values that the institution, i.e., MEA as a whole, attributes to improved performance. In 1982, MEA clearly gave a push in this direction — under an indirect pressure to prove its managing capacity is better than RVDB in view of possible rehabilitation funds from ADB. This brought the same individual Technical Officers who were responsible during the RVDB period, to increase the match between water issues and requirements, with a system-wide water saving of approximately 12 percent within one year's time. Further improvements will require more management inputs and efforts from the different staff levels which will happen only if MEA as a whole attributes value to such improvements. However, after the ADB funds became available in 1984 further improvements were not pursued anymore by MEA.

The limitation of the present demand assessment to the passive practice of reacting to water user's complaints is, to a certain extent, reinforced by the present delegation of localized allocation responsibility to block and branch-canal levels. At these levels, no responsibility exists other than satisfying water requirements within their areas to reduce the complaints from water users. Objectives like the reduction of water use by the head-end distributary channels and the block as a whole are conflicting with their interest in reducing water user's complaints with minimal management input. Saving water is in the interest of the tail-end blocks only, and is thus represented only to some degree in the allocation processes by the project-level O&M office.

CHAPTER 5

Water Flow Regulation Concern

THE OPERATIONAL TARGETS for distribution and conveyance that have evolved from the in-seasonal allocation processes constitute the starting points for the water flow regulation decision making. These targets encompass requirements with respect to the timing, duration, and size of water flows to different subsystems (i.e. water flow delivery), and related water flow regulation. On the other hand, the allocation decision making has to consider the requirements of the hydraulical and related managerial aspects of water flow regulation.

Water flow regulation requires contributions of staff for operation of the different control structures and related communication. The preparation and calculation of these contributions can reduce the occurrence of inappropriate operational methods, losses, and unnecessary delays in water delivery. The costs of preparation and calculation have to be outweighed by increased water flow regulation and delivery efficiencies — especially if iterative processes occur as for water flow regulation and delivery, preparation and calculation will be useful.

Preparation and calculation of water flow regulation refer mainly to operational methods of control structures and possibly to an operational plan for integrated and coordinated operation of different structures along canals.

Operational methods (or procedures) refer to the timing, frequency, and size of gate settings of individual control structures to realize flow changes through these structures. These operational methods can vary for different flow conditions in a canal, as for example, filling and emptying of canals, flow and level variations, little or heavy rainfall, and emergency shut-down. The operational method can incorporate different parameters like upstream and downstream water levels, backwater effects, and level-discharge curves. These curves can be assessed by experience, through theoretical formulae, or through calibration. The operational method can be determined as and when required, and at different hierarchical levels. The operational methods may or may not be laid down in an operational plan.

Such an operational plan will indicate how and at what times the control structures in a system or subsystem have to be operated during a certain period. These operational plans can be made as frequently as is necessary, and at different hierarchical levels. Different types of structures (e.g., intake works, cross-regulators, offtakes, turnouts) may or may not be covered by such a plan.

After the preparatory stage of the water flow regulation is completed the division of water flow regulation activities among the different staff can be done through more or less specific instructions, and may or may not be adapted to the actual time required or spent.

THE DECISION-MAKING PROCESSES

Technical Aspects

The operational target for the distribution from Uda Walawe Reservoir through the head sluice and power station to the Right Bank main canal is expressed in discharge. The meters in the head sluice and the powerhouse do not function properly. Consequently, the corresponding openings of the head sluice and powerhouse are determined entirely by the water level at the head of the Right Bank main canal.

This downstream water level is measured by means of a staff gauge. This assessment is less than accurate because of the occurring backwater effects upstream of the Timbolketiya siphon[5] and because the staff gauge is

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[5] The water fluctuations upstream of this siphon, which led to regular overflowing of the canal bund upstream of the siphon, have been reduced by the removal of part of the trash rack at the entrance to the siphon.

not calibrated regularly. These water levels are reported daily to the project-level O&M division by the Technical Officer of the head works.

The times of realizing changes in water issues from the reservoir are standardized, at 08.00 hrs and 16.00 hrs. There are no given requirements regarding undesirable timing of changes in issues to the main canal, as for example, changes in the afternoon which will cause water level changes at night further downstream in the main canal. The absence of gated cross-regulators to be operated after such changes in releases from the reservoir also makes such requirements less necessary. Because of the fixed times of operation, no feedback occurs regarding the exact time of realization of a change in water releases to the main canal. A change in discharge is realized through a change (which is not gradual) of the head-sluice openings, which operation is electrically powered. A manual backup provision exists for possible power breakdowns.

The operational targets for the conveyance through the Right Bank main canal upstream of the Chandrikawewa Reservoir are the minimum control water level at the offtakes to the distributary channels just upstream of the Chandrikawewa Reservoir. These water levels are maintained by allocating at least 11.3 m^3/s from the head sluice. Constant water levels along this canal reach are further facilitated by rotational allocation to the distributary channels and the Moraketiya branch canal. No operational methods or plans exist for conveyance along this canal reach because no cross-regulators are provided.

Operational methods of the offtakes along this reach of the main canal are done by gate tenders of the O&M division. Timing of these operations is determined by the rotational allocation schedules.The actual duration and quantity of the discharges to these different distributary channels, in principle, conform to the instructions of the O&M division. In actual practice, because these allocations are quite abundant, pressure from the water users for changes is limited and the actual allocations seem to be quite in line with the scheduled allocations in terms of duration. No strict monitoring of these allocations is done however. Several of the offtake structures cannot be properly operated. If the discharge in the main canal is lower, the gate openings of the offtakes are officially supposed to be lowered in line with the theoretical rating curves. The gate tenders are instructed to lower the gate with, for example, three turns of the gate key, but in actual practice, the gate tenders are quite free to adjust the quantities to the requirements.

The operational target for conveyance through the Chandrikawewa Reservoir is to maintain a water level of 5.94 m (note: this level is not in m above msl). The factors that determine this are the average required discharge to the Chandrikawewa branch canal of 4.2 m^3/s, which can be realized with the Chandrikawewa Reservoir water level between 5.48 to 8.53 m, and the required minimum level. The target level of 5.94 m allows a safety margin of 0.50 m for interruptions of inflow, and storage of runoff from the reservoir's own catchment area. This target is maintained primarily by allocation scheduling; the inflow and outflow of the reservoir are scheduled to be in balance always. During maha, this level is well-maintained; during yala less, because of the reduced rainfall probability. In addition, a minimum water level of 56.6 m above msl is required to be able to issue water to the Kachchigala Tank.

The operational method of the radial gate from the Chandrikawewa Reservoir to the Kachchigala Reservoir is determined by the water level in the Chandrikawewa Reservoir. The discharge to the tail end is kept constant at 9.4 m^3/s. The opening of the gate is determined by means of a rating curve, which has been established during construction. The gate operator is considered to be able to derive from the threads of the cables of the radial gate, what the size of opening of the radial gate is. The water level immediately downstream of this radial gate is turbulent, and it is hard to understand how this rating curve should have been established reliably, other than on a theoretical basis. Thus, the issues to the Kachchigala Reservoir cannot be more than approximate.

After rainfall, the radial gate has to be operated to keep this discharge constant. In actual practice, the gate operator maintains these water levels in the Kachchigala Reservoir very well, and spilling from Kachchigala never occurs. The water level in the Kachchigala Reservoir is kept constant to prevent spilling and breaking of the reservoir bund and to achieve constant issues to the Mamadala branch canal and the tail end of the Right Bank main canal. The sluice from the Kachchigala Reservoir to the tail is made of wooden planks. This structure is therefore difficult to operate, and in actual practice it is used as a fixed weir. The gate setting is never changed, apart from a correction or repair at the start of the cultivation season.

In the tail end of the Right Bank main canal, several gated cross-regulators are provided. Because the discharge is kept constant the gates are not used and the cross-regulators function as fixed weirs. Apart from these weirs there are some farmer constructed cross-regulators for offtaking canals which were originally designed for subsidiary field crops only, but where rice is cultivated. They are tolerated by the O&M division. To get water to the tail end of the system a rotational allocation is practiced along this tail-end reach of the Right Bank main canal. Especially during drier periods, water users try to block the canals, and try to block the openings of the cross-regulators used as fixed weirs.

Refilling of the Right Bank main canal and reservoirs at the beginning of the season is done by starting water issues five days earlier. The main canal system is never completely empty because in the off-seasons a constant discharge of 3.1 m^3/s is maintained for domestic purposes in the whole command area.

The operational targets for distribution from the main canal into the branch canal and distributary channels are expressed in water levels at the head of the respective canals. The required timing of the corresponding gate settings is in principle provided by the operational targets for distribution, i.e., the rotational allocations. The required frequency of adjustment and size of gate settings are not specified for these offtakes for different upstream water levels, but are merely a consequence of water levels at the head of the canal.

The operational targets for conveyance along the branch canal and distributary channels do not exist. As far as gated (i.e., with slide gates or stoplogs) cross-regulators exist they are not operated by the agency, but used as fixed weirs. Instead, similar to the main system, conveyance along the canals is ensured by rotational allocations. In several branch canals, water users frequently try to influence the water levels by obstructing the canal in more or less permanent ways. To ensure conveyance to the tail end (for example, in the Moraketiya branch canal) the field staff have to clean these obstructions frequently.

Within distributary channels the distribution and conveyance along the canal appear to be even more problematic. Many direct offtakes from the distributary channel exist, and the water level along the canal is manipulated even more frequently by means of "temporary and artificial stick dams erected across the distributary canal" (IIMI 1990, 67). These structures are constructed frequently by head-end water users, and broken almost as frequently by tail-end water users or sometimes by gate tenders.

No operational plans in terms of integration of the operations of the different offtaking and cross-regulating structures along all canals in time, size, and frequency of adjustment of gate settings are made at all in Uda Walawe. Such operational plans are not needed because all cross-regulators are used as fixed structures and integration of the operation of the different offtakes has been incorporated and gradually improved by the rotational allocations.

Managerial Aspects

Issues from the head sluice. The Chief Irrigation Engineer of the project-level O&M division requests the Technical Officer of the head works to release specific allocations to the Right Bank main canal, and thus supplies him with the operational targets for the head sluice. The Technical Officer of the head works always issues the requested discharge at the times fixed by the O&M division.

Establishment of operational methods for conveyance and distribution along the Right Bank main canal. Water flow regulation decision making for this canal is thus limited to the operational methods of the offtake structures along the main canal which conform to the in-seasonal allocation schedules. However, these in-seasonal allocation schedules themselves have developed gradually over time from the water flow regulation requirements for this canal reach, and allocation and water flow regulation are thus mutually well-attuned.

After a change in release from the head sluice, the Technical Officer of the O&M division informs the three gate tenders along the Right Bank main canal under his supervision and instructs them about the approximate new gate settings. He also informs the gate tender, who is in charge of the operation of the offtakes from the Chandrikawewa and Kachchigala Reservoirs, and instructs him about the required gate settings and approximate water levels. The Technical Officer regularly monitors the work of these gate tenders with respect to the realized allocations and water levels.

However, as the discharge in the Right Bank main canal is rather constant over the season this type of instruction is not given frequently. It is only after rainfall that the Technical Officer gives specific instructions to the gate tender responsible for the sluices of the Chandrikawewa and Kachchigala reservoirs about the required operations and monitors proper execution. Between the Uda Walawe and Kachchigala reservoirs, guidance, monitoring, and evaluation are done entirely by the Technical Officer, assisted by one Field Assistant for daily monitoring. This Field Assistant, the gate tenders, and the Technical Officer have to sign the attendance register in the project-level O&M office in Embilipitiya.

Downstream of the Chandrikawewa Reservoir the supervision of two gate tenders is done by two Field Assistants, who are themselves guided, monitored, and evaluated by the Technical Officer of the project-level O&M division. The monitoring by the Technical Officer of the O&M division at this canal reach is less-intensive because of the long distance to the project-level office. These Field Assistants and gate tenders have to sign an attendance register daily in a suboffice of the project-level O&M division in Uswewa. Because the discharge allocated to the downstream command area of the Kachchigala Reservoir never changes during the season, the local O&M staff have no need to be informed by the Technical Officer about discharge changes.

Establishment of operational methods for conveyance and distribution along the branch canals. Because allocation and water flow regulation are the responsibility of the Technical Officers, they make sure that within these canals the two areas of concern are mutually attuned to each other. The rotational allocation schedules incorporate the water flow regulation requirements of the branch canals to the main canal. Provisions like gated cross-regulators for influencing the conveyance through the canal are not used as such, but used as fixed weirs. In the main canal, the Chandrikawewa and Kachchigala reservoirs still require some water flow regulation decision making, but in the branch canals such reservoirs and sluices are an exception.

Thus, the water flow regulation for the branch canals is not a separate decision-making process anymore, but part of the allocation decision making. Water flow regulation in all these branch canals is the responsibility of the Technical Officers and Field Assistants of the block office. It is only in the Mamadala branch canal which commands two different blocks, that the water flow regulation and allocation along the branch canal are the responsibility of the more neutral project-level O&M division. Operation of the offtakes and cleaning of farmer built cross-regulators are done by the gate tenders. Monitoring of the proper execution of the allocation schedules and, simultaneously, the water flow regulation is done by Technical Officers and Field Assistants. These gate tenders, Field Assistants and Technical Officers have to sign an attendance register in the block office.

Establishment of operational methods for conveyance and distribution along the distributary and field channels. The allocation and water flow regulation responsibilities are delegated to the Field Assistants or gate tenders responsible for a particular distributary channel. Allocation and water flow regulation are often not scheduled, and takes place ad hoc. Often, water users themselves have taken over these tasks. If the gate tenders or Field Assistants are involved they usually take care that allocation and water flow regulation are mutually adapted and that the tail-end field canals receive water. If water users themselves operate these canals, conflicts between head-end and tail-end water users may lead to less mutual adaptation between allocation and water flow regulation. Some irregular monitoring of the gate tenders and Field Assistants by the supervising Technical Officer takes place. The responsible gate tender or Field Assistants have to sign the attendance register in the block office.

Mutual Adaptation of the Technical and Managerial Aspects

The original design of the main and branch canals in the Uda Walawe irrigation systems assumed the cultivation of subsidiary field crops in large parts of the command area. As a result of the cultivation of rice instead of subsidiary field crops, rotational water issues are required to get water to the tail-end reaches of these canals. Apart from these rotational issues, no other provisions exist in Uda Walawe for water flow regulation in these canals, except for the sluices from the Chandrikawewa and Kachchigala reservoirs.

In practice, this means that main and branch canals are operated with fixed flows, even after rainfall or during water shortage.

The adherence or possible adjustments to these rotational issues are the responsibility of one staff member, the Technical Officer or, in some instances, the Field Assistant. Under his guidance, monitoring and evaluation of the water flow regulation within the canal under his purview has been coordinated through appropriate rotational allocations. This organizational setup of making a higher-level staff member responsible for the water flow regulation within a particular canal ensures coordination of the water flow regulation along this canal and is, in that respect, a sound managerial method of water flow regulation.

Use of the existing gated cross-regulators as fixed weirs has reduced the management inputs for water flow regulation required from the gate tenders, the Field Assistant, and the Technical Officers. However, a disadvantage of this practice is the reduced possibility of using the rainfall more effectively. Moreover, it necessarily makes the in-seasonal allocations less flexible.

The rotational allocations have been developed to realize water issues to the tail end, based on water flow regulation requirements with provisions for average water consumption along the different canal reaches, and overconsumption in the head ends. It does not take into consideration flexibility with respect to the in-seasonal allocation which has led to interference by water users in the water flow regulation through the blocking of canals and the building of provisional cross-regulators. Such interferences are due to inflexible allocation decision making rather than water flow regulation anomalies.

These interferences are partly a logical consequence of the lack of flexibility in the design canal capacities for the areas that were planned for subsidiary field crops, and are partly a direct consequence of the lack of flexibility in the rotational allocations.

The use of attendance registers for the project- and block-level O&M staff may lead to some managerial control over staff, but it does not lead to more management input by such staff. The present water flow regulation does not require staff to be present very frequently. One relatively active Technical Officer suggested that trust between him and the gate tenders was very important, and that made him decide to abandon the attendance register.

CHAPTER 6

System Utilization: Opportunities for Improvement

IN THIS CHAPTER it is assumed that the Mahaweli Economic Agency (MEA) has the ambition to improve the water delivery performance and productivity in the Uda Walawe system to enable, for example, further increases in cropping intensities in the existing command area. To achieve this it is assumed that a higher level of perfection of the seasonal and in-seasonal allocation or water flow regulation decision making is required as well. No indications can be given as to which of these opportunities deserves priority, because no comparative data regarding the relation between system performance and the levels of perfection of the different key decisions have been collected as yet. In the absence of such normative values, the given opportunities could be used by the MEA as a kind of checklist.

A higher level of perfection does not necessarily lead to a better outcome. In certain cases it may be necessary to increase the quality of the decision (e.g., a better assessment of the water level over a measuring weir) rather than the level of perfection. This means that even with "perfect" feedback, foreseeing, and integration the decision maker can make a wrong decision. Similarly, a good decision that evolves from a low level of perfection may be very cost-effective.

Several opportunities for improvement given in this chapter also apply to other MEA systems. However, the Walawe system is a special system within MEA in terms of the comparatively less support it receives from the head office, and thus the author does not claim that all of these management recommendations will be valid for other MEA systems as well.

SEASONAL ALLOCATION PLANNING

Present Management Performance: The Level of Perfection

In this section, the overall level of perfection of the seasonal allocation decision-making processes is classified as low (20-40%). It conforms to the classification in the annex. It must be noted that classification as very low or high is not a judgement in itself as a very low level of perfection may lead to a satisfactory performance and may thus be cost-effective. However, in case the performance is considered unsatisfactory, a higher level of perfection is assumed to lead to a higher performance. The quantitative judgement is based on the following criteria and the classification in Table 1 on page 13.

Feedback. No feedback is required regarding the irrigable area, because this area is approximately 100 percent of the command area for every season. The feedback MEA receives with respect to the appropriateness of its seasonal allocation decisions relates to the cultivation calendar for the overall system and cropping pattern. The feedback MEA receives on the cultivation calendar in the cultivation meetings is of a very unreliable nature, given that the water users are often arguing against MEA for the sake of argument only, because their attendance at the cultivation meetings does not serve any useful purpose other than being informed of the seasonal plan decisions. Their complaints are ignored by MEA completely: A very low level of perfection (0-20%).

More feedback on the cropping pattern and varieties grown is obtained through the lists of the Unit Managers, the resulting crop planning summaries, and the regular farmer training classes. Assuming at least some gross reliability this feedback is of an average level of perfection (40-60%).

MEA has not yet tried to obtain feedback on the appropriateness of the envisaged water duties for the different subsystems, the related trade-offs with areas to be irrigated, and cultivation risks. Apart from complaints during the season, the only feedback the O&M division gets on the reliability of its estimates of the water duty are the seasonal totals of the issues from the head sluices to the branch canals, insofar as these measurements are reliable: A very low level of perfection (0-20%).

The MEA's head office does not monitor the reliability and quality of the seasonal allocation plan either. It does monitor the seasonal allocation decisions from the head sluices to the main canals, but does not know the related decisions within the command area with respect to the water delivery. No evaluation and analysis of these data take place unless serious problems occur: A low level of perfection (20-40%).

Foreseeing. Approximate assessments are made of supply and demand for the whole season. The cultivation risk is not quantified. The rule of thumb determining adequacy of supply for the whole command area has been established in an approximate way and by experience and is applied as such: A low level of perfection (20-40%).

The seasonal allocation plan of MEA does not foresee the probable cultivation calendar and cropping pattern within the blocks and branch canals; it only foresees the allocation to these subsystems. As a result no seasonal allocation plans exist for a large part of the command area: A very low level of perfection (0-20%).

The influence of the present cultivation calendar on future allocation decision-making processes is taken into account; a serious strategy with respect to maintaining or increasing the adherence of the water users to the cultivation calendar for the overall system is pursued: A high level of perfection (60-80%). However, within the branch canals and blocks such strategies do not exist at all. With respect to water duties and cropping patterns (e.g., subsidiary field crops in well-drained soils) such strategies do not exist: A very low level of perfection (0-20%). There is however a strategy of minimizing the cultivation risk to improve the confidence of the water users: A low level of perfection (20-40%).

Integration. The cultivation calendar is matched with maintenance plans. The cultivation calendar is also integrated to a certain degree with the official annual and seasonal agricultural implementation plans: An average level of perfection (40-60%).

However, the related cultivation plans of the water users in terms of the cultivation calendar and cropping pattern are in general not considered. Neither does the plan integrate the water flow regulation requirements (i.e., staggered land preparation) at block and field levels to get the water to the tail-end distributary channels. As a result the water users in return enforce some incorporation of their interests in the actual implementation of the cultivation calendar within the starting dates set for the overall system. This enforcement also influences directly the extension of the season beyond the dates set by MEA: A very low level of perfection (0-20%).

The water duties proposed by the O&M division integrate the requirements of the water users to a certain extent, because these water duties have been established in the past, to a certain extent, in a demand-driven mode with limited interventions by MEA staff within the branch canal and distributary channels. As a result of limited agency interventions, these water duties do not really represent the interests or cultivation plans of tail enders or the farmers in the areas that do not get any water at all: A low level of perfection (20-40%).

Systematics. Clear and specified rules exist in Sri Lanka regarding the seasonal decision-making processes. The cultivation committee is authorized to decide "the dates of the commencement of cultivation operations, including ploughing, sowing and reaping" (Government of Ceylon 1968, 7). However, apart from this general authorization no specific rules have been developed for the Uda Walawe system with respect to the steps to be taken to reach that decision.

For the systems managed by the Irrigation Department and the Irrigation Management Division such steps have been defined to a certain extent in Ministry Circular No. 121 of 31 May 1982 (Ministry of Lands and Land Development 1982) and others. If these rules would determine to a large extent the actual pattern of the seasonal allocation processes in Uda Walawe, the decision making could be classified to be of an average level of perfection (40-60%).

Despite this absence of formal rules with respect to the seasonal allocation decision making in the Uda Walawe system, the decision making for the seasonal allocation to the different blocks has been systemized to a large extent. The cultivation meetings play a minor role in the seasonal allocation, but the pattern of decision making is rather fixed; the O&M and Agricultural divisions do the majority of the decision making, and the Resident Project Manager makes the final decision. The water users play a minor role: An average level of perfection (40-60%).

Below the head sluices to the different branch canals, this decision making is less fixed. The seasonal allocation is more dependent on pressures of head enders with less interventions of the MEA staff. The actual allocation planning follows a certain routine which has been established over time: A very low level of perfection (0-20%).

In the absence of more fundamental management research to determine the relative importance of the aforementioned different aspects of the seasonal allocation planning, it is difficult to determine an overall level of perfection in another way than by averaging the above values. Such averaging leads to an overall level of perfection of the seasonal allocation decision-making processes that can be classified roughly as low (20-40%).

Opportunities for Improvement: Requirements with Respect to the Processes

The overall level of perfection of the seasonal allocation decision making was classified as low (20-40%). Here and in the following section it will be assumed that MEA wants to improve this to an average level (40-60%). In certain cases it may be required that the quality of the decision making should increase as, for example, in the case of the reliability of historical water level data as this reliability is affected by the dilapidated nature of the physical infrastructure.

Technical aspects. To reach an average level of perfection (40-60%), the supply assessment should incorporate an assessment of the inflow into the reservoir and the rainfall in the catchment area. Cultivation risks should be quantified. Also, the demand assessment and matching of supply and demand should consider at least the cultivation plans and decisions of the water users within the different blocks and branch canals. Requirements with respect to staggered cultivation between and within blocks and branch canals should be assessed as well, in view of the limited discharge capacity of the main canal.

In addition, the assessment of demand with respect to water duties for important subsystems (e.g., main and branch canals and distributary channels) through historical water level data, for both water abundant and scarce situations, should get more serious attention. This will increase the quality of the decisions, and indirectly the level of perfection because more reliable feedback data will reduce the chances of ad hoc seasonal allocation decision making through the increased clarity and reliability of the options and risks. For that purpose, it will be required to make the water level readings more reliable by at least one, but preferably more regular calibrations (e.g., every two or three years, depending on the siltation in a specific location).

For an average level of perfection (40-60%) the consequences of each season's allocation decisions on future expectations should continue to be considered to some degree, if a more flexible seasonal allocation planning would be implemented.

Performance evaluation will require registration of the final allocation plans for main and branch canal and distributary channel subsystems and comparison with earlier seasons to evaluate their quality. The progress of implementation of the seasonal allocation plan should be monitored and evaluated weekly.

Managerial aspects. If MEA wants to improve its water delivery performance, it will have to determine the way it is able to interact more effectively with the water users, and possibly with the involved politicians, regarding the seasonal allocation decisions.

This requires decisions about the type of consultations required in the preparatory stages regarding the water user preferences with respect to water duties and cultivation risks, crops, cultivation calendar, and cultivated area.

Such decisions also require efforts to identify and organize ways to effectively communicate with the water users of specific subsystems; it requires the identification of representatives of the subsystems who will not only represent their individual interests, but also those of the tail enders, for example. If outside facilitators like Institutional Organizers, or nongovernmental organizations, are attracted it is important that the MEA staff will feel committed to the tasks of the facilitators and the evolving water user groups. In Kirindi Oya, for example, it could be seen that the outside facilitators (i.e., the Irrigation Management Division), because of lack of cooperation of the agency staff, started to justify their presence to the water users by blaming the agency staff. This approach may work in the short term, but ultimately it will not lead to sustainable interactive processes between the agency and water users (Nijman 1991b).

Interaction with water users is especially important during the preparation phase of the seasonal allocation decision making; at that stage the water users can be consulted about their requirements and can be briefed about the trade-offs that have to be made between cropping pattern and calendar or between different subsystems. Involvement during these stages can thus reduce divergent expectations of the different interest groups at the time of decision making, i.e., the cultivation meeting. The acceptability of the final decisions to the water users would be much higher if their representatives would be more involved in the whole process, and if water users become better aware of the priorities to be made and criteria used with respect to their different preferences.

For an average level of perfection (40-60%), more interaction with water users or their representatives and possibly the involved politicians is required during the preparation stage of the seasonal decision making.

For a high level of perfection (60-80%), MEA should incorporate important influencing factors of the decision making by these groups at distributary channel level. Interaction between MEA and the water users should relate to the cultivation calendar, cropping pattern, and water duties for the season in each distributary channel.

The interaction with different interest groups should not only focus on the cultivation calendar, cropping pattern, and irrigable areas but also incorporate the related cultivation risks for an average level of perfection (40-60%), and the water duties for a high level of perfection (60-80%). This will make the different groups more aware of the different trade-offs and will compromise between them as well. The different steps involved in the decision making, if any, and the criteria that apply to the decision making have to be clear to the participants at an early stage. Criteria that could be used are:

* There should be correlation between the stagger systems of the different subsystems to match, as far as possible, the canal capacities, the optimal cultivation periods of the different subsystems, and any differing preferences.

* There may be priorities for certain subsystems regarding cultivation calendar, crops, area to be cultivated, water duties, and related cultivation risks.

* There should be seasonal rotation of benefits and preferences among the subsystems. For example, if one subsystem gets priority for this season another subsystem should get it in the next season.

* Water duties required for the different subsystems and water delivery or sharing methods that may be necessary should be set.

* Fees that have to be paid if the clients request extra water (over the specified quantity) should be set.

During the land preparation (i.e., implementation of the seasonal allocation plan), the interaction with water users required to evaluate the progress of the land preparation and possible adjustments of the seasonal plan should be regular (e.g., weekly) for an average level of perfection (40-60%), or frequent (e.g., daily) for a high level of perfection (60-80%).

MEA will have to consider to some degree (40-60%), or fully (60-80%), the consequences of the allocations for this season for the future expectations. A more explicit and active strategy incorporating priorities with respect to the different allocation parameters (i.e., irrigable area, water duties, cropping pattern, cultivation calendar, and cultivation risks) will be required for an average level of perfection (40-60%). This will enable a reduction in ad hoc decision making. For a high level of perfection (60-80%), an explicit and coherent strategy should exist for all important subsystems.

In addition, the head office of MEA should pay more attention to the processes of the seasonal allocation decision making. Opportunities for guidance, monitoring and evaluation of its staff in these complicated and often semipolitical processes are not the only advantages, but increased attention will give more status to the managerial aspects and stimulate its staff to perform better in this aspect of their profession.

An average level of perfection (40-60%) will require performance evaluation by the head office through registration of the final seasonal plan, and comparison with earlier seasons to assess its quality.

Last, but certainly not least, an average level of perfection (40-60%) will require weekly monitoring and evaluation of the actual implementation of the seasonal plan at block and project level. After completion of the land preparation an evaluation report on the realized implementation of the seasonal allocation plan should be sent to the project office and head office. For a high level of perfection (60-80%), this monitoring should become more frequent, and weekly reports on the progress of monitoring and evaluation should be sent to the head office. The aforementioned performance evaluation should lead not only to filing of forms, but to feedback to the lower hierarchical levels about the performance assessment. This performance evaluation is a basic requirement to build up some responsibility and accountability at different staff levels with respect to the seasonal allocation decisions and their implementation. Such systematic accountability is presently absent.

Opportunities for Improvement: Requirements with Respect to the Managerial Conditions

People. Increased awareness and understanding by water users (or their representatives) regarding trade-offs to be made between the seasonal allocation parameters are required. Such increased awareness will evolve from increased interaction with the planning by MEA, but in addition special training courses may help to improve this awareness.

The managerial capabilities and attitudes of the MEA staff should be improved in order to interact more effectively with water users, their representatives and their own subordinates.

The inclusion of managerial subjects in the education of the irrigation engineers, the addition of selection criteria regarding managerial capabilities for future system managers, and some change in training and professional development programs may be required. More awareness of the influence of managerial attitudes on the motivation and performance of subordinates may also help a lot.

However, the above opportunities for improvement may give the impression that several training options available to staff and water users may solve many problems; this is not the case. A precondition for such training to be effective is an increased motivation and willingness of the MEA staff to improve its performance. The MEA staff in Uda Walawe was extremely demotivated, because MEA as a whole gives little priority to its job performance compared to its political connections or its public relations with the outside world.

Therefore, MEA should develop strategies to decrease the indifference and increase the willingness of its staff with respect to its involvement in managerial aspects of the seasonal allocation processes. Irrigation engineers and agronomists alike, especially in higher echelons, should accept the management contents of their jobs, and make clear to what extent they have to spend time on this. This will only happen if their technical and managerial performance is seriously monitored and evaluated by their superiors.

More guidance and professional recognition for involvement in allocation decision making, provision of career paths related to job performance, incentive systems, and performance evaluation with respect to water delivery may be part of such a strategy. More accountability of its staff whether towards higher levels, or towards water users or, more directly, towards the use of the resource water is required. The improved adherence to the cultivation calendar which was introduced by MEA, and which led to approximately 12 percent water saving proves that increased accountability of staff towards water delivery can lead to quick results.

Water saving may be achieved, for example, by increasing the value of the resource water — as was done by the ADB's expectations from MEA as a better managing agency compared to RVDB — through selling it, through making subsidies more explicit in loans to the irrigation sector, and through more performance requirements from higher-level staff, the government and the donor (see also Nijman 1991a).

Provision of information. More information regarding the actual requirements and preferences of the water users with respect to the cultivation calendar, cropping pattern, irrigable area, staggered cultivation, and cultivation risks as well as the trade-offs between them should be provided at the preparatory stages of the seasonal allocation decision making as well as during its implementation for an average level of perfection (40-60%), and in addition to these more information with respect to the water duties should be provided for a high level of perfection (60-80%).

For an average level of perfection (40-60%), the water users' requirements at project, block (or branch canal) and distributary channel level should be considered. Such information should become available, especially during the preparatory phases of the seasonal allocation planning by the project-level O&M and Agricultural divisions for improved mutual understanding and adjustment and less divergent expectations. Improvements of the provision of information to the water users regarding the decisions, arguments, and criteria used in the different steps may strengthen confidence of the water users.

In addition, more reliable historical measurement data on realized water deliveries to important subsystems should become available for the determination of realistic water duties. This will require at least one, but preferably more, regular calibrations (e.g., every two or three years, depending on the siltation in a specific location).

For an average level of perfection (40-60%), weekly information should become available at block and project level regarding the actual implementation of the seasonal allocation plan. At the end of the land preparation, an evaluation report on the actual implementation should be sent to the MEA head office.

The aforementioned information flows needed for an average level of perfection (40-60%) require increased management inputs and efforts of different staff levels. These are unlikely to occur without increased institutional support from the MEA head office, through guidance, evaluation, and appreciation of such increased performance. To this end, regular (40-60%) or frequent (60-80%) monitoring of the processes of the seasonal allocation decision making by the MEA head office is required at least for guidance, and evaluation and especially for stimulation of staff. In the present situation, the staff involved is not appraised for its performance, other than "negatively," i.e., in cases of complaints.

Systems and methods. The presently used uniform cultivation calendar for the whole command area seems to preempt any choices by agency staff, while it actually favors the head-end water users and blocks. It reduces the need to interact with subordinates and farmers; it is a "minimum-management" solution. For an average level of perfection (40-60%), this present "minimum-management" approach will not suffice anymore. Instead, MEA and water users together (possibly in conjunction with political representatives) should develop a system or strategy for prioritizing among the allocation parameters to achieve the best compromise between cultivation risks and irrigated area (e.g., between irrigated area and cropping pattern, crop varieties and staggered cultivation, water duty and irrigated area), and for prioritizing among important subsystems, especially if the demand exceeds the supply for the season. Without such a system it will never become possible to irrigate the full command area of Walawe, even with a rehabilitated physical infrastructure. For a high level (60-80%) of perfection, a coherent strategy would exist for all important subsystems and the overall system.

Such a system could comprise principles and criteria for: systematic reduction of the irrigable area (e.g., priority rights, *bethma* [sharing of certain areas during dry seasons], alternating yala seasons for different subsystems); cropping pattern (e.g., short-term varieties, subsidiary field crops); cultivation calendar (e.g., more systematic staggering, land preparation during maha with rainfall, "variable discharge-variable duration" rotational water deliveries as described by IIMI 1990, 114); and water duties (e.g., acceptable reductions of water issues to different subsystems).

The introduction of such systems will require more management inputs and efforts of different hierarchical levels of the MEA staff, which is unlikely to happen without the earlier-mentioned active stimulation from the head office.

Provision of knowledge. MEA should initiate a synthesis on managerial techniques and attitudes (e.g., criteria for rationalizing the matching of supply and demand under different water availability situations, methods for reliably assessing the actual requirements of the water users) that may prove or have proved more or less successful in reaching mutually acceptable seasonal allocation decisions in the Sri Lankan management situation in different irrigation systems under different water availability scenarios.

Organizational rules. A characteristic of the present MEA setup is the lack of guidelines, circulars that indicate authorities, responsibilities, entitlements and tasks of different staff levels, divisions, and water user groups or their representatives. The actual implementation and performance of the seasonal planning thus depend to a larger extent more on individual insights and motivations than in, for example, the Irrigation Department. On the other hand, the "unified command" setup of MEA, at least in Walawe, leads to a much better adjustment of agricultural and O&M interests at project level during the seasonal allocation planning, compared to the Kirindi Oya setup with different line agencies.

For an average level of perfection (40-60%), clear responsibilities with respect to the seasonal planning will have to be defined for the O&M and Agricultural divisions at project and block levels. These responsibilities should be related to explicit and clear performance indicators for the seasonal planning.

The present unclarity of these performance indicators was demonstrated in the past by the rivalries in this respect between the Deputy Resident Project Managers of O&M and Agriculture of the Walawe system. Both of them did have some incentive to prove their contribution to the improved performance in crop yields in Uda Walawe since the RVDB period, because they were both hired as part-time, comparatively well-paid consultants. However, unclear lines of accountability have led even to discussions in the national newspapers about whose contributions were more relevant. These responsibilities will have to become more clear-cut, and will have to be monitored and evaluated regularly. The absence of such responsibility and accountability was very clear at block and unit levels as well, where nobody was really accountable to adherence to the cultivation calendar.

For an average level of perfection (40-60%), MEA should develop and operationalize rules that will facilitate the interaction between the seasonal planning by the O&M division and the Agricultural division and the requirements and preferences of the water users at project, branch (or block), and distributary-channel levels, especially during the preparatory stages and implementation. The cultivation meeting does not necessarily have to be abandoned, but its function as a decision-making body (i.e., its legal status) is confused with that of a decision-preparation body — decision making necessarily involves decision preparation — which creates problems and frustrations for all parties. At present, it is not even a decision-making body in Uda Walawe, but an extension meeting only. A solution may be to formalize it as an extension meeting and decision-making body with an additional function to hear remaining — i.e., unrepresented in the final decisions — water user discontent, which may be fed back to the MEA head office, for example, through the minutes of the meeting. MEA, the Ministry of Mahaweli and MASL do not provide for such rules at present.

IN-SEASONAL ALLOCATION

Present Management Performance: The Level of Perfection

The level of perfection of the in-seasonal allocation decision-making processes is classified as low (20-40%) following the classification in the annex. It must be noted that a very low or high classification is not a judgement in itself, as a very low level of perfection may lead to a satisfactory performance and may thus be cost-effective. However, in case the performance is considered unsatisfactory, a higher level of perfection is assumed to lead to a higher performance. This quantitative judgement is based on the characteristics of these processes regarding the following criteria.

Feedback. The Technical Officers get regular feedback regarding the realized allocations to branch canals and distributary channels: An average level of perfection (40-60%). (The accuracy of this feedback or its functionality does not influence the level of perfection of the decision making, but influences only the quality of the decision.)

No feedback takes place regarding the realized allocations to field channels. And, no allocations are really scheduled; the water users and possibly the gate tenders (or Field Assistants) are supposed to manage with the allocation to the distributary channel. Thus, the absence of this feedback does not influence the level of decision making.

Regular feedback regarding realized conveyance targets occurs for most important subsystems: An average level of perfection (40-60%). This feedback is complemented with irregular complaints from water users if localized shortages occur: A low level of perfection (20-40%). No feedback takes place on actual allocations during and after rainfall, other than through complaints: A low level of perfection (0-20%).

No performance evaluation by the project O&M division or the MEA head office occurs with respect to the scheduled and implemented rotational allocations, other than through complaints: A very low level of perfection (0-20%).

Foreseeing. The rotational allocation schedules allow for the necessity to allocate water to the tail-end distributary channels of the different branch canals and blocks: A low level of perfection (40-60%). (No priorities are set in the allocation schedules to reduce obvious water wastage in the head-end distributaries at the expense of tail-end canals and blocks. This is apparently not a priority and does not influence the level of perfection as such.)

The consequences of allocation decisions on future expectations are to some degree considered through the efforts to introduce and implement rigid rotational allocations during and after land preparation. Similarly, much attention is given to prevent precedences of increased discharges to tail-end blocks to prevent claims for more permanent increases: A low level of perfection (20-40%).

The operational conveyance targets for the Chandrikawewa Reservoir are oriented towards preventing spilling of water from the Chandrikawewa catchment, which is less motivated by necessity than the aforementioned foreseeing: An average level of perfection (40-60%).

Integration. Operational targets for conveyance along the main canal are integrated to some degree with those for the distribution through the rotational allocation schedules to branch canals and distributary channels along the main canal: A low level of perfection (20-40%). (Many engineers will argue that the rotational allocation schedules are not integrated adequately enough with the operational targets for conveyance to realize adequate rotational allocations to the tail ends of blocks and branch canals, compared to what was envisaged in the original design and what can be done even now; however, this shows more the incompatibility of the priorities during the system creation and utilization, rather than that it influences the level of perfection of the allocation.)

The operational targets for distribution to distributary- and field-channel subsystems take into account the short-term agricultural and water user priorities only in cases of urgency through water user requests: A low level of perfection (20-40%).

During rainfall the allocation along the main canal and within the branch canal and distributary channels is not integrated. Reduced allocation occurs only if the duration of rainfall forces the project-level O&M division to take action: A low level of perfection (20-40%).

Systematics. The rotational schedules are generally used as broad rules by the gate tenders (of Field Assistants) to allocate water to and within the distributary channels: A low level of perfection (20-40%).

Regarding the operational targets for the conveyance along the main system, some effective rules of thumb have been developed regarding important water levels and how these should be maintained: A low level of perfection (20-40%).

The operational targets for conveyance have been developed by routine only; no rules whatsoever guide this decision making: A very low level of perfection (0-20%).

For the allocation below the offtake to the distributary channels there are no rules to apply during rainfall: A very low level of perfection (0-20%). The aforementioned rules of thumb for the determination of operational targets for conveyance in the main system also apply during rainfall: A low level of perfection (20-40%). Routine rather than standing orders apply during rainfall: A very low level of perfection (0-20%).

Opportunities for Improvement: Requirements with Respect to the Processes

Because it is assumed that only a gradual improvement of the level of perfection is feasible it is also assumed that MEA aims to improve its level of perfection from low (20-40%) to average (40-60%). However, in certain cases, where, for example, an average level of perfection leads to a low quality decision, it may be necessary to increase the quality of the decision through measures like more accurate water level measurements or feedback rather than by increasing the level of perfection.

Technical aspects. For an average (40-60%) or high (60-80%) level of perfection, the in-seasonal assessment of supply to the different distributary channels along the main and branch canals will have to depend only on the water level — whether over a measuring weir or not — at the head of the distributary channel; the water levels in the main and branch canals will be relevant for conveyance only. This means that the main and branch canals should not be used anymore as small reservoirs for distribution purposes (which has gradually led, in Uda Walawe, to a permanent favoring of the head-end canals at the expense of the tail-end canals), but as conveyance canals only.

The required frequency of such assessments will have to be determined by higher-level staff, and the observations will have to be fed back to them if they deviate from the variation allowed by such staff. This allowed variation will be larger for an average level (40-60%) than for a high level (60-80%) of perfection, because for a high level more frequent feedback and allocation adjustments are, in principle, required than for an average level.

The frequency of assessment may have to be varied according to the degree of fluctuations of the main canal water level, and possibly for different water availability situations. Systemizing the frequencies for the distributary channels along the main and branch canals will also be required to facilitate guidance, monitoring and evaluation by higher-level staff.

For an average level of perfection (40-60%), the demand assessment should be by means of the water levels along the distributary channel, especially the tail end, and by means of the water levels over the measuring weirs at the head of the field channels. These water levels are used for demand assessment in combination with interaction and requests from water users or their representatives. The frequency of this assessment may be several times a day, but will be less for an average level of perfection (40-60%) than for a high (60-80%) level, because of the larger margin allowed in the allocation for localized variation.

For an average level of perfection (40-60%), regular feedback on effective rainfall in important places in the command area (e.g., for every block in Uda Walawe) takes place and is used for the demand assessment. For a high level of perfection (60-80%), this effective rainfall is measured in all important subsystems (e.g., all tracts or distributary channel subsystems) and feedback occurs daily if relevant for the allocation decisions.

For an average level of perfection (40-60%), the allocations to the distributary channels are regularly (e.g., weekly or biweekly) adjusted and laid down in allocation schedules. For a high level of perfection (60-80%), these adjustments are more frequent. Allocation to distributary and field channels is implemented accordingly, whereby a larger variation is allowed for an average level (40-60%) than for a high level of perfection (60-80%).

For an average level of perfection (40-60%), residual effective rainfall is incorporated in the weekly or biweekly allocation schedules, while for a high level of perfection (60-80%), the probable effective rainfall is considered.

For an average level of perfection (40-60%), the separate operational targets for the conveyance are expressed for the most important points along the main canal. For a high level of perfection (60-80%), this is done for all important points along the main canal.

The precondition for reaching an average or high level of perfection of in-seasonal allocation is the possibility of assessing the water levels at the head of the subsystems accurately, e.g., the functioning of measuring weirs or staff gauges under free-flow conditions, i.e., without backwater effects. This should be the case at least for the flow-measuring facilities at the head of the main and branch canals and distributary channels.

Managerial aspects. Staff of the project-level O&M division should become more involved in the in-seasonal demand assessment and consequent allocation processes below the head sluice to increase the level of perfection to average (40-60%) or high (60-80%). Without their involvement in these processes they will not be able to limit the localized overconsumption of irrigation water.

Also, this project-level O&M staff will have to regularly (40-60%), or more frequently (60-80%), reschedule the allocations to branch canals, and distributary and field channels. It will also have to make decisions with respect to the allowable margins for the field-level staff to deviate from these scheduled allocations without prior consent of higher-level staff, and with respect to ways of monitoring this.

MEA will have to determine the stages of the decision-making processes regarding the in-seasonal allocation at which the water users should be consulted and their hierarchical levels. These may take place at different times as, for example, at the beginning of the season to discuss the principles of allocation and at regular (40-60%) or more frequent (60-80%) intervals during the season.

Simultaneously, regular (40-60%) or more frequent (60-80%) interaction with the agricultural staff at project or block level may be required for a better tuning of allocations with possible agricultural programs. However, this interaction may be superfluous if more regular and organized interaction with water users is established regarding the allocations.

Allocation principles that could be subject for discussion, consultation or negotiation with water users, their representatives, and field staff refer to the quality of the water delivery service. For example:

* The required water duty for the different subsystems.

* The required flexibility of the operational targets for distribution to branch canals, and distributary and field channels, in terms of duration or flow rate.

* The maximum permitted total responsiveness (i.e., managerial and hydraulic) or delays of realization of exceptional adjustments to the scheduled allocations.

* The allowance to cope with variations in discharge (or water level) to the different subsystems.

* The predictability of the water issues in terms of the required information supplied to water users and field staff about allocation schedules and adjustments.

* The criteria that should be used in the allocation decision making for different water availability situations (e.g., equity between subsystems), cultivation risks, and agricultural productivity.

These interactions with the water users could have different levels as indicated in Table 8, but should be of level three or four to reach an average level or high level of perfection without too much enforcement by the agency. The form of these consultations will have to be determined by the MEA head office, in consultation with project-level staff because successful interaction depends to a large extent on their commitment to such interaction.

Table 8. Levels of conditions for establishing adjustments in cooperation.

Level	Categories of conditions		
	Information supply	Consultation	Responsibilities
1	One-sided/current affairs	None	Independent
2	Two-sided/intentions	None	Independent
3	Two-sided/intentions	Consultations without obligations	Independent
4	Two-sided/intentions	Consultations directed at binding agreements	Independent
5	Two-sided/intentions	Consultations directed at decision taking	Common or "umbrella"

Source: Kampfraath 1978.

The latter is important because the Sri Lankan experience with the Irrigation Management Division is that with respect to the in-seasonal allocation the mechanisms between the different hierarchical levels of the O&M staff are such that passive and active obstructions of such bottom-up processes are very easy (Nijman 1991b). Without real commitment of the MEA head office and project staff the bottom-up processes will not be very effective in the short run, and may be even counterproductive in the long run.

Consultations initiated and maintained by MEA could be attended by the more or less centralized levels where allocations are scheduled, and by lower hierarchical levels. Apart from that, procedures have to be established regarding urgent complaints and requests by the water users.

Good communication lines have to be established with the field-level staff as well, to increase the managerial responsiveness towards required adjustments in the allocation schedules. If such lines do not exist it will become more difficult to deliver the water within certain requirements that evolve from the consultations with the water users, including the separation of operational targets for conveyance and distribution. These communication lines should thus be even better for a high level than for an average level of perfection.

For an average level of perfection higher-level staff should regularly instruct, guide, monitor, and evaluate the Technical Officers, Field Assistants and gate tenders with respect to the actual implementation of the scheduled allocations. This will not only improve their allocation decisions, but will stimulate them as well.

Development of such project-level guidance requires that the MEA head office takes a more active and initiating role in guiding, monitoring, and evaluating the in-seasonal allocation processes in its irrigation systems. Performance evaluation through registration of allocation schedules and comparison with important earlier experiences, and regular monitoring and evaluation of actual implementation of most important operational targets are required for an average level of perfection (40-60%).

In the interaction with water users and field staff the credibility of the matching of supply and demand at higher-hierarchical levels is very important and this is something which should be carefully cultivated by the MEA staff.

Opportunities for Improvement: Requirements with Respect to the Managerial Conditions

People. The existing technical expertise of the different staff levels is sufficient if project-level O&M staff will become more involved in localized demand assessment and allocation processes. However, experience in quantifying water duties, flexibility, predictability, variability, and responsiveness may have to be developed for staff and water users.

Managerially, a first need is an increased awareness of all O&M staff levels about the managerial aspects of their daily work content. In addition, higher-level staff will have to become willing and capable to interact more effectively with lower-level staff and water users, and this will require improved managerial skills and attitudes.

As for the seasonal allocation, inclusion of management subjects in the education of the staff, addition of managerial skills in the selection criteria for future irrigation managers, changes in training and professional development programs will be required. More awareness of the influence of managerial attitudes on the motivation and performance may help as well.

However, increased awareness of the managerial aspects of the in-seasonal allocation processes and related skills will not increase the present level of perfection. Motivation and willingness of the MEA staff to improve their performance in this respect are more important. A similar point has been argued for the seasonal-allocation planning, which means that MEA will require or stimulate its staff to improve its performance. However, presently MEA as a whole does not give much priority to the water delivery performance. Therefore, the government or the donors will have to increase the accountability of MEA in terms of its effectiveness and efficiency in using water resources.

Provision of information. The project level that prepares the allocation schedules requires regular (40-60%) or frequent (60-80%) feedback of realized water issues to branch canals, and distributary and field channels and corresponding water levels in the main and branch canals. Also, it should get feedback on adjustments of scheduled allocations. This feedback could be realized through forms, in which case they should be cross-checked by daily independent measurements of water issues to at least distributary canals, and through regular field visits by project-level staff.

For an average level of perfection (40-60%) regular feedback of residual effective rainfall is required. For a high level of perfection (60-80%), frequent feedback of actual demand incorporating effective rainfall is required.

In addition, good communication lines are required for an average level and a high level of perfection to be able to react to exceptional deviations from the scheduled allocations that cannot be covered by the established allowable margins. Related to this are the information-processing requirements; the use of computers and standard software to make frequent and quick changes in the schedules and produce notes on the new schedules for dissemination to field staff and water users. In addition, to make management less dependent on individual staff members, allocation experiences should be recorded, for example, in a database, seasonal reports, etc.

For an average level of perfection (40-60%), performance evaluation by the head office through registration of allocation schedules and comparison with important earlier experiences, and regular monitoring and evaluation of actual implementation of the most important operational targets is required. Potential performance indicators for the in-seasonal allocation concern are thus the water duties for different main and branch canals and distributary channels which could be monitored regularly. This requires, again, an increased accountability of MEA as a whole towards its water delivery performance, which is unlikely to come about without outside requirements in this respect.

Systems and methods. For an average level and a high level of perfection, it seems useful to decide on a certain system of allocation for different subsystems that can be relatively easily monitored by higher-level staff, but which is acceptable to the water users. Such a system could systemize the allocation decision making and thus facilitate the interaction among staff and between staff and water users. Four methods of allocation are possible: 1) fixed discharge and variable duration: 2) variable discharge and fixed duration; 3) variable discharge and variable duration; and 4) fixed discharge and fixed duration.

The first requires more management input from agency staff but allows water users to standardize the rotation within the distributary and field channels to a certain extent. The second is easier for agency staff but requires much more management input and internal organization from water users to manage the varying durations to different farm plots if the supply is tight compared to the demand. The third requires most management input from agency staff, but relatively less from the water users. The fourth is presently practiced; it is the least management-intensive for the agency, but does not allow for tight water supply over the whole season.

If MEA intends to supply less water than the demand in the long run, the second option may be preferable for the agency. Presently, however, only the first and third options seem to be feasible in Uda Walawe for an average level of perfection (40-60%). However, if MEA allows more abundant water supply to the different subsystems any of the rotational allocation options may be feasible for the agency and the water users; in such a situation the fourth option is the least management-intensive for the agency and is therefore implemented at the moment. Performance improvement with the fourth (or second) option requires the enforcement of increased management inputs from water users only, which seems unlikely to occur now in the absence of viable and effective water user groups. The first option seems more fit for that purpose, whereby the third can be used in a transitory trial-run period. In all cases, it is important that the adopted allocation method is acceptable to the water users of the different subsystems — which will probably require some compromising between the allocated water duties — and that water users are aware of the scheduled allocations.

For reaching an average level or a high level of perfection it is also important to have a system to record the allocation experiences of different subsystems in a specific irrigation system in such a way that the departure of field-level or higher-level staff will cause minimum disruption to the water delivery service because of loss of experience. Any such discontinuities will reduce the credibility of the service delivery by MEA. Facilitating systems in this respect may include the filing of minutes of meetings with water users and staff, the building up of a data bank where the reasons for a certain allocation to a specific subsystems are given, the making of seasonal reports highlighting the main seasonal and in-seasonal allocation processes, etc. The advantage of such a data bank is that it builds up experiences, etc. within MEA, on how the allocation processes, water duties, cropping patterns and calendars, and cultivation risks evolve over time in a specific irrigation system.

For an average level of perfection (40-60%), a system has to be developed to make more effective use of rainfall. Several such systems have been proposed in the past by consultants, but their application to save water awaits institutional support of MEA as a whole.

Provision of knowledge. For in-seasonal allocation, the only technical knowledge lacking is that on the systematic building up and consequent exchange of experience in dealing with allocation in Sri Lanka. This will be specifically necessary for the envisaged quantification of water duties, flexibility, predictability, variability, and responsiveness.

Despite the enormous amount of irrigation management literature about water user organizations, there exists little exchange of experiences regarding systematic mechanisms of interaction between higher levels of agency staff, field staff, and water users for in-seasonal allocation. Such exchanges should be initiated by MEA itself, to prevent its engineers from considering this type of knowledge as a threat to their own professionalism.

Organizational rules. For an average level of perfection (40-60%), the MEA should develop clear and consistent rules with respect to the assessment of demand and allocation decision making in its irrigation systems (methods of supply and demand assessment, allocation methods for different water availability situations and relevant hierarchical levels, the feedback requirements, etc.).

For a high level of perfection (60-80%), it could establish combinations of mutually attuned rules with respect to the frequency of supply and demand assessment, the hierarchical levels where allocation scheduling would have to take place, the feedback requirements, the incorporation of effective rainfall in the allocation schedules, etc.

A common solution to the clash of distribution and conveyance targets along main and branch canals is to establish separate organizational structures for distribution and conveyance for the main and branch canals. The separation of project and block offices in Uda Walawe is such a solution separating the conveyance and distribution along the main canal and within the branch canals. This separation may help to a certain degree, but in Uda Walawe it does not prevent the gate tenders (or localized managers like the block staff) from making ad hoc adjustments of the distribution targets among themselves to react to immediate water users' demands; it is only in case the level of perfection of the in-seasonal allocation is upgraded, and these ad hoc water user demands are taken care of, that the confidence of water users and gate tenders required for further improvement of the separation of distribution and conveyance targets may evolve. This increased level of perfection will not evolve without increased accountability of the different staff with respect to the water delivery performance; without such accountability different configurations of the organizational structure will not solve these conflicting interests of conveyance and distribution.

Rules concerning the hierarchical and financial authority of staff involved in in-seasonal allocation are required to make this decision making less dependent on individual motivations, behavior, and attitudes. In Uda Walawe, the line authority of the project-level O&M division regarding the allocation at block level by the Technical Officers seems to be weakened by the block office organizational setup. The prevalence of the aforementioned localized block interest over the overall system interest is thus reinforced by the organization structure in the absence of any accountability towards the water delivery performance. Instead, it seems better to maintain the direct-line hierarchy with clear responsibility and accountability along the line. For an average (40-60%) or high (60-80%) level of perfection, more guidance, monitoring, and evaluation by the project-level O&M staff and more direct hierarchical authority and responsibility of this project level O&M division up to the field-level staff involved in allocation processes are required. Different staff levels in this line should be made accountable and responsible for the water use within their area.

Managerially, rules about the frequencies of consultations with water users, their representatives, and agency staff with respect to allocation principles, including requirements with respect to decisions to be made (e.g., the criteria listed under managerial aspects of the required processes) at these consultations, and the recording of the proceedings should be developed, as well as enforced.

MEA will have to make an extra effort to organize water users into viable groups to facilitate interaction between its staff and water users. To that end, it will also be required that MEA establishes rules about the responsibilities, entitlements, and rights of water user organizations in order to enable these groups to play a meaningful role in the allocation decision-making processes. Given the required increased management inputs, a serious effort to interact with water users — which itself is a prerequisite for viable and effective water user groups — seems unlikely to evolve without increased accountability of MEA staff and the MEA as a whole with respect to the water delivery performance.

WATER FLOW REGULATION

Present Management Performance: Level of Perfection

The overall level of perfection of the water flow regulation is roughly low (20-40%). This quantitative judgement is based on its characteristics regarding the following criteria.

Feedback. Because of the routinized operational methods, irregular feedback takes place regarding the few operational methods implemented for conveyance along all canals (i.e., the operation of different offtakes, and the operation of sluices from the reservoirs). Obvious experiences like operational methods used when structures are broken are fedback to the responsible Technical Officers: A low level of perfection (20-40%).

Feedback of information on time spent by gate tenders and Field Assistants, according to the attendance register signed by them, varies from none to some: A very low level of perfection (0-20%). Instead, regular feedback occurs to the project-level O&M division about the resulting approximate water levels at the most important locations along the main system, i.e. about the in-seasonal allocation decisions. Allocation has made water flow regulation decision making superfluous to a large extent.

Foreseeing. Most actual operational methods are established on an ad hoc basis, because the operational methods of the offtakes do not really matter as long as they are in line with the allocation schedules. Over time, some experience with respect to the consequences of certain operational methods for the distribution and conveyance has developed. For example, the use of the gated cross-regulators as fixed weirs is a result of the insight that variable flows would require increased management inputs (especially with stoplog-type gates) of the different involved staff levels to realize allocations to the tail end: A low level of perfection (20-40%).

Integration. The few practiced operational methods (e.g., operation of cross-regulators, clearing of obstructions in canals, operation of sluices of reservoirs) are well-integrated with their influence on the distribution and conveyance along main and branch canals: A low level of perfection (20-40%). Along the distributaries this integration is left to the water users themselves and is at a low level. Unless serious irrigation problems occur in particular distributary channels, the agency staff is not much involved in water flow regulation decision making in the distributary and field channels: A low level of perfection (20-40%).

Systematics. The involvement of higher-level staff like the Field Assistant and Technical Officer in the water flow regulation leads to more systematic decision making regarding operational methods (e.g., adjustment of the cross-regulators and timing of operation of the head sluice). Experience in operational methods has thus been built up by gate tenders as well as by their immediate supervisors. However, no specific rules are established in this respect and the above depends to a large extent on the individuals involved: A low level of perfection (20-40%).

Opportunities for Improvement: Requirements with Respect to the Processes

Because it is assumed that only a gradual improvement of the level of perfection is feasible, this section assumes that MEA aims to improve its level of perfection from a low (20-40%) to an average (40-60%).

If an increased level of perfection requires improvements in the physical infrastructure this will be mentioned. Moreover, the requirements to maintain the present low level of perfection and reach an average level will be indicated, after the completion of construction (under the present rehabilitation project) of the gated cross-regulators in the main canal and fixed cross-regulators in the branch canals.

Technical aspects. For an average level of perfection (40-60%), the exact time of actual operation of the reservoir sluices will have to be recorded and the project-level O&M division will have to be informed immediately about this time. Also, for an average level of perfection (40-60%), the actually realized discharges through the reservoir sluices of Uda Walawe and Chandrikawewa reservoirs will have to be measured and such information will have to be provided immediately to the project- and block-level O&M divisions, respectively. For this purpose the staff gauges at the head of the main and branch canals should be made more functional through regular calibration, or through the construction of more permanent measuring structures. In addition, the O&M divisions will have to determine the undesired periods of the day for operation of the reservoir sluices, especially in case the envisaged gated cross-regulators in the Right Bank main canal come into operation after the rehabilitation.

To maintain the present low level of perfection (20-40%) after the construction of these gated cross-regulators, the gate tenders will have to be informed about approximate time and size of flow variations at their cross-regulators and offtakes. Such information necessarily has also to incorporate some approximate information about the time and size of the operation of upstream cross-regulators, distribution to offtakes and losses during conveyance to their cross-regulator.

For an average level of perfection (40-60%), with or without these gated cross-regulators, this information provision to the gate tenders should become more specific. This will require the measuring of the discharge at the upstream offtakes along main and branch canals, or downstream of the first cross-regulator in the upper reach of the main canal, or at important points along the tail-end reaches of the main canal. These discharge measurements require regularly calibrated staff gauges or measuring structures at all distributary-channel offtakes from main and branch canals.

To maintain the present low level of perfection (20-40%) after the construction of these gated cross-regulators, the gate tenders will have to be instructed with indicative operational methods for the gated cross-regulators that will arrange the conveyance along the main canal and reduce the time required to stabilize the main canal after the operation of the reservoir sluices, rainfall in the command area, or important changes in distribution in upstream reaches of the main canal.

For an average level of perfection (40-60%), the gate tenders will have to be provided with more specific instructions with respect to the operational method to be used for every operation of the reservoir sluices, during rainfall in the command area, or important changes in distribution in upstream reaches of the main canal. Such operational methods include the time and size of gate settings, and the frequency of adjustment for all structures along the main canal, i.e, an operational plan.

To maintain the present low level of perfection (20-40%) after the construction of these gated cross-regulators, the actual time and size of gate adjustment required for the flow variation to reach important points along the main and branch canals (e.g., the reservoirs, the head ends and tail ends of main and branch canals), and the time required to stabilize at these points after an important change of discharge through the reservoir sluices, heavy rainfall, or important changes in distribution in upstream reaches of the main and branch canals will have to be fed back to higher-level staff.

For an average level of perfection (40-60%), with or without these gated cross-regulators, such feedback will have to be supplemented with all realized changes in distribution along the main and branch canals; also, without the gated cross-regulators, more accurate information is required regarding discharges realized in all distributary channels along the main and branch canals. These discharge measurements require regularly calibrated staff gauges or measuring structures at all distributary-channel offtakes from the main and branch canals. Moreover, for an average level of perfection (40-60%), regular feedback has to occur about level variations along the main and branch canals.

Managerial aspects. To maintain a low level of perfection (20-40%) after the construction of these gated cross-regulators, staff of a higher level than field level (i.e. the Technical-Officer level, at least) will have to instruct the gate tenders and Field Assistants about the operational methods of the gated cross-regulators after an important change of discharge through the reservoir sluices, heavy rainfall, or important changes in distribution in upstream reaches of the main canal. Moreover, they will have to monitor and evaluate the implementation of these operational methods to be able to give the above instructions.

For an average level of perfection (40-60%), with or without gated cross-regulators, higher-level staff involvement will have to become more regular, because the water flow regulation will have to be monitored more regularly. In addition, more specific instructions with respect to the operational methods will be required. The establishment of timing of operations, allowed deviations of the water level from the target water levels, frequency of checking for different flow-stability situations, and allowed sizes of adjustment of gate settings for specific discharge variations necessarily require increased involvement of higher-level staff.

Higher-level staff will have to be involved in initiating certain operational methods for gated cross-regulators, implementing them and monitoring the consequent stabilization of the main canal, identifying possible improvements in operational methods, and identifying the required communication between the different cross-regulator operators, etc.

At the time of important water flow changes along the main and branch canals, higher-level staff will have to ensure that quick and reliable information regarding realized distributions, the operations of structures, and the discharge at specific locations along the canals is available for the operational planning. For an average level of perfection, special technical staff (e.g., system or subsystem engineers) will be required to prepare realistic operational plans.

For an average level of perfection (40-60%), after the construction of these gated cross-regulators, more attention may be required for matching the exact timing of the operation of the reservoir sluices with the managerial responsiveness of the staff of the project and block-level O&M divisions and to warn and instruct the gate tenders along the main and branch canals. This may be done through some form of consultation at the block-level O&M divisions and the project-level O&M divisions about the exact timing of operation of the reservoir sluices.

This matching is important because without an exact starting-up time of destabilization of the main- and branch-canal flows, the coordination of the operations of the cross-regulators and offtakes along the main canal will become less exact as well, and small destabilizations are propagated with increased amplitude along the main canal to the tail end.

Opportunities for Improvement: Requirements with Respect to the Managerial Conditions

People. For an average level of perfection (40-60%) the expertise of gate tenders and involved higher-level staff is necessary to achieve appropriate operational methods for water flow regulation decision making without the gated cross-regulators. The present practice of "approximate" water flow regulation to realize water issues to the tail ends will have to be refined and made more accurate. The basic condition for this is the willingness and motivation of MEA to increase its management inputs in this respect.

This is even more important with the introduction of the gated cross-regulators after the rehabilitation which will increase the required management inputs tremendously as can be derived from the described process requirements. In Kirindi Oya, the awareness that conveyance and the destabilization in the main and branch canals have to be managed for variable flows — which is an implicit design assumption — leave alone the fact that it has to be managed before the reservoir sluices are operated, appeared to be still absent among the Irrigation Department staff. This lack of awareness of the management requirements implicit in the operations of gated cross-regulators will be similar in Uda Walawe. Such awareness and expertise could be improved by training of the staff by means of models simulating the water flow in the main canal under different operational methods, and under different scenarios (e.g., Malaterre 1989).

However, as in the case of the seasonal and in-seasonal allocation, the management of the water flow regulation requires a change in attitude of the higher-level staff of MEA regarding the interaction with lower-level staff. The remarks about the allocation decision making on training, as well as about the accountability of the MEA staff towards water delivery performance in earlier chapters are valid for the water flow regulation as well.

Provision of information. For an average level of perfection (40-60%), the O&M divisions should be provided with the actual time of operation of the reservoir sluices and realized discharges.

For an average level of perfection (40-60%), the gate tenders should be informed about the exact time and size of flow variation at their structures, the required time and size of gate adjustment and frequency of checking the resulting level changes, and frequency of adjustment of the gate settings.

For an average level of perfection (40-60%), the actual time and size of gate adjustment required for the flow variation to reach important points along the main and branch canals (e.g., the tail ends, or the head ends of branch canals and distributary channels), and the time required to stabilize at these points after an important change of discharge through the reservoir sluices, heavy rainfall, or important changes in distribution in upstream reaches of the main and branch canals, should be fed back to higher-level staff. Also, information on all changes in distribution realized along the main and branch canals should be fed back to higher-level staff on a regular basis. Moreover, for an average level of perfection (40-60%), regular feedback should occur about variations in water level along the main and branch canals.

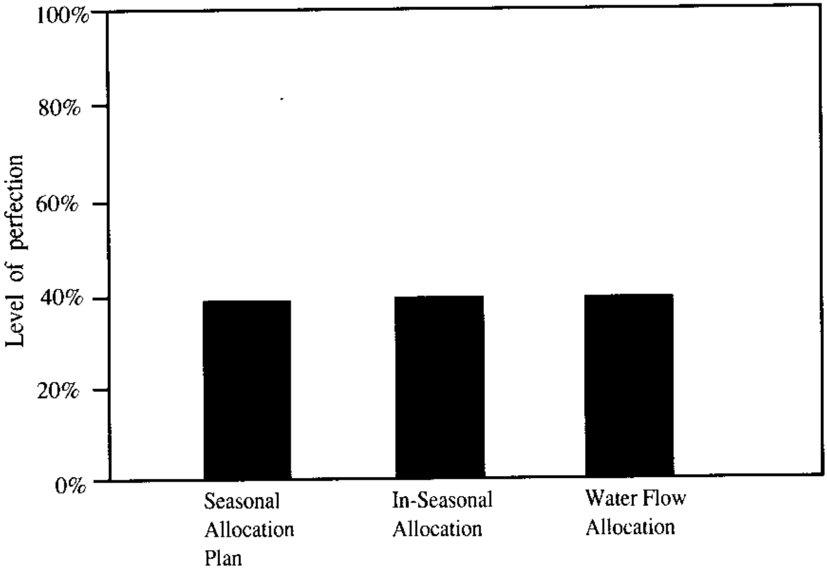
Systems and methods. MEA may decide to maintain the present use of gated cross-regulators as fixed weirs, which will limit the required management inputs for water flow regulation by the MEA staff. On the other hand, this leads to the disadvantage of being unable to limit water issues after rainfall or make more responsive allocations to different subsystems while reducing the present excessive water wastage in the different head ends.

MEA may also consider the use of the gated cross-regulators for regulation of variable flows in the main system. Theoretically, this will increase the required management inputs tremendously, to probably unfeasible levels. But as the Chandrikawewa Reservoir provides for intermediate storage in the upper reach of the main canal and an additional intermediate storage facility is available in the middle or tail-end reach of the Right Bank main canal, these management inputs downstream of the Chandrikawewa Reservoir could be reduced. Both options are suitable for an average level of perfection (40-60%).

Provision of knowledge. MEA will have to build up knowledge about the operational methods used in different systems, with and without gated cross-regulator and intermediate storages, and its consequences for conveyance and stabilization of the water levels along the main and branch canals. Such knowledge could be developed through trial-run techniques in its systems or through the application of simulation models to experiment with different operational methods and procedures for water flow regulation. However, the application of such know-how depends ultimately on the willingness and the motivation of the project and head-office staff of the MEA to improve its performance in water flow regulation.

Organizational rules. For an average level of perfection (40-60%) MEA should establish rules concerning the responsibilities of higher-level staff in the water flow regulation (e.g., the involvement of higher-level staff required for the establishment of operational methods and the provision of information to higher hierarchical levels and field staff after important flow changes in the upstream reaches of the main and branch canals, and the monitoring of the consequences of the water flow regulation).

Figure 7. The levels of perfection achieved in system utilization processes, Uda Walawe.



PRIORITIZING AMONG OPPORTUNITIES FOR IMPROVEMENT

The levels of perfection achieved in system utilization processes in Uda Walawe are graphically displayed in Figure 7. Higher levels of perfection are assumed to lead to higher system performance. However, it is still unknown to what degree the different key decisions contribute to system performance; the relative contributions of the different key decisions have to be determined through comparative research in different irrigation systems before they can be used as normative indicators of the levels of perfection for the different key decisions to reach a certain performance. Such comparative research will be undertaken in the near future by IIMI's performance research. In the absence of such normative values the given opportunities could be used by MEA as a kind of checklist.

CHAPTER 7

Strategic Concern: Desired System Objectives

THE STRATEGIC CONCERN deals with the identification of desired system objectives (e.g., water delivery, land settlement, employment, and agricultural production) of an irrigation system, matches these with the availability of resources (i.e., the feasible system objectives), and defines the capacities that are needed (i.e., the functional system requirements) to reach these objectives. The strategic concern has been split up in this paper into three key decisions: the desired system objectives, the feasible system objectives, and the functional system requirements. The latter two are dealt with in chapters 8 and 9 respectively.

The desired system objectives evolve from the objectives of the donor, the national and local politicians, the line ministries and the departments, the national planning organization, the local authorities and the community, and the beneficiaries of an irrigation system.

For an irrigation system one such objective, whether implicitly or explicitly stated, may be the reduction of cultivation risks through more control over water in certain areas at a certain point in time. Other related objectives may be a desired increase of agricultural production, alleviation of poverty, reduction of unemployment, settlement of landless people, appeasement of political supporters or geopolitically sensitive areas, saving of foreign exchange through increased exports or reduction of imports, sustainability of the environment, external funding for agency projects, etc. The study of decision-making processes with respect to the desired system objectives and their managerial conditions has been less detailed than the studies given in the other chapters, because they take place at high levels in agencies, the government, and the donors. The relevance of this decision making for the water delivery can be very important; however, a broad picture as given in this chapter is considered sufficient.

THE DECISION-MAKING PROCESSES

Technical Aspects

The objectives of the Walawe Irrigation Improvement Project (WIIP) are

> consistent with the Government's sectoral development objectives, ... <and> aims at increasing agricultural production, farm income and employment opportunities in the Project area <i.e., the area commanded by the right bank main canal> through improvement and rehabilitation of the existing irrigation facilities. The Project will improve the existing irrigation system to provide adequate, timely and equitable irrigation supplies on a sustained basis for year round cropping in about 12,000 net ha of the Project area thereby increasing the cropping intensity, crop yields and farm incomes benefitting some 11,000 farm families settled in the Project area......An improved irrigation system in the Project area will also ensure adequate irrigation supplies for the existing and currently planned irrigation projects <e.g., the ADB financed Sevanagala Sugar Development Project> on the left bank of the Walawe river. These projects are currently facing water shortages due to excessive and wasteful use of water in the Project area (ADB 1984a, 20).

The scope of the project included:

> (i) irrigation system rehabilitation involving main, branch and distributary canals, on-farm irrigation distribution system and appurtenant structures; (ii) rehabilitation of about 550 km of service roads; (iii) provision of domestic water supply in the scattered settlements and village centers; (iv) adaptive research on crop diversification; (v) provision of essential equipment and vehicles for sustained operation and maintenance of the irrigation system; and (vi) consulting services and training involving provision of 60 man-months of consultant input to assist in Project implementation, about 12 man-months of overseas training in irrigation management and establishment of a Training Unit in the Project area to impart training to Project staff and farmers. These components are

designed to rectify the design and construction flaws in the original project, significantly improve irrigation management at the system and farm level, and support full realization of achievable benefits (ibid.).

Thus, explicit project objectives appear to be the rehabilitation of the Right Bank area of the Walawe project to ensure full benefits of the earlier investments in the project area, as well as to ensure adequate water supplies to the existing and planned projects in the Left Bank area.

No more explicit references were made to the desirable system objectives from the point of view of the Government of Sri Lanka, MEA, the water users or the local communities, but it has been assumed that the water users, especially the tail enders, would welcome a rehabilitation of the system. IIMI research staff in fact observed that most water users of Uda Walawe did welcome the broad idea of a rehabilitation project. However, the desirability of the main project objective, i.e., reducing the water duties in the head-end reaches to much lower levels, from the point of view of the directly involved agency staff and water users, has not been assessed and is doubtful.

The above were the objectives as laid down in the relevant donor documents. Further elaborations of these objectives by the government are not available. For example, the time span in which these objectives (i.e., increased agricultural production and jobs for the people) had to be achieved was not related to this project by the government.

How the increased agricultural production is to be attained; whether through increased cropping intensity, other field crops (i.e., crops other than rice), or through extension of the command area has been implicitly and explicitly defined through the assumption that the rehabilitation project aims to achieve the full benefits envisaged for the original Walawe project.

Managerial Aspects

A number of reasons have led to the Walawe Irrigation Improvement Project (WIIP) and its desired objectives. Immediately after completion of the original Walawe project in 1979, the Government of Sri Lanka and the donor were both aware of the need for completion and rehabilitation of the project. At first, in 1979, the government requested RVDB "to carry out a program of rehabilitation of the irrigation system for both the Right and Left Banks and that sufficient local funds would be allotted" (ADB 1979, 75). At approximately the same time, the division of the donor agency responsible for project appraisal and implementation identified the need for rehabilitation and completion of the project, in its Project Completion Report.

It observed that

> Uda Walawe was expected to ultimately serve about <32,724 ha>, divided into <13,332 ha> on the right bank and about <19,392 ha> on the left bank. However, irrigation water use in the Project area far exceeds original expectations and threatens to curtail further developments on both banks. Only about 70 per cent of the right bank area for irrigation at the time of appraisal is actually served, and this area is consuming about three times the water proposed for irrigating the entire right bank area. Only the lack of development under the left bank canal to date has permitted this excessive use. The entire supply from Uda Walawe Reservoir and local tanks is now devoted to irrigating an average of about <8,484 ha> on the right bank, within the Project area, and about <4,404 ha> on the left bank <i.e., 38% of the original envisaged command area>.
>
> This extraordinary high water use relates primarily to: (i) improper cropping pattern — while the appraisal envisioned some 55 per cent of the net irrigable area to be planted to irrigated upland crops such as cotton and maize, in fact more than 95 per cent of the net irrigable area is consistently double cropped in paddy; (ii) poor on-farm water management —over-application and paddy-to-paddy deliveries, with large return flows and no provision for returning such to the irrigation system typify the area; and (iii) inadequate staffing and inefficient utilization of funds for operation and maintenance — the system has fallen into serious disrepair from head works to farm level delivery (ibid., 7).

The report further states that

> Primarily, operational problems relate to the systems being run on a continuous flow basis rather than on a rotational basis as originally

> conceived. Other than at the reservoir, measurements and records are not made. Further down the system, upstream users monopolize canal flows and use them wastefully, to the detriment of lower users who commonly face shortages; available legal measures to prevent such problems are not applied (ibid., 8).
>
> Downstream, only minimal efforts are exercised for proper rotational irrigation operations at the Project level (ibid., 55).

The report, thus, clearly acknowledged the lack of motivation and willingness of the management in Uda Walawe with respect to the water delivery.

The report calculated four alternative Economic Internal Rates of Return (EIRRs) for the original project. Incorporating investments made before the donor joined the project in 1969, the EIRR would be 7 percent under the 1979 performance, and 10 percent assuming a rehabilitation and completion of the project. Considering only the investments since the donor's involvement, these EIRRs would be 8 percent and 11 percent respectively (ibid., 65). It has been remarked that these EIRRs would have been much lower even, without the unexpected tripling of the price of rice since the original donor appraisal, which represented "a five-fold increase in the benefit of the Project for every ton of rice produced" (ADB 1982, 12). The EIRR for the proposed rehabilitation only was estimated at 32 percent, assuming it would start in 1980 (ADB 1979, 65).

The above assessment led to the recommendation in the Project Completion Report for follow-up action which said that "serious concern of the Bank would relate to the gross uncertainty that the preparatory efforts to be made by the RVDB and the resources to be provided by the Government will be sufficient to meet the actual needs of the rehabilitation work" (ibid., 80). This donor fear was justified given its experience with the original Walawe Development Project where financial problems of the RVDB played an important role (ibid., 74). Moreover, the new government had given priority to the Accelerated Mahaweli Project in the allocation of funds.

Accordingly, the Project Completion Report advised as follows:

> It would be in the best interests of both the Bank and Government if a mutual consultation could be held as soon as possible for the dual

> purposes of (i) setting up a time schedule for the full completion of the Project works .... and (ii) ensuring that a complete and highly effective rehabilitation and improvement program will be prepared and successfully carried out (ibid., 80).

It concluded:

> Thus far, there is no indication that RVDB has felt the need for consultant services in the planning and execution of the rehabilitation program. During the final meeting with the Project Completion Review Mission, RVDB's Chairman appeared to be confident that the said program could be prepared by his staff before the end of 1979. Considering the possible size of the necessary rehabilitation effort in order to be effective, however, and particularly in view of the overwhelming constraint that has been imposed on the technical manpower in Sri Lanka by the implementation needs of the Accelerated Mahaweli Scheme, assistance from a consulting firm is probably necessary. This would have to be discussed with the Government. It is recommended that if the need for consultant services is confirmed during the proposed consultation and, if requested, the Bank may consider providing a suitable form of technical assistance to help the Government in the preparation and execution of an adequate program of rehabilitation and improvement of the entire irrigation system, as a necessary step towards the realization of the full benefits from the Bank-assisted Project (ibid.).

While the Project Completion Report explicitly refers to the lack of managerial inputs of RVDB to achieve the original project objectives, it recommends a combination of physical rehabilitation and improved operational procedures to solve these problems. In 1982, the Project Performance Audit Report of the Post-Evaluation Office of the donor largely confirmed the assessment of the Project Completion Report of 1979. In addition, it elaborated more explicitly on the managerial aspects of the failure of the original project in its recommendations to the donor: "From the economic point of view, <the Project Evaluation Mission> is of the opinion that the Bank's further assistance should give priority to the improvement of irrigation management rather than to the correction of poorly designed and constructed irrigation facilities" (ADB

1982, 32). It further recommended to the new managing agency, MEA, that "a realistic cropping pattern compatible with the physical, economic and social conditions should be developed and introduced as soon as possible. Attempt should also be made to motivate farmers to adhere to a determined cropping calendar" (ibid., 32).

The Project Completion Report showed clear willingness of the donor to start a rehabilitation of Uda Walawe in 1980. In contrast, the Government of Sri Lanka did not give much priority to this project as has been mentioned before. In 1982, the Project Performance Audit Report observed in this respect that

> even though the major findings of <the Project Completion Report> were conveyed to the Government and a Consultation Mission was proposed by the Bank in January 1980, the Government's consent to receive the Mission was communicated to the Bank only towards the end of 1980 and the consultation meeting did not take place until April 1981. Though the Government agreed at the meeting to prepare by August 1981 a proposal for the rehabilitation of the Project for Bank consideration, it was not accomplished even at the time of the <Project Evaluation Mission's> visit in February 1982 (ibid., 28).

In April 1982 (i.e., four months after MEA officially assumed responsibility for Uda Walawe), the Government of Sri Lanka agreed to the rehabilitation. However, this agreement came only after the donor used the leverage of an international funding agency. First, the Appraisal Mission for supplementary funding of Kirindi Oya made such funding to Kirindi Oya conditional to the willingness of the government to rehabilitate Uda Walawe. In addition, the donor would consider funding of a road construction project in the Accelerated Mahaweli Program only if the government was willing to agree with a rehabilitation of Uda Walawe. Another incentive for the government to accept a rehabilitation of Uda Walawe was the donor's explicit willingness at that time to consider future loans for development of the Walawe Left Bank. The latter was envisaged to boost the EIRR of the donor's overall investments in Uda Walawe.

At this time, no decisions had been made regarding the type and nature of the rehabilitation project. In early 1983, the donor sent a mission to identify priorities for the rehabilitation project and to prepare terms of reference for a detailed feasibility study. The mission stated that "major problems faced by the Walawe irrigation system can be attributed to a past lack of management rather than to inherent design or construction defects" (Wolf 1983, iv). The report continues that "major rehabilitation...would not be justifiable or cost effective. On the other hand, a program of minor rehabilitation and improvement of the irrigation system <i.e., a sort of elaborated maintenance program> in combination with improvements in system management is considered necessary" (ibid.). Options to augment the water supply to the system should be considered only after improved managerial performance would result in approximately 30 percent lower water duties (ibid., A.2). This pre-feasibility report thus proposed a limited improvement of the water delivery performance and minor rehabilitation (i.e., basically management upgrading) as a precondition for further purely engineering solutions to get more water to the tail-end reaches of the system. Major rehabilitation as an engineering solution to lower the water duties was considered unfeasible at this stage. This conditionality proposed by the consultant hired for this mission was not supported by the donor however.

In May 1983, a detailed feasibility study was commissioned to a consultancy firm, which in its Feasibility Report of January 1984 proposed a "conceptual improvement of the water management system" (SOGREAH 1985, 5). This proposal involved a major rehabilitation within all distributary-channel subsystems combined with a program for organizing the water users by means of institutional organizers. The feasibility study thus proposed an engineering solution for the excess water use in Uda Walawe, without giving further project objectives which would tackle the managerial performance of the managing agency apart from training and an operation and maintenance manual. While the MEA top management did not agree with the omission of the augmentation options for the main system to enable more water to be issued to the tail-end blocks, the aforementioned leverage used by the donor with respect to Uda Walawe did not allow it to change SOGREAH's proposals.

In August 1984, the donor's Appraisal Report recommended a major rehabilitation program which incorporated mainly construction components. The rationale was that water saving over the whole command area would make it possible to obtain the originally envisaged benefits of the project in terms of command area and cropping intensity, and would save water for earlier and future donor investments in the Left Bank; an all or nothing strategy. The only difference with the original Walawe project is a more "conceptual design approach," a training component for the O&M staff and the preparation of an Operation and Maintenance manual; a method for tackling the managerial problem of water waste by the head-end reaches was not given. The report mentioned the forming of water user groups but did not allocate any funds to start these. According to MEA, the donor's Appraisal Mission could not approve funds for this purpose because the additional US$2 million required would endanger the EIRR which included all sunk costs. For the same reason, the donor had made it clear from the beginning that they would not invest more than US$10 to 12 million in the rehabilitation of Uda Walawe. While MEA preferred these water user groups to be incorporated, it did not insist on it and gave priority to the hardware aspects within these funding limits. Involved staff felt that such donor criteria are definite, and that the MEA did not give much weight to this program that it wanted to sever its relation with the donor staff.

Mutual Adaptation of Technical and Managerial Aspects

The rehabilitation project was not considered a priority by the Government of Sri Lanka. The disappointing results of the earlier investment and the low EIRR of 7 percent motivated the donor to use the leverage of several potential loans to the government to push the Walawe Irrigation Improvement Project (WIIP) which was originally attributed a low priority. Therefore, the WIIP objectives can thus be considered to be more desirable in the eyes of the donor than of the government. The most desirable objective was the improvement of the EIRR, through rehabilitation of the irrigation system and envisaged water saving. The water saving, in addition, would ensure the water availability for past and future investments in the Left Bank command area of Uda Walawe. Consequently, the commitment of the Government of Sri Lanka to the achievements of the WIIP has been rather low. It has been observed by IIMI during this study that the project was considered by project and head-office MEA staff to be more a project of the donor than of MEA.

From the moment the government had agreed to a rehabilitation, the further definition and elaboration of desirable project objectives was done mainly by the donor staff and consultants. The role of project-level MEA staff was thereby limited to delivering basic data, while MEA top management was involved in making final decisions only. Their role in decision preparation was very limited, and to the degree they were, they felt the leverage and priority given by the donor towards the rehabilitation of Uda Walawe. Important criteria used for determining the desired system objectives were the EIRR and hydraulic engineering soundness, rather than their desirability towards MEA project staff and different interest groups of water users. The commitment of these latter groups towards the achievement of WIIP objectives has been limited throughout the whole project.

The desirability of reducing the excessive water use by the head-end blocks and introducing subsidiary field crops on well-drained soils has been determined by the donor staff and consultants, but the involved project staff, water users and their politicians have not been consulted at all about the desirability of these objectives. It is well-known in Sri Lanka and it has been proven that it is impossible to enforce farmers to grow certain crops (see for example Jayasekara in a discussion on Uda Walawe in Institution of Engineers 1983, 139). This was acknowledged by the donor's Project Performance Audit Report which recommended that "a realistic cropping pattern compatible with physical, economic and social conditions should be developed and introduced as soon as possible" (ADB 1982, 32). While the donor's Appraisal Report explicitly recognized this, they implicitly assumed that water duties in the well-drained soils could be improved to levels similar to those of subsidiary field crops.

In general, it seems surprising that after the Project and the Post-Evaluation Divisions of the donor agreed on the lack of managerial performance as the basic cause for project failure, another construction-oriented solution was again implemented with only training and an operation and maintenance manual to tackle the root of this problem. All reports stress the need to improve the managerial performance, but the interpretation of what the related desired objectives for another project should be are different for every report and the management aspects have slowly faded away in the chain of reports. Apparently, individual insights and opinions of the donor staff and consultants were allowed to play a major role in the identification and evaluation of the most desirable project objectives. The donor did not shy away from enforcing them on the national government, agencies, and water users.

A logical result of such an approach to identifying desirable system objectives is the lack of identification of clients and implementers (i.e., the national government, the agencies, and the water users) with these desirable objectives; they are desirable for the donor, but not for them. The project is a donor project and realization of its objectives is considered a donor problem rather than theirs.

CHAPTER 8

Strategic Concern: Feasible Objectives for Rehabilitation

MATCHING DESIRED SYSTEM objectives with available resources (e.g., funding for investment, staffing capabilities, future staffing, and maintenance budgets) evolves into the determination of feasible objectives for system rehabilitation. While the desired system objectives encompassed things like system rehabilitation or improvement, cropping patterns, land settlement, and system sustainability, the focus in this chapter will narrow down to water related issues. Feasible system objectives are, for example, the area to be commanded by irrigation water at a certain point in time, the different crops to be grown and their cropping intensities, the acceptable cultivation risks, the predicted performance of water delivery, the economic effectiveness and efficiency of an investment, etc.

The feasibility assessment depends to a large extent on the assumptions made with respect to the expected benefits (e.g., water duties and related irrigable area, crop yields) and available resources (e.g., maintenance funds, water and land resources, quantity and quality of staffing, service fees for cost recovery). These assumptions can be supported by, for example, historical data from similar earlier investments, surveys of the existing benefits and resources, and theoretical scientific approximations.

THE DECISION-MAKING PROCESSES

Available Water Resources and Related Augmentation Options

Technical aspects. The effective active storage capacities of Uda Walawe and the Chandrikawewa reservoirs are 240 mcm and 10 mcm, respectively. Data available for assessment of the water supply available to the Uda Walawe system has been rather limited. In the absence of actual records the design of the dam in the sixties was based on synthetic flow data of a 26-year period. Near the dam site a gauging site was established in 1957, which provided flow data up to March 1960. Near Embilipitiya a gauging station provided flow records from 1942 to 1967. For the present system additional data are available. Between 1972 and 1980, the inflows at the dam site were calculated by the Reservoir Balance Method. Moreover, new inflow measurements were started after 1984.

Inflow data of some of the tributaries of the Walawe River were available as well. The Hulanda Oya River provides inflow to the Chandrikawewa Reservoir and some broken inflow records between 1954 and 1962 were available. The Mau Ara River discharges into the Mahagama Reservoir on the Left Bank and inflow records were available for the years 1954 to 1962.

Based on the above figures several assessments of the available water resources have been made over time. The donor, in its Project Completion Report, estimated the average annual inflow into Uda Walawe Reservoir at 1,095 mcm, of which the regulated volume varied between 725 mcm and 565 mcm depending on the water consumption of the system itself. The annual regulated volume of the Hulanda Oya would vary between 13 mcm and 28 mcm depending on the regulating capacities of the Chandrikawewa Reservoir (ADB 1979, 94). How these volumes were estimated is unclear. Presumably, they originate from the original project appraisal in 1968. No remarks have been made about the seasonality of the water availability in terms of its functionality for the cultivation. Only the supply and utilization of return flows to the Ridiyagama system were quantified for different scenarios.

PRC consultants estimated the average annual water inflow (i.e., 50% dependable inflow) to Uda Walawe Reservoir at 987 mcm, based on statistical analysis of inflow and rainfall data from 1943 to 79 (PRC 1982, III.9). It neither assessed the related regulated water resources, and related probabilities nor did it provide a similar assessment for the other tributaries which supply water to the system. No remarks were made about the seasonality of the water availability, or about the supply of return flows to subsystems.

SOGREAH estimated the average reservoir inflow over the 40 years before 1983 at 1,100 mcm. The average annual regulated volume between 1974 and 1983 was estimated at 720 mcm. A volume of 665 mcm had been regulated in the past in 8 out of 10 years. Its report adds, "however, there had been opening of spillway gates outside the flood period and a fairly imprecise management of the releases. It seems that a good management of the reservoir could enable to increase water resources available from the Walawe dam" (SOGREAH 1984, A2.12).

Despite insufficient inflow data of the Hulanda Oya River, SOGREAH estimated the average annual inflow at 45 mcm, of which, it estimated, only 15 mcm could be effectively utilized due to the required minimum water level to be maintained for issuing to the Kachchigala Reservoir. The average annual inflow of the Mau Ara was estimated at 54 mcm of which only 5 mcm was expected to be effectively utilized. The total annual supply to the Uda Walawe system was therefore estimated at 740 mcm. In 25 percent of the recorded years the supply at the end of the yala season appeared to be critical, with one actual crop failure in 1983 (ibid., A2.12). SOGREAH made the potential irrigable area dependent on this actual regulated volume (ibid., A2.14). A water balance study for the already developed (in 1983) command area showed a potential regulated volume of 785 mcm in nearly 9 out of 10 years, provided better operation rules for the reservoirs would be practiced.

At the same time, SOGREAH also advised to restart flow measurements upstream of the Uda Walawe Reservoir and upstream of the diversion structure for the Ridiyagama system, or, alternatively, to restart the gauging station in Embilipitiya. An additional gauging station in the Hulanda Oya, upstream of the Chandrikawewa Reservoir, was considered useful "to have knowledge of the regime of inflows at the dam to clarify the doubt regarding run-off coefficient of the catchment area, to control operation of the reservoir, and to evaluate gain of water resources to be expected from an increase of the dam active capacity" (ibid., A2.22).

SOGREAH also stated that too little data were available on actual return flows to quantify them. It estimated a theoretical total return flow of 191 mcm for the overall system. Apart from the recapture by the Ridiyagama system it advised recapture by existing or rehabilitated village tanks and that "a detailed study <i.e., regarding possible use of return flows> should be carried out on the basis of experiments, detailed survey of existing tanks and possible capacity increases" (ibid., A6.6). It made a cost estimate for one such tank and extrapolated these for 37 existing tanks which were found on the original Blocking Out Plans (BOP) and which would allow for capture of 18 mcm.

The donor's Appraisal Report of 1984 adopted the assessment and outcomes of SOGREAH's feasibility study, apart from the water balance study. The donor used the water balance for the planned, instead of the existing, command area but did not derive the annual regulated volumes from this (ADB 1984a, 75). It quantified the seasonality of the supply to the system to conform to SOGREAH's findings.

In its Inception Report, the foreign consultants for the rehabilitation project, Sir M. MacDonald & Partners Ltd. (MMP) adopted SOGREAH's estimates. They installed several new measurement stations in line with SOGREAH's advice. No conclusions were reported except for the smaller supply from the Hulanda Oya than estimated before (MMP 1986a, A2.5).

In 1989, MMP also established the influence of the Samanala Reservoir, under construction upstream of Uda Walawe, on the inflow and regulated volume of the Uda Walawe Reservoir and its distribution over the year. With the Samanala Reservoir the probability of a 700 mcm inflow would increase from 65 percent to 80 percent, or from 60 percent to 65 percent, depending on the data set used (MMP 1989a, 6). Between 75 percent and 95 percent reliability, "operation of Samanala <reservoir> with a firm power target would increase low flows particularly in the post-yala dry season and decrease significantly the flow into the two wet seasons" (ibid.). In addition, the influence of Samanala Reservoir on the annual regulated volumes was calculated for different scenarios, and appeared to be relatively marginal.

Apart from the possible capture and utilization of return flows by means of village tanks, different reports also mention possible ways of augmenting the available water resources; by raising the bunds of Uda Walawe and Chandrikawewa reservoirs, and by rerouting the Chandrikawewa main canal. Raising of the Uda Walawe bund envisaged an increased supply to the overall system, while the other option, in addition, aimed at providing more supply to the tail-end blocks.

The donor's Completion Report envisaged an increase of the average annual supply by the Hulanda Oya River to the Chandrikawewa Reservoir from 13 mcm to 28 mcm through the raising of the Chandrikawewa dam with the associated gated spillway. The donor's pre-feasibility study estimated increased average annual water supplies of: a) 37 mcm by the raising of the Chandrikawewa Reservoir level by 2.13 meters, b) 96 mcm by raising the Uda Walawe Reservoir level 0.91 meters, c) 37 mcm through the bypassing of the Chandrikawewa Reservoir, and d) 25 mcm by the capture of return flows. In addition, it mentioned a possible annual water saving of 35 mcm by the separation of the domestic water supply from the irrigation canal network (Wolf 1983, A.6). Related costs for these five options were given per volume of increased water supply and per unit additional irrigable area.

SOGREAH studied several augmentation options as well. Raising of the Chandrikawewa Reservoir or bypassing it would yield an average annual volume of 20 mcm, raising the Uda Walawe Reservoir by 1 or 2 meters would yield an average regulated volume of 40 or 98 mcm, respectively, capture of return flows would yield 18 mcm, implementation of the Samanala Reservoir 55 mcm and separation of the domestic water supply system from the irrigation canal network 12 mcm (SOGREAH 1984, A2.44). The donor's Appraisal Report of 1984 did not quantify any of the augmentation options, but incorporated the "rehabilitation of 15 minor tanks to capture and re-use the return flows from the irrigation system" (ADB 1984a, 82).

Managerial aspects. Probably due to the rather insufficient data available to assess the water resources available to the Uda Walawe system, much effort was needed in reaching the assessments of all the reports mentioned above. While the statistical techniques vary, the conclusions are largely similar.

The probability criteria determining the water availability for the Uda Walawe system were apparently left to the involved specialists rather than to the Government of Sri Lanka or the donor. However, the difference between the 75 percent and 50 percent probable inflow figures and the present actually regulated volume figures were considerable, approximately 200 mcm and 70 mcm, respectively.

This lack of an explicit criterion was compensated by some of the experts who prepared a report on the water balance of the reservoir over a number of years with historical monthly inflow figures. This water balance report indicated the success (in percentages) of assumed cropping pattern, irrigated area and related irrigation requirements. The available water resources were not explicitly expressed. The disadvantage of this practice is the difficulty of assessing the success of irrigation requirements deviating from these assumptions. Moreover, the water balance report covered a period of 15 years only, while inflow figures for a period of 40 years were available.

SOGREAH has mentioned in this respect the usefulness of recognizing the existing regulated water resources as an important intermediate result and "reference point," because these water resources would be less dependent on the hypotheses made (SOGREAH 1984, A2.13). For its report on water balance, however, it used historical monthly inflow records as well. In its calculations, the difference between the probable inflow and the actually regulated water resources was 740 mcm for the intermediate result and 758 mcm for the water balance.

The augmentation options were considered at the request of the donor and the Government of Sri Lanka. The pre-feasibility study considered them feasible, and "potentially cost effective since the major portion of the conveyance and distribution system already exists and costs would be confined primarily to upstream facilities. The consultant believes that implementation of an augmentation option should only be carried out, if, and only if, the program of minor rehabilitation that precedes it meets certain targets for amounts of water applied per hectare and for areal extent irrigated" (Wolf 1983, v). Thus, the loan money for the augmentation options was proposed to be used as an incentive to improve the managerial performance first. The total cost of the proposed minor rehabilitation program was US$4.7 million. As mentioned in Chapter 7 this conditionality was not supported by the responsible donor staff.

During the feasibility study, apart from the capture of return flows, these options were considered too expensive by the donor representatives for the present rehabilitation project because it would reduce the Economic Internal Rate of Return (EIRR) of the total investments in Uda Walawe (i.e., including sunk costs) below 10 percent and would thus endanger approval by the donor's management. The total approved loan was, however, US$13.7 million, which would have allowed for Wolf's minor rehabilitation and, for example, the rerouting of the Right Bank main canal above the Chandrikawewa Reservoir. The augmentation options were thus given little priority compared to reduction of the water duties per area, even if the costs per ha were tripled. The main reasoning behind this was the donor's priority for saving water for the Left Bank and thus enabling the improvement of the EIRR of the past and future investments there.

Raising of the bund of the Chandrikawewa Reservoir was considered unpracticable by the MEA anyway because new investigations into the foundation of the dam would be required, no borrow pits were available within 8 km, and it would prohibit cultivation of the entire command area downstream of the reservoir for three seasons. Retracing of the Right Bank main canal was explicitly proposed by an early CECB study (CECB 1976, V.12) and by SOGREAH (SOGREAH 1984, A2.27).[6] In principle it had also been preferred by the MEA's top management but the leverage used by the donor with respect to the Walawe Irrigation Improvement Project (WIIP) made it difficult for them to resist the donor in this respect. Raising of the bund of the Uda Walawe Reservoir by one meter was considered feasible and cost-effective by the donor and MEA, but was decided to be done under the development of the Left Bank, to keep the EIRR above 10 percent. For the same reasons only 15 of the 37 proposed village tanks were retained.

The donor Appraisal Report of 1984 retained the proposals of the feasibility study. However, during implementation of the rehabilitation project the project top management changed its mind and, apart from two village tanks, decided to abandon this only remaining augmentation option, because it feared that rehabilitated tanks would not only use return flows but would demand water rights and extend their command areas further. This would only increase the water duties for the present official command area and thus endanger the success of the project objective of making water available for development of the tail ends of Right Bank and Left Bank command areas. This last argument, in fact, dominated the entire decision making with respect to inclusion of augmentation options; neither of them would guarantee the development of the entire originally envisaged command area on Right Bank and Left Bank and the related improvement of the overall EIRR. Sustainability of these village tanks, and other functions like bathing and drinking water were not considered in this decision making.

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[6] The dropping of the Right Bank main canal in the Chandrikawewa Reservoir had not been envisaged in the original design, but had been done after political and other local interventions during the actual construction. Therefore, retracing may have been politically very difficult.

Feasible Water Delivery Concept

For the determination of feasible reservoir capacities and dam heights by means of a water balance, it is necessary to establish the feasible irrigation requirements of the envisaged command area as well. The feasibility of these irrigation requirements depends again on the feasibility of the envisaged water delivery concept. The different reports preceding the WIIP considered different water delivery concepts which will be discussed hereafter.

Technical aspects. The Project Completion Report states several impediments in the water delivery concept of the original project: limited permissible water level fluctuations in the Chandrikawewa Reservoir seriously reducing its regulation and storage effectiveness; single bank canal creating several dead storages at permeable reaches and causing heavy percolation losses; insufficient cross-regulators in main canal "limiting the flexibility of rotational operations of the system and necessitating higher water levels than required....resulting in excess discharge and water wastage downstream" (ADB 1979, 52); the absence of measurement structures at heads of branch canals, and distributary and field channels "rendering rotational operations of the irrigation system problematic" (ibid.); and lack of provisions for reuse of drainage water.

The report also remarks that "downstream <of the head sluices> only minimal efforts are exercised for proper rotational irrigation operations at the Project level. Other than at Walawe Reservoir, no records were maintained" (ibid., 54). And, "a primary cause of low irrigation efficiency is related to paddy cultivation on highly permeable soils in Tracts 2-7. The groundwater table is found near the surface, and an impermeable pan is thus not developed over time. About four to ten times more water than actual crop water requirements percolates below the root zone, most eventually emerging in drains to the Walawe River" (ibid., 55).

The report provides for two possible future interventions for the donor investment in Uda Walawe. Case 1 provided for no further intervention. Case 2 provided for "better operation and maintenance organization and practices to sustain the agricultural production in future years. No major physical improvement, except for the desilting of distributary and field channels is envisaged" (ibid., 48). Case 3 envisaged: "(i) improved organization and more effective utilization of budgets for operation and maintenance together with provision for additional communication and transport equipment, parts and supplies, and of the services of a Water Management advisor, and (ii) completion and rehabilitation of Project facilities without modification of the Walawe Dam" (ibid.). Apart from the increased number of flow control and measurement structures, Case 3 included major components as "raising Chandrikawewa dam with associated spillway, partial lining and construction of right embankment of Right Bank canal, drainage under crossings and cross channel regulators" (ibid., 96).

The writer of the report does not prioritize among the technical aspects of the water delivery concept and the willingness and motivation of staff and head-end water users to put more effort into using existing or improved water control facilities. His argument is that without such additional facilities it is probably less easy to realize rotational issues, and thus these facilities should be provided first. Major rehabilitation (i.e., Case 3) is given priority, provided the government confirms the need for technical assistance by a foreign consultancy firm. The latter is considered to be necessary to overcome to a certain degree the lack of managerial capacity and inputs by the managing agency.

Technically, the Project Performance Audit Report agrees fully with the Completion Report on the water delivery concept, i.e., the single bank canal and the lack of flow control and measurement structures. Also, the Audit Report implicitly recognizes the lack of motivation and willingness of staff to make efforts in realizing rotational issues, by blaming the lack of agency performance on the absence of "a good management system" and "adequate number of capable personnel" (ADB 1982, 15). Water management training and an organizational structure which are "less biased against personnel engaged in operation and maintenance activities in terms of professional rewards," (ibid.) would solve the managerial aspects of the water delivery concept. It considers the MEA an improvement in this respect, compared to the RVDB, because "since the change-over <i.e., only one-and-a-half months before the ten-day mission took place>, MEA has made good progress in solving almost all the problems. <Project Evaluation Mission> believes that under MEA the Project has a good chance of meeting its long-term objectives" (ibid., 23).

The quoted improvements are the initiation of some repair works by the MEA, a "new organization structure" which "provides good communication, both horizontal and vertical within the organization and between organization and settlers" (ibid., 24), and the reduction of the number of surplus workers from about 4,250 to 969 during the month the mission visited Sri Lanka. Unlike the Project Completion Report, this report prioritizes among the technical and managerial aspects of the water delivery concept as follows: "From the economic point of view, <the Project Evaluation Mission> is of the opinion that the Bank's further assistance should give priority to the improvement of irrigation management rather than to the correction of poorly designed and constructed irrigation facilities" (ibid., 29).

PRC report advocated that improvements were to be achieved through "a heavy maintenance program rather than a rehabilitation project" (PRC 1982, S.6). This program recognized that: "Some new water control structures are required <along branch and distributary canals> and there are no measuring devices in the project today. There are no controls at the entrance to the field channels" (PRC 1982, S.5). The report strongly prioritizes the management aspects: "it is axiomatic that solutions to these problems <i.e., the excessive inequitable water deliveries> must be sought prior to or concomitant with new capital expenditures for physical facilities. Realization of the project's real potential will require an approach that addresses the management problems with which the project has been fraught from the beginning. These are indicated as; proper scheduling of deliveries, maintenance and repair of system facilities, improved discipline among farmers, government and political authorities, and on-farm water management" (ibid., S.1).

PRC doubted that "one or two individuals <of the project O&M staff> would be able to make any lasting change in O&M" after a rehabilitation of the system.

> Large amounts of money would have been spent but the basic or underlying problem would not have been solved even though all facilities would be available ... Introducing new procedures through re-structured O&M organization would require the placement of new people into positions with some re-ordering of responsibilities and duties. An expatriate consultant with correct and supportive philosophy should be employed to assist the work, train employees and pass on new technical knowledge, act as catalyst to the local staff, prepare a long range operations program with all the intermediate steps required to reach it...The consultant would either assist in the operation of the system or it could take over the operation using a local consultant to supply some of

> the staffing. Once the project was running smoothly, the local consultants' staff would be gradually withdrawn as the project's staff becomes trained. The consultant would remain on an advisory basis for a period until the project had complete control. The latter approach seems worth trying as the results on the first approach <i.e., rehabilitation> are fairly predictable (ibid.).

The pre-feasibility report opts for a similar approach with respect to the technical aspects, i.e., a heavy maintenance program and provision of additional flow control and measurement structures. Like the Project Performance Audit Report, the report believes that "The new implementing agency, MEA, has the enthusiasm required to make a change in the Walawe performance. Indeed, the maintenance investments made in 1982 have resulted in vast improvement in facilities since the consultant last visited the system in 1979. System performance results — area irrigated, water duties, cropping intensity, and yields — are all highly improved. However, without special financial assistance continued improvement may be difficult" (Wolf 1983, v). Improvement of the managerial performance was envisaged through training in O&M, increased operational control by MEA down to the field-channel level, and increased farmer participation. To ensure such improved managerial performance Wolf proposed to make the augmentation options conditional to further performance improvements during the heavy maintenance program; a clear attempt to give an incentive to the managing agency to increase its motivation and willingness to improve the managerial performance.

SOGREAH proposed a "conceptual improvement of the water management system" (SOGREAH 1985, 5), i.e., fixed discharge and flexible duration rotational deliveries and reduction of water level fluctuations in canals and reservoirs. A much higher increase in the number of flow control and measurement structures than in the earlier reports was proposed (e.g., 55 gated and 675 ungated cross-regulators). The conceptual improvement also comprised the construction of new parallel field channels "in such a way that all farm plots are supplied with water by field channels with a maximum of 12 hectares per field canal" (ibid., 7).

Unlike all earlier reports, except for the donor's Project Completion Report, the feasibility-level consultants considered the technical aspects of the rehabilitation more important than the managerial aspects: "The present structural condition of the irrigation infrastructure, as seen above, is the major obstacle to efficient water management. Other obstacles to a proper water management are the lack of qualified staff at <project> and block levels, the lack of training of the existing staff, the absence of written operation and monitoring procedures" (SOGREAH 1984, 8). Thus, SOGREAH did not consider the motivation and willingness of staff to increase its managerial performance problematic. Also SOGREAH considered MEA's managerial ability sufficient "provided proper consulting services be made available to it" (ibid., ii).

This neglect of managerial performance by agency staff is considered justified partly by the design assumptions with respect to the parallel field channels. Within these channels, water users are supposed to operate an internal rotation, i.e., it attaches "more responsibility to the farmers but less to the operating agency. Because of the variable delivery duration in the field channel, the time that a farmer or a group of farmers irrigate their allotments will have to be adjusted over the season with the change of delivery duration in the field channel. This demands very close interaction and communication among farmers served by one field channel. To sustain such interactions, they are required to be organized as a cohesive group working towards a common interest or objective" (IIMI 1990, 116). However, serious inconsistencies are inherent in this assumption; apart from the often conflicting interests of head-end and tail-end water users along a field channel, their common interest is to get more water to their field channel rather than to save water for the interest of the other channels. Equitability between the field channels has to be initiated and directed by agency staff for larger subsystems, rather than by farmers themselves at the level of the smallest subsystem.

With respect to the managerial aspects of the water delivery concept, SOGREAH stated that: "(i) updating of blocking out plans, (ii) regularization of encroachments, (iii) implementation of groups of water users at turnout level, and (iv) establishment of procedures for communication between water users and project staff and for the planning of water distribution" (SOGREAH 1985, 6) were prerequisites for the proper organization of the water distribution after rehabilitation. These constraints were already partly handled through surveys, administrative measures and the setting up of farmer organizations by the project authority. For the rest, "an operation and maintenance manual is expected to be prepared and the training of project staff is planned to make the application of this manual effective" (ibid., 8).

The donor's Appraisal Report of 1984 endorsed the conceptual view of SOGREAH: "The design of the canal network did not take full account of water management requirements. There is no proper turnout unit as such. Service areas of field channels vary from 1 to 28 ha. A number of farm turnouts are located directly on the distributary canals. Thus, effective rotational distribution is difficult in most parts of the Project area" (ADB 1984a, 12). The improved performance by MEA between 1982 and 1984 is still considered insufficient compared to the achievable benefits. "These improvements are ad hoc and temporary, entail high recurring costs and cannot be sustained over time without a systematic and well designed improvement and rehabilitation program to rectify design and construction deficiencies of the existing irrigation system which are considered fundamental impediments to improved system operation and maintenance on a sustained and equitable basis" (ibid., 8).

Thus, the Appraisal Report contains a detailed description of the technical water delivery concept along SOGREAH's proposal (ibid., 22). The report does not mention anything about the motivation and willingness of agency staff, other than listing the performance improvements during the 1982-1984 period. It endorses SOGREAH's proposals for improvements of managerial performance, i.e., consultancy services and water management training to different staff levels. While it endorses the need for water user organizations and describes in detail their role in the allocation decision-making processes, "the task of mobilizing and organizing farmer initiative and leadership and promoting collaboration and interaction among farmers will be entrusted to the Unit Managers" (ibid., 34). The loan budget does not provide for organizing water users which is remarkable given the heavy reliance on it in the proposed water delivery concept with parallel field channels, and given the report's remark that "an element of risk" for a successful project was attached to timely organization of farmers into effective water user groups (ibid., 42).

In addition, the donor tries to ensure increased managerial performance of MEA: "Assurances have been obtained from the Government that an adequate number of qualified O&M staff, including Deputy Resident Manager O&M, will be recruited to strengthen the Project's O&M division, and necessary budgetary allocations will continue to be made to MEA for O&M purposes. The engagement of a Deputy Resident Project Manager O&M will be a condition to loan effectiveness" (ibid., 33).

Managerial aspects. The Appraisal mission for the original donor investment in Uda Walawe considered the design of a single bank canal and its rerouting along the Chandrikawewa Reservoir undesirable. Instead, the need to change many flaws in design criteria and procedures was recognized by this mission, because "the then prevailing irrigation facilities (main canal, distributary and field channels and control structures) were not properly constructed or designed for effective regulation and distribution of water" (ADB 1982, 13).

The Project Performance Audit Report regrets that no detailed feasibility assessment was undertaken at the that time in view of these deficiencies and considers the donor's own performance in project preparation in this respect inadequate. Such an assessment had not been done "as it was thought it would interrupt the ongoing works and delay the implementation of the Project. <The Appraisal Mission>, however, attempted to reformulate the Project with a view to correcting the identified deficiencies and develope it in consultation with the Government implementation programs for the Project development" (ibid., 14).

However, the responsible Projects Division of the donor comments, in this respect, that it strongly advised the Government of Sri Lanka to review its design of a single bank, "but this was ignored by the Government....that it was not possible for <the Appraisal Mission> to accomplish this as it had to completely reject the traditional design criteria such as the single-bank canal which had been accepted in Sri Lanka for many years. Not until the reappraisal of the Kirindi Oya Irrigation Settlement Project in 1981 did the Bank succeed in convincing the Government to abandon the traditional design criteria of the single-bank canal" (ADB 1982, 14).

Thus, while this perceived constraint was already identified before the donor decided to become financially involved in Uda Walawe, all following reports by the donor staff and consultants try to correct it. Interaction between the MEA staff and the donor staff and consultants about a feasible water delivery concept for Uda Walawe has been limited in all these reports, because the provision for more control and measurement structures was considered a basic prerequisite for improved water delivery performance by all of them.

This perceived prerequisite should be considered against the traditional Sri Lankan water delivery concept. This traditional concept focused on least-cost construction that provided for little control by the managing agency over water flow (i.e., invariable flow), and merely provided an on-off water flow to subsystems whereby the lack of control mattered less, because of the frequent reuse of water further downstream and the often available intermediate storages. This system was relatively uncontrolled with respect to water use but because the design was focused on the reuse of drainage water within the system through single-bank contour canals, intermediate reservoirs, etc., the actual water use efficiency was often difficult to judge exactly.

A small minority of Sri Lankan engineers have argued against increasing the flow control structures up to the level of field channel and farm turnout, but have advocated rationalization of the designs with respect to the reuse of water (e.g., Ismail in Institution of Engineers 1983, 144; Mendis 1977). Implicit in their arguments is their perception of the difficulty and unfeasibility, in the Sri Lankan managerial and political environment, to control water deliveries to different subsystems, let alone up to the farm level. Similarly, Chapters 4 and 5 demonstrated that the pursued increased control over the conveyance along main and branch canals by means of gated cross-regulators implied very optimistic assumptions with regard to the required managerial inputs. Similarly, these chapters showed that increased control below the offtake to the distributary channel subsystem appeared to be even harder to achieve.

Given the necessity to justify any investment with improved water duties, the donor staff and consultants apparently saw few other opportunities than providing the technical facilities for improved control over water flow. They had limited time available and no means anyway to ensure any improved managerial performance. This need for justification of investment has led, over time, to the enforcement on the Sri Lankan agencies of a water delivery concept which is technically sound, but which considers the management inputs more as a variable. In their turn, the responsible top-level decision makers of the managing agencies, given the necessity to obtain foreign funding for irrigation investments, have slowly accepted and institutionalized these new water management concepts, while being aware of their unfeasibility in the Sri Lankan situation. Given the general political interests in obtaining foreign funding for irrigation investments, and the leverage used by the donor to push its own ideas about what is feasible, these top-level decision makers indeed have to maneuver in a complex environment.

Some Sri Lankan engineers have even written about their frustrations over the unwillingness of top management to recognize openly the limitations of irrigation management in the Sri Lankan context, and the implications for irrigation-investment decisions. For example, Visvalingam on Uda Walawe:

"Turning to the Uda Walawe experience, I must say that the lessons which were learnt there, were by no means, unique to it. Almost all the pitfalls had been encountered previously at Gal Oya and elsewhere. Those concerned just walked around these pitfalls but did not bother to fill them in. So we had to discover them anew in Uda Walawe." (Visvalingam 1986, 2) and Mendis on reuse of water within the distributary canal system: "It is an unfortunate fact that such statements from such persons have a certain ex cathedra aura of truth, whereas the reality is the exact opposite. It does not require much imagination how politicians have been misled down the years by such advice, with resultant development of underdevelopment." (Mendis 1989b, 38). The result of the above processes is the comparatively excessive emphasis on increased control over flow without explicitly acknowledging its managerial feasibility.

The managerial constraints are implicitly acknowledged by the donor through its insistence on foreign consultants, the need for an operation and maintenance manual, and related water management training. However, the influence of foreign consultants on the actual managerial performance is very low. An operation and maintenance manual prescribes the ideal utilization of the system, whereby it is left to the judgement of the consultants what "ideal" means; the managerial inputs are considered again as a variable. The consultant usually has to describe how the system can be utilized 100 percent, while he and his counterparts know that this is unfeasible.[7]

Commitment to actually implement the proposed strategy is often very low, especially in a situation like Uda Walawe, where the project as a whole is considered more a donor than a MEA project. Only the pre-feasibility study tried to cope with this lack of commitment, by making the funding of further augmentation options an incentive to the managing agency to improve the water duties and irrigated area.

The proposed improvements in water duties and command areas in the different reports represent the insights and opinions of the individual engineers of the feasibility or appraisal team, and possibly the top management in MEA. This subjectivity of the feasibility assessments could be felt extremely well after the donor Appraisal of 1984 dropped the organizing of water users, or at

[7] It is akin to accepting the specification of a manufacturer that the machine you are buying performs at 100 percent efficiency in order to justify the acquisition while both the buyer and seller know it performs at 60 percent efficiency.

least its funding. This made the rehabilitation program essentially a repetition of the original construction in 1969 with very little justification that the water duties would really improve apart from MEA's apparent enthusiasm to do so.

Assumptions regarding the influence of minor or major rehabilitation, water-management training, water user participation, and increased numbers of control and measuring structures do not reflect the actual feasibility of improvements. Realities from the field and project level about the opportunities and constraints with respect to the feasibility of project objectives are not represented. The donor missions are extremely short-term for this purpose; the pre-feasibility mission spent three weeks in Sri Lanka of which five days were in Walawe (Wolf 1983, iii); the feasibility mission spent five months in Sri Lanka — to produce a report of 573 pages — and the appraisal mission of 1984 spent three weeks in Sri Lanka. Only the PRC consultant stayed for one year in the project area, but even then his interaction with MEA was constrained which reduced opportunities to assess the feasible project objectives well. Thus, longer-term missions of outside consultants do not guarantee a better feasibility assessment.

Apart from the gradually developed broad acceptance by the Sri Lankan agencies of the proposed water delivery concept, the influence of the individual foreign consultants on the details of the feasible water delivery concept for Uda Walawe was relatively large, because MEA itself did not have staff to be involved in such decision making. Only the Project Director in the head office was seriously involved in this decision making at head-office level, and at project level, the staff were used by the missions mainly for the supply of data. A serious interaction, considering, for example, a feasible strategy of reducing water wastage by head enders did not take place at any stage at project level according to MEA staff. Unlike the Irrigation Department, MEA has very limited technical support staff to develop and sustain its own professional expertise.

Because of this limited technical expertise, the choice of this water delivery concept in Uda Walawe was less part of a ritual (that has to be followed to justify the investments) for the MEA, than it was in Kirindi Oya for the Irrigation Department staff;[8] most decisions have been taken by local and foreign

[8] In Kirindi Oya it was more a ritual because the involved Irrigation Department and donor staff did not believe that the water delivery concept would really remedy the managerial constraints (Nijman 1991b).

consultants and project staff did not even consider it their own water delivery concept. As in Kirindi Oya, however, the actual feasibility of the adopted water delivery concept is less the MEA's problem than the donor's.

Feasible Field and Ex-Sluice Irrigation Requirements and Command Area

The essential aspects of the feasibility of an investment in irrigation capacities, whether for new construction, maintenance or rehabilitation, are the envisaged improved water utilization efficiencies, related cropping patterns and potential extensions of command areas. These requirements were established in several reports for the Uda Walawe system and are described in this section. Justifications for these requirements are handled in other sections of this chapter.

Technical aspects. For the original Uda Walawe project, the envisaged field irrigation water requirement for rice was estimated at 1,708 mm for two seasons. The annual ex-sluice requirement for rice was 2,390 mm, thus envisaging 40 percent conveyance losses (Wolf 1983, 1). Field irrigation requirements for sugarcane and cotton were estimated at 1,162 mm and 814 mm per year, respectively (SOGREAH 1984, A1.71). Sugarcane and cotton were envisaged to be grown in 4,364 ha and rice in 7,023 ha of the Right Bank (ADB 1979, 98). Related ex-sluice diversion requirement was 2,377 mm, or 317 mcm for the 11,387 ha in the Right Bank area (ibid., 49).[9]

The Project Completion Report found an actual ex-sluice requirement for the overall Right Bank area of 530 mcm for irrigating only 62 percent of the Right Bank area envisaged in the donor appraisal of 1969 (ibid., 48). This corresponds to a water duty of 7,547 mm "or three times the appraisal estimate" of the duty for rice in the donor appraisal of 1969. Of the 62 percent area cultivated on the Right Bank, the actual area under rice cultivation was 6,823

[9] The original envisaged Right Bank command area was 13,358 ha which was later revised (ADB 1979, 67 and 98). To derive the annual diversion requirements, which are not explicitly stated in the Project Completion Report, this original estimate of the area was multiplied with the envisaged overall duty of 2,377 mm (ibid., 49).

ha, while subsidiary field crops were cultivated in 200 ha only (ibid., 99). On the Left Bank about 3,500 ha were cultivated with rice and subsidiary field crops.

The Project Completion Report estimated overall water duties to become 5,704 mm with minor operational improvements (i.e., Case 2 as described in the preceding section), and 2,692 mm after rehabilitation of the system (i.e., Case 3), which correspond to assumed improvements of 25 percent and 65 percent, respectively (ibid., 94). Case 3 assumed the same area to be cultivated with subsidiary field crops and related low water duties as provided in the original Appraisal Report of 1969. This would allow extension of the total irrigable area from the present 12,535 ha to 16,388 ha and 29,864 ha in the Right Bank and Left Bank, with related annual ex-sluice requirements of 684 mcm and 565 mcm, respectively.

The PRC report envisaged annual field irrigation requirements for rice of between 2,239 mm and 3,641 mm depending on the percentage of land prepared in dry condition in maha and yala seasons. Total project efficiencies of 20 and 50 percent were considered, with and without effective rainfall. Cultivation of subsidiary field crops was considered unfeasible, apart from the existing area of sugarcane on the Left Bank. The potential irrigable areas varied between 22,522 ha and 35,300 ha (PRC 1982, S.4), which, compared to the actually cultivated 12,535 ha in 1982, suggests improvements of at least 80 percent and up to 180 percent were assumed for a cropping intensity of 200 percent.

The pre-feasibility study estimated annual ex-sluice irrigation requirements of 3,445 mm for rice, including 70 percent conveyance efficiency by means of the modified Penman method. Comparing this figure with the original Appraisal Report estimate, the pre-feasibility mission remarks that "underestimation of water duty at appraisal resulted in an overestimation of the area that can be irrigated" (Wolf 1983, 6). The pre-feasibility mission did not start with these original assumptions regarding cropping patterns, duties and command area but instead looked more pragmatically at the land already committed to be irrigated, and what improvements in water duty would be required to reach these committed targets.

The actual annual duties between 1981 and 1983 were already improved to 5,850 mm, i.e., by 23 percent compared to 1979 (ibid, 1). Commitments for existing and future irrigated lands of 12,146 ha on the Right Bank and 8,800 ha on the Left Bank had diversion requirements of 418 mcm and 303 mcm, respectively. For the Right Bank this required a further improvement of the water duty to 3,285 mm, or 55 percent. Instead the report proposed 3,445 mm, or 41 percent improvement, and cultivation in the overall command area of 20,900 ha in maha and 19,100 ha in yala (ibid., 8), or an extension of 39 percent compared to the peak area irrigated till 1982 of 12971 ha (ibid., 6).

The feasibility study envisaged annual ex-sluice irrigation requirements for rice of 4,590 mm in the short term and 3,180 mm in the long term in the Right Bank area, representing improvements of 27 percent and 84 percent, respectively, compared to the requirements during 1981-1983. Related ex-sluice diversion requirements for the total command area were 748 mcm in the short term and 745 mcm in the long term, or approximately 60 mcm more than the existing diversion requirements. In the short term, the command area would expand from 11,120 ha (ADB 1984a, 74)[10] to 17,615 ha (SOGREAH 1984, A1.66), or 58 percent, and in the long term to 29,840 ha (or 168%). Subsidiary field crops would be cultivated in 1,644 ha in the short run, and in 8,901 ha in the long term (SOGREAH 1984, A1.90).

The ADB Appraisal Report of 1984 estimated annual ex-sluice diversion requirements for rice and subsidiary field crops at 3,775 mm and 934 mm respectively. Cultivation of subsidiary field crops would increase from 2 percent to 4 percent of the irrigable area only. Overall diversion requirement for 11,940 ha of the Right Bank area was estimated at 405 mcm, or 3,391 mm, which assumes an improvement of 72 percent compared to the achieved duties over the 1981-1983 period. The irrigable area in the Right Bank area would be increased from 8,070 ha to 11,940 ha (or by 48%), while the Left Bank area would be increased from 3,050 ha to 5,905 ha (or by 94%). The overall command area would increase from 11,120 ha to 17,845 ha, or by 60 percent. While no diversion requirements are given for the Left Bank area, this would be 200 mcm assuming a similar duty as the Right Bank.

The potential irrigable area under the Uda Walawe Reservoir is estimated at 31,606 ha, or an improvement of 284 percent over the actual area, but a water balance projection was made for the envisaged area under the rehabilitation project only (ADB 1984a, 76). This potential irrigable area would require

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[10] SOGREAH overestimated the existing irrigated area by 6,495 ha or by 58 percent in its report (SOGREAH 1984, A1.66).

1,071 mcm, which is much higher than SOGREAH estimated available regulated water resources of 740 mcm. Implicitly, the envisaged long-term command area under the Uda Walawe Reservoir might have been reduced in the Appraisal Report from 32,788 ha in 1969 to 17,845 ha in 1984, or by 54 percent. As this extension of the cultivated area was an important reason for this rehabilitation project as described in Chapter 7, it is more likely that the donor Appraisal Report did not want to make explicit projections about the actual feasible command area in the long term. Both the Project Completion Report and SOGREAH estimated the available water resources for the Ridiyagama system, situated downstream of Uda Walawe system, to be greater than its water requirements "in all cases...consequently it would never be necessary to release water by the by-pass of the Walawe Reservoir to feed the anicut" (SOGREAH 1984, A2.17). However, the donor Appraisal Report of 1984 states that a total shortfall of 69 mcm might occur. A water balance study showed that "even if the Uda Walawe Reservoir were to meet these shortfalls through by-pass releases to the lower Walawe river, the shortfalls could have been accommodated without affecting the irrigation supplies for the Uda Walawe system in 14 out of 15 years" (ADB 1984a, 76).

Managerial aspects. The annual water duty of 2,377 mm originally assumed by the donor in 1969 was quite optimistic compared to the average annual ex-sluice water duty of 3,810 mm used in Sri Lanka by the Irrigation Department for the design of major tanks (Arumugam 1957, 32). The original donor assumptions were used as a basis for a feasible command area and related economic feasibility. When these targets were not achieved by 1979, further feasibility assessments were not oriented toward estimating the actual feasible targets in terms of water duties and command area; they were oriented rather at achieving the original 1969 targets in terms of water duties and irrigable area, and thus project benefits in the long term. Likewise for Kirindi Oya it has been found (Nijman 1991b) that reliance on the EIRR only is quite misleading with respect to the actual feasibility of the adopted project objectives. Only the pre-feasibility study by Wolf takes a slightly different approach, by determining the improvements in water duties required to achieve the already committed irrigable areas instead of the originally targeted areas.

The calculations by means of theoretical formulae like the modified Penman formula seem to give rather subjective outcomes; assessments are different and

Table 9. Evolution of performance targets, Uda Walawe.

Report	Annual ex-sluice water requirement (mm)	Implied improvement (%)	Developed command area Right Bank (ha)	Developed command area Total potential (ha)	Implied improvement (%)	Cropping intensity (Right Bank) (%)	Implied improvement (%)	EIRR[c] (%)
Appraisal Report (ADB 1969)	2,377	60	13,358	32,724		200		12
Project Completion Report (ADB 1979)	2,692	25-65	10,771	29,864	(73)[b]	200	64	7-10 (32)[c]
PRC/ECI 1982	?	80-200	13,200	22,522-35,300	80-200	200		-
Wolf 1983	3,445	41	12,146	20,900	39	190		-
SOGREAH (1984)	2,497-4,246	27-84	11,140	17,615-29,840	58-168	190	40	25-35[c] 8-10
Apraisal Report (ADB 1984[a])	3,591	72	11,940	17,845-31,606	284 (60)[b]	185	38	20-22
Actual (ADB 1979)	7,574[a]		7,010			122		
Actual (Wolf 1983)	5,850		9,291	12,791				

[a]For rice only
[b]Right Bank only
[c]Rehabilitation investments only

vary between 1,708 mm and 4,590 mm (or 270%) depending on the assumptions made. Even for a new construction project the values obtained by using these theoretical formulae, instead of gross values, seems to be of doubtful accuracy (Nijman 1991b). Specifically based on experience in Uda Walawe similar conclusions were published as early as December 1983 by Visvalingam: "Purely scientific research results on the physiological requirements of plants in respect of water provide a very misleading basis for computing irrigation requirements. The depths and frequencies of irrigation needed in practice were found to be very much higher than those assumed in the feasibility studies" (Visvalingam 1986, 4).

For a rehabilitation project, the variability of these assessments is much too subjective and unreliable to justify potential improvements below 100 percent or so. The use of theoretical formulae to justify water duty improvements of 25-65 percent, 80-200 percent, 41 percent, 27-84 percent and 72 percent, by the Project Completion Report, PRC, pre-feasibility, feasibility, and appraisal studies, respectively, seems absurd. Especially after 1982, when basic improvements had been achieved with relatively limited management inputs, justifying further achievements has much less to do with theoretical water requirements than with constraints to realize increased management inputs. Irrigation efficiency has a very vague meaning given the errors in its assessment in this way.

However, the assumed benefits of a project consequently do also vary roughly within this range of assumed water duties through the present method of assessment of feasible project objectives. The assumptions made regarding the future water duties of a system have a major impact on the economic feasibility. Despite this importance large variations occur in the assessments by different donor staff and consultants.

The interaction between the donor staff and consultants and the MEA staff regarding the feasible water duties and command area were dominated, since 1979, by the donor objective to achieve an acceptable EIRR which includes the sunk costs. The MEA top-level or project-level management was not really actively involved in all of the above assessments. The official Feasibility Report was done by a foreign consultant, hired and paid by the donor. The donor does this to get a more objective picture of the feasibility of a project than could be expected from the national government and agencies. On the other hand, in general, it is difficult for an outside consultant to reliably assess possible and feasible improvements in water duties and irrigable areas.

As can be concluded from chapters 3 to 6, such improvements depend to a very large extent on the motivation and willingness of the managing agency to achieve improvements, and can thus be expressed reliably only by that agency itself. Only they can really achieve the feasibility of such improvements given their relations with the water users and the preferences with water users and agency staff. However, their opinions in this respect are unlikely to come out if funding feasibility is at stake and, especially, if the donor and consultants do not even involve them in these assessments.

The official Appraisal Report of the donor only repeats the same type of assessment by the outside consultant for the Feasibility Report, and this is not necessarily the agencies' strategy for improvement. Of course, each specialist will have his own subjective interpretation of theoretical water requirements, their feasibility, and required strategy which will lead to another outcome. Neither the donor nor the Government of Sri Lanka has established rules and criteria regarding the use and consistency of these theoretical assessments and their outcomes. For the involved decision makers in MEA, the actual estimated feasible water duties are irrelevant as long as they obtain the funding for rehabilitating Uda Walawe; it is part of an internal donor justification rather than anything else. Commitment of the agency in realizing this unfeasible target water duty may thus be very limited as well.

Feasible Cropping Patterns, Intensities and Yields

Factors that directly influence the assumptions with respect to feasible water duties and related command area are the assumptions with respect to the cropping patterns, cultivation calendars, and cropping intensities. Apart from their importance for these assumptions, cropping intensities, cropping patterns, and cultivation calendars have a major influence on the economic-feasibility assessment because they are the major outputs of an irrigation system.

Technical aspects. Before or at the time the donor became involved in Uda Walawe, the government had decided that rice would be grown on the well-drained soils of the area upstream of the Chandrikawewa Reservoir. This decision was taken on the "insistence" of a then minister. Visvalingam considers this as "a disastrous example of the misapplication of ministerial omniscience" (Visvalingam 1986, 5). The original donor project envisaged cultivation of subsidiary field crops in the Right Bank only, in about 50 percent of the area downstream of the Kachchigala Reservoir. It appears that only 5 percent of the area was actually cultivated. The Project Completion Report concluded that preparatory measures had been insufficient in this respect, and that it is "often difficult to effect substantial changes of a cropping system once it is fairly well established" (ADB 1979, 50).

The Project Performance Audit Report endorsed this and recommended that "a realistic cropping pattern compatible with physical, economic and social conditions should be developed and introduced as soon as possible. Attempt should also be made to motivate farmers to adhere to a determined cropping calendar" (ADB 1982, 32).

The Feasibility Report of 1984 envisaged the increase of the cropping intensity in the Right Bank area from 136 percent to 190 percent in the short term and the long term for a constant irrigable area of 11,940 ha. Without the project it would increase by 148 percent. The annual area cultivated with subsidiary field crops would increase from 709 ha (4%) to 1,810 ha (8%) in the short term, and to 5,405 ha (24%) in the long term. For the Left Bank the cropping intensity would increase from 111 percent to 190 percent, in the short and the long term both with and without the project. In the long term the irrigable area would increase from 5,675 ha to 17,900 ha. Because of SOGREAH's overestimation of the total existing irrigable area by 6,495 ha or 58 percent, it is difficult to judge the above values. In the short run, it did not envisage major increases in areas cultivated with subsidiary field crops. Rice yields were assumed to increase from 4.0 t/ha (ton per hectare) to 4.5 t/ha without the project and to 4.8 t/ha with the project in the short term and the long term.

The Appraisal Report of 1984 envisaged an increase in cropping intensity from 134 percent to 185 percent for a constant irrigable area of 11,940 ha. The annual area cultivated with subsidiary field crops would increase from 709 ha (4%) to 1,500 ha (7%). Rice yields would increase from 4.0 t/ha to 4.5 t/ha. Without the project, the cropping intensity, yields and area cultivated with subsidiary field crops would remain the same. Justification for the increased cropping intensity was the envisaged improved water duties. No justifications are given for the yield figures and the zero-growth for the "without" situation. Note that SOGREAH's "without" is equal to the donor's "with" yield projection.

Managerial aspects. Understanding of the reasons behind the nonadherence of the water users and the agency to the envisaged cropping pattern in the original Uda Walawe project led to the understanding in most reports that the introduction of subsidiary field crops in Uda Walawe would be very difficult. The Project Performance Audit Report even stated that "Recommended cropping patterns to irrigation projects should be based on pilot or existing scheme on an operational scale" (ADB 1982, 30).

Both the Project Completion Report and the Project Performance and Audit Report remark that the cultivation of rice in the well-drained soils of the tracts upstream of the Chandrikawewa Reservoir was one of the major factors leading to excessive water duties; their feasibility assessments of the cropping patterns are correct, but do not correspond to the assumed feasible water duties after rehabilitation. The SOGREAH and Appraisal Reports reasoned along the same lines.

The Government of Sri Lanka and the donor do not provide for rules with respect to the consistency in sequential feasibility assessments; the feasibility and appraisal studies make conflicting "with" and "without" project assessments whereby no justifications or references to earlier assessments and experiences are apparently required.

Feasible Maintenance and Related Life Span of the Project

Technical aspects. The Project Completion Report assumed a life span of 30 years for the rehabilitation project. SOGREAH and the donor's Appraisal Report assumed a life span of 28 years for the rehabilitation project and related production increases from the completion of the project construction in their calculation of the economic rate of return. The background to this 28-year life span is the expected life span of 50 years of the dam from 1968. However, experience with similar rehabilitation projects elsewhere reveals that the water delivery performance severely deteriorates after several years due to lack of maintenance funds. In practice, downstream development of many irrigation systems has to be rehabilitated every 15 years; 28 years is quite optimistic in this respect. The donor does not mention this risk in any of its Feasibility or Appraisal Reports.

The estimated high operation and maintenance cost of US$67/ha over the 28 years is "based on the experience of various irrigation schemes in the world" (SOGREAH 1984, A8.13). A typical budget is added, but no reference is given for this amount. The donor's Appraisal Report adopted a value of US$28/ha without clarifying or justifying the size of this figure. In addition, it made several covenants in the Loan Agreement with the Government of Sri Lanka with respect to organization of water users and their participation in allocation decision-making processes, and provision of "adequate" staffing for O&M by MEA (ADB 1984d, 22). The meaning of "adequate" was not specified apart from the provision of a Deputy Resident Project Manager, O&M whose availability would be conditional for loan effectiveness.

Managerial aspects. The provision of sufficient maintenance funds is problematic in many developing countries. So, whatever maintenance costs are assumed to be necessary by the donor or MEA, it is very unlikely that MEA will be able to obtain funds that will maintain the physical infrastructure for a period of 34 years without a major rehabilitation.

A certain air of unreality of the donor and the Government of Sri Lanka exists in this respect. The donor has included a covenant into the loan agreement in which the government assures the donor that these funds will be made available in future. So, the donor is formally not responsible for insufficient operation and maintenance funds. However, the donor and the government staff involved knew at the time of signing that this pledge would not be realized. Most interviewed top-level government staff and donor staff acknowledged that they agree to this type of loan convenant although they know that there is little chance that this will be adhered to. In that perspective, it tends to be more a ritual to facilitate loan approvals, rather than a way of solving perceived serious constraints for the feasibility of the whole project.

The Government of Sri Lanka and MEA will not be accountable to the donor for the actual feasibility of the donor's assumptions regarding the envisaged irrigation system, or to the level of O&M funds or the life span of the project. Neither are the donor staff members apparently accountable to anybody regarding this type of unrealistic assumptions. Realistic and true assumptions for the feasibility of the envisaged irrigation system become very unlikely within such a setting.

Feasible Cost Recovery from Beneficiaries

Technical aspects. Cost recovery from beneficiaries is perceived as a crucial aspect of the maintenance feasibility of the system. For that reason the donor, in coordination with other donors, set the following requirements regarding countrywide cost recovery of loans in the irrigation sector (i.e., Kirindi Oya and Uda Walawe):

> The Irrigation Ordinance (Chapter 453 as amended by Act No.48 of 1968) enables the Government to levy charges and recover costs of irrigation projects. The amount of charges is to be determined by a competent authority on the basis of the value of the lands benefitted, and the capital and maintenance costs of the Project facilities. An assurance has been obtained from the Government that a cost recovery plan will be prepared and submitted to the Bank by 1 January 1979, with respect to full recovery of operation and maintenance cost and a portion of the capital cost of the project from the beneficiaries. The Government will also ensure implementation of the approved cost recovery program. Submission of the cost recovery plan acceptable to the Bank will be a condition precedent to major disbursements anticipated in mid-1979 (ADB 1977, 31).

The appraisal of the original Uda Walawe project envisaged a water charge of Rs 40 per irrigated acre a year to meet all O&M costs, though at the time only Rs 5 was being charged. After several suspensions of the related legislature the Government of Sri Lanka introduced a levy of Rs 30 nationwide. Collection was started in 1979. The Project Completion Report, written simultaneously, commented that the "The small amount of water levy decided by the Government reflects the need of a realistic assessment of operation and maintenance costs" (ADB 1979, 60).

However, the Government of Sri Lanka experienced difficulties in the actual collection of service fees from the water users. The donor acknowledged this, in 1982, in an Appraisal Report for Kirindi Oya, but insisted and obtained assurances from the government along the following lines: "...by 31 December 1983, prepare and submit a cost recovery program acceptable to the Bank whereby progressive increases in irrigation service fee commencing with effect from 1 January 1986 will result in recovery from Project beneficiaries one-half of the total operation and maintenance costs of the Project by 31 December 1990, and recovery of total operation and maintenance costs by a date to be specified in the cost recovery program (Principal Loan Agreement..)" (ADB 1982, 49).

The capital cost recovery for Kirindi Oya would amount to Rs 13,600 per ha/year (ibid., 41) which is considered unreasonable by the donor given the estimated net farm incomes of Rs 19,000-23,000 per ha/year (ibid., 150). This income is however considered enough to recover the full operation and maintenance costs of Rs 494 per ha/year (ibid., 41). The modest introductory level of operation and maintenance costs rate must be seen "in the context of the present levels of nonpayment of fees, and of recent reductions in fertilizer subsidies and increases in transportation costs" (ibid.).

The Uda Walawe Appraisal Report of 1984 records that the government has amended the Irrigation Ordinance to impose a levy of Rs 247 per ha:

> This rate represents about 50 per cent of average O&M costs on a country wide basis. The Government has agreed to review this rate periodically and increase it progressively at 20 per cent per annum.....The Mission considers this progressive approach appropriate and consistent with the general Bank policy on irrigation cost recovery and has obtained suitable assurances from the Government regarding attainment of full O&M cost recovery by 1989, the introduction of variable irrigation service fees, regular reporting on the progress of fee collection and on improvements in the collection mechanism (ADB 1984, 35).

In the second Kirindi Oya Appraisal Report of 1986, the donor acknowledges that the government has implemented the promised cost recovery scheme, but that the recovery rate had dropped from 42 percent in 1984 to 8 percent in 1985. Reasons given by the government include:

> (i) the as yet incomplete coverage of IMD's program, and thus the inadequate administrative functions in some districts; (ii) in many locations, the worsening security situation; (iii) in some places, farmers' perception that their margins were not adequate to pay these higher fees; and in some cases, (iv) no apparent connection between the irrigation service fees and adequate/improved service. Concerned by this perform-

ance and the implied inequities between paying and non-paying farmers, in June 1986 the government temporarily froze irrigation service fees (ADB 1986, 30).

The donor considers the government's temporary pause justifiable, but it considers the decision to exempt all systems in the country smaller than 200 ha (instead of smaller than 80 ha) from the cost recovery as being too high, as it would "effectively exempt more than 40 percent of countrywide irrigated areas....The government has reiterated its intention to ultimately recover full O&M costs and has agreed to include in the <Sri Lankan Major Irrigation Rehabilitation Project> study consideration for reintroducing the limit of 80 ha above which irrigation fees would be collected" (ibid.).

Managerial aspects. The donor in conjunction with other donors has put more serious efforts and leverage in enforcing a cost-recovery program, than in any other performance aspect of its investments. Apart from loan covenants (ADB 1977, 40; 1982, 44; 1984a, 35 and 1986, 49) they have monitored the progress of the achieved recoveries and invested in related studies and programs. Despite this the government and donor staff appear to be somewhat hypocritical regarding this loan covenant, similar to that for the allocation of operation and maintenance funds.

The aforementioned and the following chain of interventions by the donor show a strong enforcement of these cost-recovery programs — but only superficially. The Kirindi Oya Appraisal Report of 1977 states that "Submission of the cost recovery plan acceptable to the Bank will be a condition to major disbursements anticipated in mid-1979" (ADB 1977, 31). Implementation of such a program was incorporated in the loan agreement.

In 1982, the donor went as far as to threaten the Government of Sri Lanka that "in the event the program is not implemented with effect from 1 January 1986, the Bank may consider invoking Section 8.07(b) of the Loan Regulations, which permits the Bank to accelerate the loan maturity" (ADB 1982, 41).

Despite these threats, in actual practice the donor has little power to enforce its covenants because of overriding excuses from the side of the government. In the absence of a real water delivery service by MEA and the Irrigation Department, there exists little rationale for the cost recovery, and enforcement of the cost recovery appeared to be a political issue. Strong political lobbies against the irrigation service fees exist, especially in Uda Walawe. Successful implementation depends very much on the commitment of politicians to this program. Without it, the government and the donor can agree on those covenants, but the chances for a successful program are very limited.

Feasible levels of cost recovery rates also depend on this political commitment. As long as these politicians are not involved in their assessment, the evolving proposals of the government are for its fulfillment of the donor requirements in order to obtain the foreign funds, rather than a feasible program. Consequently, the politicians and the government do not feel accountable to implementing this enforced cost-recovery program. The feasibility is again more the concern of the donor than of the government or MEA, because future donor loans are not threatened by the government's performance in cost recovery.

Feasible Implementation Schedule

Technical aspects. SOGREAH and the donor's Appraisal Report of 1984 considered a period of six years as sufficient for realization of the rehabilitation of the system. The justification for this period is the time schedule representing the different project components to be completed sequentially. Constraints as mass encroachments, related time required to establish reliable Blocking Out Plans, and time required to effectively organize water users were not considered in this schedule. Instead, they were considered prerequisites to be realized by MEA for a successful rehabilitation.

However, the Project Completion Report is very explicit in stating that an important reason for delayed and unsatisfactory implementation of the original project was "the long-standing problem of land encroachment which defies prompt solution" (ADB 1979, 13). SOGREAH envisaged the Blocking Out Plans to be completed during 1984, but recognized at the same time that "it will take four years from 1984 to solve the problem of encroachments" (SOGREAH 1984, A9.12). By 1983, SOGREAH estimated that about 15,500 encroachers were occupying 36 percent of rice lands inside and outside the Blocking Out Plans, of which only about 3,000 cases had been taken up during 1983 (ibid., A9.10). A way "to hasten the process would be to give top priority to the regularization of irrigated lots...it seems that legal power and enforcement measures exist but it could be that the main reason for not settling speedily and definitely on the regularization and eviction process of encroachments lie in political if not politician's concerns, which is a matter no new set of regulations can solve" (ibid.). Despite these concerns, SOGREAH never refers to encroachments as a risk for the implementation schedule or economic feasibility even while reliable Blocking Out Plans are prerequisites for detailed designs and are thus especially relevant in view of SOGREAH's new water delivery concept.

The Appraisal Mission of 1984 "was informed by the MASL that as of April 1984 permits have been issued to settlers for about 7,100 lots in the Project area. Based on a recently drawn-up work program, land permits for the balance of 3900 lots will be issued by June 1985" (ADB 1984a, 18). It considered this optimistic but achievable, despite the report's quotation from the Project Completion Report that "the long-standing problem of land encroachment defies prompt solution" (ibid., 9). Unlike SOGREAH, it refers to the encroachment and effectiveness of water user organization programs as a risk for the economic feasibility and "these risks have been taken into account while estimating future yields, cropping intensities and benefits" (ibid., 42).

Both the Project Completion Report and the Project Performance Audit Report concluded that the original implementation schedule expected by the donor's Appraisal Mission was unrealistic "in view of the complicated and pioneering nature of the Project, lack of adequate preparation and proven capability of the Executing Agency" (ADB 1982, 19). Adherence to the implementation schedule "as reformulated by the <Appraisal Mission> depended substantially on the services of expatriate consultants....the Government complied with the loan covenants on the use of consultants <in the original project> for the sake of formality without any real intention to benefit from them. As a consequence, the consultants were not able to contribute significantly to the success of the Project as expected by <the Appraisal Mission>" (ibid., 19). The Appraisal Report of 1984 provided for foreign consultants for design and construction and water management assistance and supervision.

Managerial aspects. Planning and scheduling of the implementation of the Uda Walawe system have been done by SOGREAH and the donor and not by MEA, because of the influence of the project progress on the EIRR — towards which the donor staff is more accountable than the staff of the Government of Sri Lanka — which makes it more necessary that the donor plans the project implementation itself. With respect to major constraints like the encroachments and the organization of water users, the responsibility for timely implementation is delegated to MEA. By means of loan covenants MEA assures the donor that the fixed targets will be met. Unlike the Irrigation Department, MASL and MEA give more priority to maintaining these targets to demonstrate to foreign donors their implementing capacity. For similar reasons, MEA's top management is also more supportive of foreign consultants.

The MASL's action plan to solve the encroachment problem in 1984 was quite unrealistic and optimistic in view of the picture given by SOGREAH, and the donor's experience in Uda Walawe. By 1984 the approach of MASL and the donor towards the feasibility of Uda Walawe's rehabilitation project had clearly become biased in favor of the project, despite great risks involved in the longstanding and serious encroachment problem. Even in 1990, the encroachment problem which has been partly the cause for the two-year delay in design and construction implementation is far from solved and because of the time pressures exercised by MEA on the CECB designers, the detailed designs have often been based on very unreliable Blocking Out Plans (especially in the tracts upstream of the Chandrikawewa Reservoir). More gradual rehabilitation of the project from head-end to tail-end reaches would have been more logical in view of the above constraints, but it has not been considered.

Economic Internal Rate of Return

Technical aspects. The overall feasibility of a project is determined by the donor by means of the Economic Internal Rate of Return (EIRR). Its calculation uses all the aforementioned assumptions with respect to costs and benefits. Benefits are assessed for the "with" and "without" situations. These are, in practice, difficult to assess, because it is difficult to assess what the future yields of the existing areas would be for the "without" situation.

The Project Completion Report calculated four EIRRs. The EIRR of all investments in Uda Walawe since 1964 was calculated at 10 percent if the proposed rehabilitation would be undertaken, and 7 percent if O&M works would be carried out to sustain the existing level of production for the remaining 30 years. The latter was considered the most representative EIRR which was therefore presented by the donor to its Board in the loan proposal for the rehabilitation project (ADB 1984b, 15). Considering only investments since the donor's involvement in the system, these two options resulted in EIRRs of 11 percent and 8 percent, respectively. At appraisal in 1969 the estimated EIRR was 12 percent.[11] The rehabilitation project itself would have an EIRR of 32 percent.

Unlike the original donor's Appraisal Report which attributed the cost of the entire dam to the Right Bank area, this report attributed only 80 percent to the donor's project, because 20 percent of the average annual water diversions went to the Left Bank area (ADB 1979, 109).

SOGREAH's feasibility study calculated EIRRs for three scenarios: the rehabilitation project for the Right Bank only without major modifications to the cropping pattern; new cropping patterns and water management methods leading to further development of the Left Bank; and development of the Right Bank and the Left Bank without rehabilitation. Without sunk costs the EIRRs for the three scenarios would be 35 percent, 35 percent, and 8 percent, respectively. With sunk costs (including 80 percent of the cost of the dam) the EIRRs would be 9 percent and 10 percent for the first two scenarios.

A sensitivity analysis for the first scenario resulted in EIRRs of: 32 percent for a 20 percent cost escalation of rehabilitation; 35 percent (i.e., no effect) for a 20 percent cost escalation of O&M costs; 29 percent for a 20 percent decrease in benefits; and 25 percent for a combination of these three. Including the sunk costs these percentages would be 9, 9, 8, and 8, respectively.

The Appraisal Report adopts these values. However, without any justification in the report it attributes only 60 percent of the cost of the dam to the Right Bank area. The sensitivity analysis does not consider the sensitivity of the cost escalation of O&M costs, but instead a delay of project implementation by 2 years, the EIRR for the latter being 20 percent, and for the combined scenarios 22 percent.

During implementation it appeared that SOGREAH had underestimated or erroneously omitted several items, e.g., the excavation costs of the new parallel field channels and related raising of distributary-channel bunds. By 1988, the completion of the project was estimated to require US$11.6 million above the originally allocated US$13.7 million. Of this amount US$3.8 million was

[11] The reason the EIRR was still relatively high compared to disappointing results was the increase in the price of rice "representing a fivefold increase in the benefit of the Project for every ton of rice produced" (ADB 1982, 12).

allocated by the donor because it was due to the depreciation of the US dollar as compared to the Special Drawing Rights, and US$2.2 million was to be financed by the government. The remaining US$5.5 million was requested as a supplementary loan from the donor's Special Fund. The EIRR at this time was estimated at 21 percent (ADB 1988, 9),[12] which implicitly means that the rehabilitation project would not have improved the EIRR, including sunk costs, much above the 7 percent in 1979. For this reason the donor's Projects Division did not approve this extra allocation even though it meant that the tail-end tracts of the Right Bank would not be rehabilitated at all. Instead, the extra funds were allocated to Sri Lanka through the Agricultural Support Program of the donor's Programs Division. The EIRR is not used as a criterion for this kind of financing. Before this time, the donor had already intimated to the Government of Sri Lanka that it was not willing to fund further developments in the Left Bank of Uda Walawe.

The estimate by IIMI in 1990, assuming a 10 percent further water saving leading to a cropping intensity of 150 percent, and assuming an optimistic yield increase to 5.5 ton/ha, was a fall of the EIRR to just 8 percent for the rehabilitation investments alone (IIMI 1990, VII.6). This estimate itself seems still quite optimistic given the limited capacity of the Right Bank main canal to issue the required extra discharge for the envisaged further extension of the tail-end command area by approximately 4,000 ha.

Managerial aspects. Given the enormous uncertainties implied in the assessment of the feasible water duties, cropping patterns, related command areas, and implementation schedules, the use of the EIRR seems rather prone to manipulation; the EIRR can be used by the donor, the government, and the agency staff to make any project feasible or unfeasible. No rules exist with respect to the "without" assumptions, neither to the size of assumed improvements nor to the consistency and justification of attributing 60 percent or 80 percent of the sunk costs to the EIRR for the Right Bank.

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[12] This appeared as an overestimate because about US$3 million had been already spent during 1988. The EIRR at the time was 14 percent (IIMI 1990, VII.6). In a reaction to this IIMI publication, the donor showed that it had revised its estimate by November 1988 to 16 percent.

The sensitivity criteria of two years' delay and 20 percent deviations of costs and benefits are rather marginal compared to assumed improvements of 70 percent in water duties, related cropping intensities and benefits, the longstanding encroachment problem, and the effectiveness of the water user organizations. Apparently, the sensitivity analysis does not have to cover either all perceived risks in quality and quantity or their potential influence on the EIRR. As a result, the perceived feasibility of all aforementioned objectives for the Uda Walawe project were more determined by the EIRR and the willingness of the donor and the government staff and consultants to realize the loan, than by their actual feasibility.

The abovementioned arguments demonstrate the atmosphere in which the feasibility and appraisal of the Uda Walawe project have taken place. The assumptions that have been made during the feasibility and appraisal phase have been governed by the willingness of the managing agency, the government, and the donor to realize the loan. The consequent unfeasibility of these project objectives is taken for granted by MEA, the government, and the donor staff and consultants (i.e., they do not take responsibility for their own creation) as far as they do not impede project completion or the EIRR estimates till that time.

The rigidity of the EIRR brought the donor even to a situation where it had to decide to stop funding at the expense of the tail-end blocks for whose benefit the whole rehabilitation should have been intended. Top levels of the Government of Sri Lanka argued with the highest levels of the donor that the latter had started this project in the first place with little enthusiasm from their side, which should make them responsible for completion of the project. Also lower-level individual donor staff members felt responsible for this contradiction, and thus they facilitated funding through the Agricultural Support Program. The abandonment of the EIRR in the latter case makes the very rigid application of the EIRR in other instances doubtful. Also, given the uncertainty and size of variability of the underlying assumptions, its use at present leads to very inconsistent feasibility assessments by the donor and the government. The willingness of both parties to fund certain investments seems to prevent this assessment at present.

National Opportunities

Technical aspects. No requirements regarding maximum allowed investments per settler, or per increased agricultural production, or per area to be commanded, or per job created existed with respect to the determination of feasible system objectives. In fact, no national opportunities for the investments were considered other than the financial, the EIRR. The donor considers an investment opportune if the EIRR is above the cutoff rate of 10 percent.

Managerial aspects. The absence of any requirements of the government with respect to the maximum investments per settler, per increased agricultural production, per mcm regulated or saved, and per increased area commanded reflect the political priority given to the acquisition of foreign funds and related "politically visible" large-scale investment projects like Uda Walawe and Kirindi Oya. In this case, this priority for foreign funding was explicit in the direct link between supplementary funding for Kirindi Oya and roads in the Accelerated Mahaweli Project and the agreement of the government with the donor requirement to rehabilitate Uda Walawe.

The idea of the EIRR is to compare different investment opportunities with respect to their profitability. A major drawback of the EIRR in this respect is described by Tiffen:

> The ability to compare unlike projects is one of the chief theoretical benefits of the EIRR. It should make it possible for a government to decide whether to put its money into a road or a factory or a dam. Actually, it is seldom so used; each Ministry typically compiles its own projects. Theoretically again, it should enable a Ministry to decide which of several projects is the most desirable. Actually, it is likely that only one major project is studied in detail at a time, except perhaps in the case of a river basin study. More usually, therefore, the EIRR or <Net Present Value> is used to decide if a project reaches or exceeds the target currently established for project adoption (Tiffen 1989, 71).

Within the donor this target is fixed at 10 percent, which seems rather rough and inappropriate for determining opportunities for the money in a specific country. No mechanism exists within the donor to check the validity of this target rate in a specific country.

Overall, the EIRR seems of limited value to determine the actual national opportunities for investment decisions. The earlier cited reports on Uda Walawe focused on less capital-intensive interventions of upgrading the management and heavy maintenance, while the latter changed back to more capital-intensive interventions with little upgrading of the management. The EIRR for the less capital-intensive options have never been calculated, while they provided for much better opportunities for investment. Thus, the actual application of the EIRR allows for justification of almost any size of investment for the same purpose which seems to have led to an enormous loss of opportunities in Uda Walawe by the Government of Sri Lanka. Also, no requirements exist to compare the several options (including the less capital-intensive) with respect to the project objectives in terms of the EIRR, in order to give more clarity of the consequences of certain politically inspired projects; in this case "politically" refers more to the internal political processes in the donor, than within the Government of Sri Lanka.

Concludingly, the above shows that while theoretically speaking the EIRR is probably the most objective indicator for determining the economic national opportunities for an investment, its actual managerial use by agencies and the donor staff makes it very unreliable in assessing the feasibility of the envisaged project objectives and the actual opportunities.

While it thus seems that the short-run decisions are not considering the national opportunities, Kikuchi found that the rice price fluctuations and related cost-benefit ratios were in fact influencing irrigation investment decisions in the medium and the long term (Kikuchi 1987). Ongoing research in Sri Lanka by Kikuchi gives similar outcomes.

Several actors in this process argued that the EIRR is oriented towards economic opportunities only while an irrigation project like Uda Walawe has several social and political benefits also (e.g., settlement and employment). This may be true but these other benefits have a price as well. Insofar as these benefits go above their economic prices they are subsidies or welfare. Without making this subsidy aspect more explicit, the present feasibility assessment serves little purpose other than serving as a ritualistic internal donor procedure which seldom leads to a loan refusal. Typical in this respect is the remark of an interviewee of the author that it would be interesting to study the donor's starting-up processes of projects, because somehow they seem to be unable to stop the ball after it has started rolling.

The attitude of the politicians, the government and the agencies with respect to the loan money of the donor is rather short term in that the opportunities of, for example, a water supply system to settlers, or a more or less capital-intensive rehabilitation are considered zero; whatever the donor is willing to fund is a gain to the department, ministry, and related individuals. The national opportunities of these funds are not seriously taken into account.

Mutual Adaptation of the Technical and Managerial Aspects

The feasibility and appraisal assessments for the Uda Walawe rehabilitation by the government and the donor do not try to assess the real feasibility of the rehabilitation. Instead they serve to justify the project objectives in terms of the internal donor criterion, the EIRR. This function of the feasibility assessments is clearly demonstrated by the decision-making processes: the inconsistency in the use of the EIRR as well as in the assessment of the underlying assumptions and the related lack of rules and requirements to prevent manipulation of the EIRR; the use of unrealistic assumptions regarding availability of O&M funds, cost recovery, improvements of water duties, implementation schedules; the unrealistic use of loan convenants for serious impediments to these optimistic assumptions; and a sensitivity analysis which does not cover the actually recorded and perceived risks for project success. The outcome of the rigid application of the EIRR by the donor to determine the feasibility of almost all project objectives is only to a certain degree determining the justification of the loan; it was even abandoned in the end when the continuation or justification of the loan itself was endangered.

Feasibility and appraisal assessments for donor funding are done by outside consultants. Their ability to assess the real feasibility of the project objectives appears to be limited, given the crucial importance of the motivation and willingness of the managing agency to increase their management inputs to realize these project objectives (as has been described in chapters 3 to 6). Inputs of the managing agency into the feasibility assessments are limited to data provision, and, possibly, the participation of its top management. However, this top management is also not objective towards obtaining donor funding for its project; their scarce inputs in this decision making will not seriously endanger the project concept and related funding. Only the donor seems to worry about the EIRR. Perceptions of the opportunities for the loan money of the donor and the top management in agency and government are quite similar. In the case of the Sri Lankan agencies, the opportunities of the money are determined by relatively short-term political and agency priorities only, whatever the cost-effectiveness or estimated EIRR. However, also for the donor, the EIRR appears to be a mechanism for loan justification.

The feasibility assessments use scientific concepts (e.g., water delivery concepts, theoretical water requirements) for feasibility assessments, which require data rather than being dependent on the aforementioned ineffective interaction — which is, however, also hampered by the short-term nature of missions by the donor staff and consultants. These scientific approaches allow for undisturbed use of capital-intensive engineering biases in assessing feasible system objectives. This capital-intensive nature of the feasible system objectives matches very well with the "primary purpose" of the involved donor as a development bank which is "administering the transfer of capital from the <Bank> members who are developed to those who are developing" (Evans 1984, 76). Less capital-intensive approaches would require more interaction because they necessarily have to rely more on the managerial inputs and managerial feasibility by the managing agency rather than on its technical feasibility.

The actual objective of the feasibility assessments appeared to be more the rehabilitation of the EIRR of the earlier donor investment in Uda Walawe than the rehabilitation of the Uda Walawe itself (this process has also been described in Chapter 7). The result of this approach to feasibility assessment has led to a project where the real feasibility of solving the extreme head-end problem in the system has not been considered. Chapters 3 to 6 described the essentially managerial constraints to reducing the water use by head enders. Another strategy for solving the head-end problem would have been the relatively low-budget investments in augmentation of the water supply to the tail-end blocks by means of, for example, rerouting the Right Bank main canal upstream of the Chandrikawewa Reservoir. The latter option would have evolved if the project level and the top MEA management had had their way, i.e., if this type of decision was left to their own discretion.

However, improving the EIRR required the reduction of water use by the Right Bank as a whole to allow for the originally envisaged development of the

Left Bank. The donor staff and consultants judged capital-intensive major rehabilitation feasible, whereby again managerial performance was considered a variable. Even the small investment required for organizing water users was dropped to further upgrade the EIRR. The very risky nature of this capital-intensive approach was not acknowledged by the donor. The relatively high yielding EIRRs of the two less capital-intensive options were not even calculated; a capital-extensive problem (i.e., managerial motivation and willingness) has been solved in a capital-intensive mode.

The rigid use of the EIRR combined with the donor's own bias towards capital-intensive investments seems to be the major cause for the unfeasibility of the project objectives; to justify capital-intensive irrigation investments in terms of the EIRR, the donor staff have to fix, at an early stage in the project, optimistic estimates of all major benefits (i.e., water duties, command area, cropping intensities, life span, and implementation schedule). These optimistic assumptions again enforce a certain rigidity in the improvement concepts to ensure, at least theoretically, low water duties (this is demonstrated also in Chapter 9). If the water delivery performance appears to be less during system utilization than assumed, all related benefits will be less and the rigid use of the EIRR requires rehabilitation at the end of the construction period along the same lines of the original feasibility assessment. Managerial solutions are never effectively tackled, because they are extremely capital-extensive and seem difficult to approach for the donor as a capital-intensive investment bank, and also in view of the aforementioned lack of objectivity of the staff of recipient governments, agencies, and consultants.

Lessons learnt by the donor through internal analysis of the original investment in Uda Walawe focused on increased use of donor staff and consultants during project implementation, which denotes an increased responsibility on the part of the donor (ADB 1979 and 1982). However, these solutions will only reinforce the absence of responsibility in the managing agency towards the project objectives and reduce their managerial inputs further. Increased commitment and responsibility within the managing agency are more important than ensuring temporary responsibility through outside consultants; short-term performance conflicts here with long-term performance. Thus more sustainable irrigation development also requires that internal donor project performance monitoring should change its focus from the present short term only to more long-term performance. The government and the agencies should develop responsibility and accountability towards long-term project objectives, but this also requires that the donor gives them this responsibility.

Another approach — which would not solve this responsibility gap however —would be phased development of the scheme to allow for more careful feasibility assessment through the incorporation of actual managerial performance of the agency. The Project Performance Audit Report concluded that this would have been better for the original investment, but did not extrapolate this to the rehabilitation project (ADB 1982, 19). The first phase of the rehabilitation project could have focused on the managerial aspects of the head-end problem, after which the feasibility of extension of the command area could have been assessed more reliably.

However, the donor staff and consultants will never be able to assess really feasible project objectives. The necessity to use outside and comparatively unbiased consultants for feasibility assessments because of a positive bias of the national government and agencies towards donor funding is acknowledged. On the other hand, such an assessment should be based on explicitly defined and elaborated system objectives proposed by the national government and agencies. If a project proposal is not defined and developed by the national agency it will not feel committed to and responsible for the identified project objectives.

Therefore, if the government and agencies are to play this role, donor involvement in these processes will preferably have to be limited to assessing the technical and managerial feasibility of an already developed plan. This increased responsibility and role for the national parties cannot be achieved without more objectivity of the donor staff and consultants to loan approval. Increased objectivity will require more freedom for the donor staff and consultants to judge the EIRR of a project proposal below the cutoff rate, and thus facilitating a loan refusal for an unfeasible project proposal, whether it be unfeasible in the short or long term. If the donor decides to give a loan even while the cutoff rate is not expected, the subsidies involved will at least become explicit. Presently, the realization of targets of the loan is an important informal staff-performance indicator within the donor, which does not stimulate a more careful assessment of the feasibility. In fact, the efforts of the staff of the donor to be more careful in the assumptions concerning the feasibility depends mainly on their individual motivation rather than on an institutional incentive from the donor organization itself. The donor requires that the EIRR remains above 10 percent at the end of the construction period, i.e., at project completion. Developments with respect to the EIRR after that time are not monitored and the performance of the donor staff is not appraised by it. Similarly, the donor consultants cannot be expected to be completely objective towards the feasibility of a project, given the donor's own interest in realizing loan targets.

CHAPTER 9

Strategic Concern: Functional Requirements for Rehabilitation

WITHIN THE FRAMEWORK of the identified desirable and feasible project objectives as described in chapters 7 and 8, system rehabilitation decision making also covers the determination of the specific functional system requirements for the envisaged investments with the available resources, i.e., requirements with respect to physical infrastructure, staffing, communications, and possibly water user organizations.

Functional requirements with respect to the command area may refer to the size, suitability, and location of the command area. Functional requirements with respect to canals may be the conveyance through the canal and distribution to other canals. Conveyance and distribution functions can be expressed in terms of (peak) discharges or water levels and their variability, passive and active controllability, responsiveness, equity, safety, and long-term flexibility.[13] The canal may also function to capture drainage and runoff water from its own catchment and it may function as a semi-storage reservoir as in the case of a contour canal. Moreover, it can function to deliver drinking and bathing water for people and livestock. A passive function may be the maintaining of a certain groundwater level in its surroundings.

Similarly, the functional requirements of a reservoir may be the storage capacity and flood resistance. And, it may function as a cultural meeting point for a village, or a fishing ground, or it may provide recreation, and bathing and drinking water, especially during off-seasons, or maintain a certain groundwater level in its immediate surroundings.

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[13] Long-term flexibility refers to the degree that a system is able to change in cropping pattern and operational mode in the future without changing canals and structures (Tiffen 1983, 3)

Functional requirements with respect to structures can be the (peak) discharges, control water levels, passive and active controllability, adjustability, easiness to operate, sediment passing capacity, permissible head losses, safety in case of breakdown, and operation efficiency.[14]

Functional requirements with respect to staffing refers to the intensity and frequency of interventions required, and the related requirements for communication between different levels of staff and between staff and water users and other parties of interest like politicians and other agencies.

Functional requirements are not the same as a design concept but are the requirements related to an appropriate design concept. Actual design is a different process which consists of the implementation of the design concept. In some design concepts as in the Walawe Irrigation Improvement Project (WIIP), functional requirements may include the water users as well, as they may be required to function as a group to effectively share the allocated 1 cusec (i.e., 28.3 l/s) discharge among themselves.

THE DECISION-MAKING PROCESSES

The WIIP aims to rehabilitate the downstream development of the reservoirs only. Rehabilitation of these reservoirs and of their spillways and head sluices were explicitly excluded from this project as described in Chapter 8, and their functional requirements were not further considered.

System Layout

Functional requirements for system layout refer to requirements about roads, drainage, boundaries of command, tract and turnout areas, and areas for settlement. These requirements may be specific water delivery methods (e.g., rotational), the controllability over water flow, the (peak) irrigation require-

[14] Operation efficiency is the average proportion of the effective volume delivered and the actual volume supplied for a certain structure (Schuurmans 1989, 696).

ments for irrigation, and the bathing and drinking of livestock and people. For the WIIP this refers to the layout within the existing system of main and branch canals and intermediate reservoirs which will be retained as such.

Technical aspects. The existing layout of distributary channels was also largely maintained. The basic requirement for the system layout within the distributary channel is the facilitation of rotational issues. To that end, new subdistributary and parallel field channels were planned within this existing layout "to concentrate offtaking canals at several rather than many locations along major canals so as to provide farm outlets only from field canals" (MMP 1986a, 17). This so called "rationalization" of the layout meant that water delivery to all individual farms and farmers would occur through farm turnouts along a field channel. To save on construction costs the existing field channels had in some cases been constructed very long in the original project and turnout areas served by them were "extremely variable from <1 ha> to <28 ha>" (SOGREAH 1984, A3.9), which was considered a "major inconvenience" (ibid.). "Another inconvenience of the scheme is that a number of farm turnouts are fed directly by distributary canals" (ibid.). "This structural situation impedes the organization of rotational distribution and entails the inequity and unreliability which is at present characteristic of the water distribution. Any efforts to improve the situation will have a very limited effect unless structural modifications to the distribution system are implemented" (ibid., 7). The required parallel field channels did not exist in Uda Walawe and had to be newly excavated.

The exact location of the parallel field channels and individual farm turnouts were to be determined on the basis of the so-called Final Village Plans (FVP) prepared by the Lands Branch of the MEA office in Embilipitiya and laid down in the final Blocking Out Plans (BOP). Proposed layouts of canals and related reservations were to be sketched on these Final Village Plans and submitted to MEA for approval and necessary action as land acquisition, regularization and reblocking out. If existing reservations for field channels were insufficient, field channel lining was envisaged to reduce their width.

Detailed criteria for the provision of offtakes along the proposed field channels and layout of field channels and farm ditches were given in the MMP manual on design criteria: "if a small lot (less than half a hectare) does not have direct frontage to a field canal, it should not be provided with a separate farm outlet and farm ditch or any other arrangement. It should instead be considered as continuing to receive drainage water from adjacent lots, or if this is not possible, omitted as out of command" (MMP 1987a, 7).

Lands originally blocked out for subsidiary field crops were to be considered rice lands for design purposes. Canal, drain, river, reservoir or road reservations and irrigation supplies to homesteads were "not to be regularized, unless specifically requested by MEA" (ibid., 6). Irrigated encroachments on other reservations (e.g., pasture, fodder and forest) were to be regularized "wherever practical" and provided with the standard internal canalization (ibid.). Offtakes to irrigated private lands in the command area would be maintained or provided. Internal canalization would remain outside MEA responsibility and outside the scope of the WIIP. No specific criteria were developed for drinking and bathing facilities and thus these facilities were provided at regular intervals along the main and branch canals.

Existing provisions for reuse of drainage water "should be maintained in the rehabilitated system," but no attempts should be made "to raise current retention levels" (ibid., 7). Other new drainage reuse facilities "such as that proposed on Kachchigala Ara in Tract 10 of Muravasihena Block, should be developed wherever a clear saving in water can be made with a modest increase in capital cost" (ibid.).

Further renovation of the drainage system was to be minimized:

> Most surface runoff in Embilipitiya and Chandrikawewa blocks is from terrace to terrace and no field drains will be required. The 'collector' drain at the valley bottom is usually quite steep and incised. As far as possible, drain renovation should be minimized. Structures on the drain should be checked by a condition survey. If a drain is rapidly eroding, the need for any fall structures, particularly to protect the existing structures should be established. Existing temporary weirs or drains usually feed designated highland or pasture land, or supplement flows at the end of field channels. Generally these weirs will not be rebuilt as part of the rehabilitation. After discussion with the Block Manager, the need for providing irrigation facilities to lowland areas will be determined. Wherever possible this should be an extension to the existing irrigation system. The land is less steep in the three southern blocks, so there may be a need for new drains and rehabilitation of existing drains. If there are salinity problems, improved drainage may be necessary for that reason also (ibid., 65).

Managerial aspects. The basic functional requirement regarding the layout for the Walawe Irrigation Improvement Project (WIIP) comprises the rotational issues. This requirement had been proposed by SOGREAH and endorsed by the donor in terms of reference for MMP (MMP 1986a, A.2). SOGREAH proposed the rationalized turnout concept also and this was endorsed by the donor in the MMP's terms of reference (ibid., A.1). While some MMP consultants had preferred less flexibility at the level of distributary and field-channel turnouts, they were explicitly restricted to rotational water delivery by their terms of reference. MEA head office and project offices agreed formally with the design criteria proposed by MMP in December 1986 (MMP 1987b, 13).

The rationalized turnout concept is widely recognized and accepted by irrigation engineers inside and outside of Sri Lanka. However, this rationalized layout deviated from the traditional field-to-field irrigation practiced in Sri Lanka, whereby some sort of understanding about water sharing practices between interdependent water users had evolved gradually over tim. Drainage flows from this field-to-field irrigation were captured and reused through the use of contour canals (e.g., Mendis 1977, 55). Originally, SOGREAH introduced this rationalized turnout concept in Sri Lanka in Mahaweli System H.

The underlying assumption of this turnout area concept is that water allocations and deliveries in a "regular" canal pattern are easier to control for the agencies. This is because the regular pattern is based on standard one cusec discharges, offtakes to individual farmers, and standard rotations. In well-drained soils these parallel field channels, indeed, facilitate the potential conveyance efficiency to the individual allotments situated downstream of the uppermost terraces. In general however, these assumptions also imply a degree of motivation and discipline of staff and water users to save water and adhere to these assumptions for the benefit of the overall system and the national economy.

These assumptions have not yet been proven true, and inconsistencies in this reasoning have been mentioned in Chapter 8. On the other hand, the disadvantages of this regular pattern of parallel distributary and field channels are the increased requirements of control structures, increased costs for excavation of field channels and farm ditches, construction, operation and maintenance, the mentioned requirements of water users' associations to share water within these parallel field channels, the coordination of land-settlement processes with layout and water user groups, increased water management capacities, etc. The increase in costs was also the reason why the RVDB originally designed and constructed a less rationalized layout in Uda Walawe. Thus, despite its increased costs, the validity of the assumptions in terms of improved water delivery performance has never been discussed or evaluated. For this reason, PRC and Wolf explicitly argued against a capital-intensive rehabilitation (PRC 1982, S.6 and Wolf 1983, iv).

Given the fact that the ratio of irrigation requirements for lowland and upland is approximately 1:2, the rationalized turnout area or "one cusec" concept requires, implicitly, a very accurate assessment during the design phase of the proportions of upland and lowland in a turnout area to achieve an appropriate layout. However, these proportions of lowland and upland in the turnout are seldom assessed reliably; not only in Uda Walawe but in Kirindi Oya and many of the Mahaweli systems the assessment of soil types has been unreliable or, because speedy construction was required, has not been done at all.

The advantages of the small tanks and single bank canals in terms of the permanent availability of drinking water in the command area, or in terms of decentralized buffers for unregulated irrigation and drainage flows are neglected. Moreover, other functions attributed to reservoirs but not translated into requirements by MEA or the Irrigation Department, are the provision of drinking water in the off-seasons and the several arguments with respect to the ecosystem function of the village tank, e.g., cultural center, bathing, food in terms of fish, seeds, stems and tubers, manure and fertilizer, and clay (Mendis 1977, 55).

Despite this heavy reliance on assumptions only and its inherent inconsistency in view of the accuracy of available data during design, the rationalized turnout concept is recognized and accepted widely among irrigation engineers around the world. The Irrigation Department has accepted this concept in its Technical Guidelines and the agencies under the Mahaweli Authority rely heavily on the professional expertise of the Irrigation Department in this respect. The lack of creativity, initiative and interest within the Irrigation Department in defining appropriate functional system requirements and developing more appropriate design concepts and related responsibility and accountability issues are described in a parallel case study (Nijman 1991b).

While the Irrigation Department has its own professional divisions for these decision-making processes (e.g., the Designs Branch), MEA does not have such capacities at all. MEA has two Chief Irrigation Engineers in its head office who have to provide all specialist backstopping to all the MEA systems. Therefore, if required, their involvement in Uda Walawe could have been very limited only. Moreover, they would have endorsed the proposed turnout concept because of its wide acceptance within and outside Sri Lanka and the insistence of the donors on this more scientific concept. In actual practice, the donor took the decision with respect to the design concept and enforced a heavy role for the foreign consultants in its actual interpretation. Agreement of the top management in the head office and at project level has limited meaning in view of the donor's leverage and political and agency priorities for project funding. Decision preparation is done mainly by the donor staff and consultants, and decision making only by MEA.

According to their terms of reference, MMP had to "define, in conjunction with Project staff, the design criteria upon which the rehabilitation works will be based" (ADB 1984a, 95) and CECB was responsible for "preparation of the detail designs" (MASL 1985, A.1). CECB had drafted their own terms of reference and it was signed by MASL without verification with the donor or the MEA Project Director. This construction of task division led to confused responsibilities on the actual definition of functional requirements for system rehabilitation. MMP usually drafted design criteria which were then discussed with CECB and MEA top management. The amended drafts were later compiled into a manual of design criteria (MMP 1987a).

MMP advised thereby that "all proposals should be discussed with the farmers as they will be aware of the existing irrigation problems, and may have useful suggestions as to how they may be overcome" (ibid., 8). Similarly, "the exact location of farm outlets can be revised at the time of construction after discussion with farmers. This will be essential in case of field canals which were designed to preliminary blocking out" (MMP 1988b, 9). Also, "individual layouts for each turnout unit have been prepared. These are intended for issue to Unit Manager, Field Assistants and farmer leaders so that the rehabilitation plans can be explained and discussed" (MMP 1987d, 1). However, MMP's remarks in this respect were in the margin of the design criteria and no procedures were developed on how CECB should interact; at what stages, regarding what issues, and with whom. Detailed designing and related interaction with water users and block-level and field-level MEA staff were thereby considered the responsibility of CECB. Instead, CECB used the MMP manual on design criteria as the "bible" for the detailed design works in the same way as the Irrigation Department uses its Technical Guidelines for new construction projects. This led to a rigid "blueprint" approach of system rehabilitation with little systematic matching of the proposed system's functions with actual requirements of water users and agency staff.

This approach of CECB was due to a combination of reasons. CECB encountered serious incompatibilities between the official Final Village Plans and the actual field situation. Due to the mass encroachment problem and the abovementioned time pressures, these Final Village Plans actually reflected an up-to-date best guess of the existing legalized farm boundaries in the command area. This unreliability was a logical consequence of the time pressures; for example, in August 1986 MMP strongly urged reblocking out (MMP 1986c, 3) which resulted, by October 1986, in authoritative new Final Village Plans for Embilipitiya block (MMP 1986d, 5), i.e., in a time frame which makes their reliability very unlikely. CECB's initial interaction with water users on land issues like location of farm turnouts and farm ditches led to serious delays in the design work, especially in the head-end blocks where mass land grabbing had been most severe during the original Uda Walawe project. The MEA top management did not like this and distrusted CECB's motivations in this respect as they were paid on an expense disbursement basis. Moreover because the CECB's terms of reference did not have a clause for delays, MEA organized monthly Progress Meetings chaired by the Managing Director of MEA to give at least some high-level push to their work progress. Performance appraisal in Mahaweli usually focuses on project progress targets because of the political priority attributed to accelerated implementation of the Mahaweli projects. CECB reacted to these pressures by applying the design criteria rigidly to the Final Village Plans and abandoning the match between design and actual field situation or actual requirements of water users and agency staff. This rigid and hurried design process led to all sorts of inappropriateness of designs and related wastage of money and opportunities.

Cost reduction for specific choices was nobody's responsibility either. While the MEA top management decided in the Progress Meeting that no homesteads and reservations would be commanded, "unless specifically requested by MEA" (MMP 1987a, 6), time pressure combined with pressures from farmers to bring or keep these areas under command often led to commanding such areas, even if branch canal bunds had to be raised for the purpose. CECB argued that such areas should be incorporated because else they would tap water illegally anyway.

In this case CECB thus did adopt the design criteria to field requirements but against instructions of the MEA's top management. On the other hand, it would deny any responsibility for the designs. In other cases CECB applied the design criteria extremely rigidly. IIMI observed, for example, that rigid application of the design criteria led in distributary canal 3 of Binkama block to the design and construction of seven control structures, two parallel field canals, and raised distributary canal bunds to command only two allotments by means of a parallel field channel instead of direct outlets. Extreme cost overruns of the project estimates due "substantially" to distributary channel raising have led to an adaptation of the design criteria by MMP in this respect (MMP 1988b, 7). No responsibility for cost reduction in the separate choices was introduced however.

The decision making about the incorporation of a maximum of 2,024 ha of private lands and the exclusion of village tanks in the system layout under the WIIP were governed by the reluctance of the MEA's top management to include areas which were expected to claim additional water in future at the expense of the official command area, if indeed included under the WIIP. This assumption is probably correct, but in the rationale of the rehabilitation project, a rationalization of the internal canalization of these areas would have been more consistent with the strategy pursued within the command area to increase the productivity of water and reduce issues to the Right Bank area as a whole. The figure of 2,024 ha was determined on the basis of the design capacity of the main canal for 11,334 ha, rather than on actual data of the size of these areas in the command area (MMP 1987b, 12).

Despite MMP's few specific guidelines in this respect, MEA played no role at all in the designs of system layout due to CECB's blueprint approach. The few spontaneous suggestions and requests from block-level MEA staff were not communicated by project-level MEA staff to CECB and MMP, or they were neglected by CECB. Only MMP reacted now and then to such inputs. More serious interaction with different MEA staff levels started only during the actual construction in the field, when contractors were confronted with mismatches between design and field situation and water users' requirements. It was only after such confrontations occurred that the Resident Project Manager appointed two Agricultural Officers as intermediates between the water users, the MEA staff, and CECB. Even then, CECB regretted the MEA's interference which it considered as biased towards water users' interests, and unprofessional with respect to the engineering rationale of the whole rehabilitation concept.

The "blueprint" designs were also facilitated by the approach of completing the majority of designs for the entire command area before any construction was tendered and implemented. The construction was awarded in fairly large packages, and apart from one field channel, no representative experiences with the functionality of the layouts were available till 1990. By that time all designs had been finalized and adjustments were more difficult. However, such adjustments were necessary frequently due to mismatches with the field realities and in such instances CECB and the contractors had to be paid extra for the additional designs and frequently required iterative mobilization costs for contractors. Clearly, a more gradual development of the command area from head end to tail end with much smaller contracts could have led to a more effective and appropriate design and construction process. The choice for large packages was made by the MEA top management primarily for better quality control. This reason might have been valid, but without a gradual implementation, the large packages seem very inappropriate for system rehabilitation.

Irrigation Requirements and Peak Irrigation Requirements

Technical aspects. Within the above layout, peak irrigation requirements for field channels were fixed at one cusec (i.e., 28.3 l/s) and the area commanded by each field channel was adapted to this fixed peak discharge. Main and branch canals were envisaged to serve areas larger than 350 ha, distributaries to serve areas between 350 ha and 15 ha, and field channels to serve areas smaller than 15 ha (MMP 1986a, A1.3). This is similar to the classification of the Irrigation Department. These sizes were based on calculations of theoretical water requirements by means of the modified Penman formula.

Major assumptions made in this formula are the cultivation of direct seeded rice in the short term, an effective rainfall of 70 percent of the 80 percent probable rainfall and a deep percolation of 5 mm/day. Moreover, "Land preparation requirements have been taken as an initial application of 150 mm followed by 105 mm/week thereafter. A filling requirement to bring the field up to full depth of water has been added at the rate of 25 mm/week after seeding. Two refilling applications of 50 mm have been allowed following draining down the fields for fertilizer and pesticide treatment" (ibid., A2.8). Application efficiency was assumed to be 80 percent, and field-channel efficiency 90 percent. Results were compared with the values adopted by the Wolf report and by the Irrigation Department based on agricultural research in Maha Illuppallama; the MMP's proposal for annual irrigation requirement at the farm outlet of 3,104 mm was less optimistic than Wolf's proposal of 2,411 mm and the Irrigation Department's proposal of 2,485 mm (ibid., A2.15). No comparison was made with the existing irrigation requirements or water use in Uda Walawe; the assumed improved performance (i.e., 40% compared to the 1981-1983 averages[15]) was not made explicit. Neither was any reference made to actual irrigation requirements in other systems in Sri Lanka or elsewhere.

The resulting normal peak design requirements were 1.8 l/s/ha, while canal capacities were to be checked for 125 percent design flow, i.e., 2.25 l/s/ha[16]. The sensitivity analysis for percolation rates up to 7 mm/day and no effective rainfall was calculated at 2.61 l/s/ha for maha and at 2.75 l/s/ha for yala. Measured values by IIMI for the land preparation in Uda Walawe were 760 mm against assumed values of 490 mm at the farm turnout for both lowland and upland soils, and peak water requirements between 3.4 and 11.5 l/s/ha at the heads of sample distributary channels (IIMI 1990, 101).

The implicitly assumed improvements of MMP were justified by the rationalized layout and the resulting opportunities for rotational water deliveries along and between field channels, also during land preparation. Important conditions for successful implementation of these rotational deliveries were advance warning to water users by means of notice boards and advance planning of these rotations in line with soil suitabilities for subsidiary field

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[15] This value was calculated adopting the Irrigation Department's estimate of 70 percent conveyance efficiency in the distributary channels and the main canals.

[16] In his review of this paper, a consultant remarked that an additional tolerance of 10cm in turnouts and CPOs provides for a capacity of about twice the normal discharge. However, the author has not been able to trace any evidence of this.

crops in view of the limited design capacities of distributary channels and branch canals (MMP 1989b, 4). An operation manual was written incorporating the improved operational procedures for system managers, which will be described later in this chapter.

In situations of no rainfall, a one-week period of 25 percent[17] extra discharge was envisaged to be required during maha, i.e., 35.3 l/s. Peak discharges for large distributary channels and branch canals were calculated so that they would have to be operated continuously. Only the smaller distributaries were envisaged to be rotated and generally for significantly longer periods than before the rehabilitation. Effective use of rainfall was envisaged through weekly information exchanges between field and system management about actual and assumed rainfall, and consequent adjustment in discharges following "designed" operating rules (ibid., 21). With respect to percolation assumptions, MMP has said that "in the absence of field measurements of actual losses due to percolation, assumptions have to be made. It is considered that the soil conditions in Walawe are sufficiently different from other areas in Sri Lanka for which data is available for it to be advisable to carry out further soil tests. These should be field water tests during normal cultivation by farmers" (ibid.).

An M.Sc. student did such tests and found values between 23.8 mm and 26.5 mm per day (Cornwell 1987). IIMI observed that only one sixth of these losses consisted of deep percolation, the rest being horizontal seepage (IIMI 1990, 73). Despite these results MMP never adjusted the peak irrigation requirements to conform to these much higher seepage and percolation estimates.

MMP envisaged that the discharge of 28.3 l/s in the field channel would be distributed through 75-mm or 100-mm pipe offtakes which were already prevalent in Uda Walawe: "Their capacity is approximately 5 l/s or 6 l/s. At normal discharge the flow in a field canal must therefore be divided between five or six lots. If the discharge is divided between more than six farmers the stream flow to each becomes too small for satisfactory distribution within the lot" (MMP 1986b, 2.4). This was changed later to 7 to 8 farmers. MMP came with this suggestion after a field visit to Mahaweli System H where water users tried to divide water continuously with 150-mm pipes. MMP assumed that 75-

[17] The 25 percent assumed effective rainfall is based on the potential depth of water which can be accumulated in the field.

mm or 100-mm pipes would better facilitate such continuous water delivery than 150-mm pipes.

Managerial aspects. The MMP's Monthly Progress Report of February 1986 reported inconclusive results from infiltration tests, and concluded it would be impossible to determine accurately the farm percolation losses. The MMP's selected comparison of its irrigation requirements with those of Wolf and the Irrigation Departments seems somewhat biased toward justification of its own proposal because for unspecified reasons the SOGREAH's estimate was not included in the comparison. The SOGREAH's estimate was the only less optimistic estimate than the MMP's one, i.e., 27 percent improvement only.

MMP proposed to test the assumptions in the field in a pilot field channel in the head end of the command area. In addition, it initiated the field test by the M.Sc. student. The pilot area appeared to need or use more water than envisaged (Merrey and Jinapala 1988). Despite this and the much higher seepage and percolation figures observed in Cornwell's thesis, the MMP did not adjust its peak irrigation requirements for areas with likely high lateral seepage rates, i.e., the head-end areas.

After the first structures had been demolished because of limited peak discharges it appeared that MMP did have a rationale behind its low estimates. "From the outset of the project it has been known that the ultimate success of the rehabilitation works would depend on the farmers diversifying away from rice to other field crops (OFC) and also on reducing wastage of water that currently goes on in the upper tracts" (MMP 1989b, 3). Despite this awareness the consultants realized that in the short term no significant changes in the existing cropping pattern could be expected and they calculated peak irrigation requirements for rice cultivation only. However, to stimulate or enforce the cultivation of subsidiary field crops MMP adopted low percolation values: "Nearly everywhere in the project area there is a mix of both <low lands> and <well-drained uplands> on the field canals. It was considered impracticable to define the mix of <these> and to calculate the water requirements separately on each field canal; it was therefore decided to adopt an average figure for design purposes....that are low for <upland> soils but are slightly high for <lowland> soils...it was felt that this would act as a deterrent to farmers trying to grow rice on unsuitable soils and at the same time encouraging them to reduce their losses" (ibid.).

The adopted peak irrigation requirements had been a source of controversy from the beginning. The MEA project-level staff of the O&M division had argued against these optimistic values for the head-end reaches of the command area, but formal correspondence between the MMP and the MEA project staff was limited to details about the theoretical water requirements. This is an ironical interaction, given the fact that both the MMP and the MEA project staff were well aware of the theoretical nature of the crop water requirement calculations in view of the real issues (e.g., the excessive water use by the head-end reaches on unsuitable soils largely due to excessive lateral seepage). While the MEA project staff communicated its reservations to the head office, the relations between the Project Director and the MEA project staff were not good enough to request changes from MMP in this respect. Instead, the MEA head office agreed with the consultants: "As a policy decision it was agreed with MEA that paddy cultivation of the <upland> soils should in medium to long term be discouraged. It was therefore considered totally inappropriate to supply additional water to farmers in <upland> soils to grow rice by allowing a higher deeper percolation rate than the average design figure of 5 mm/day" (MMP 1989a, 3).

The MMP and the MEA head offices were in fact unwilling to change these figures because it would endanger their main strategy towards solving the water wastage in the head-end reaches and thus achieving the rehabilitation project objectives of extending the command area from 8,070 ha to 11,940 ha (i.e., by 40%). Thus, over time MMP and MEA made a change in their design assumptions with respect to cultivation of subsidiary field crops; in earlier stages the cultivation of rice in the short term was acknowledged as inevitable while later it was considered irresponsible: "Issuing more than the proposed limits to any field canal during land preparation would not be `flexibility', it would be `abdication of responsibility'" (ibid., 4). The increased area to be cultivated with subsidiary field crops was necessary "because the capacity of the upper reach of the Right Bank main canal is limiting" (MMP 1988c, 3). The design discharge was to be increased from 20 to 25 cumecs through small improvements, but other augmentation options (e.g., rerouting Right Bank main canal) were not seriously considered, because they were outside the terms of reference of the present project.

However, this shift in the design assumptions seems rather odd given the experiences in this respect reported upon in the Project Completion and Performance Audit Reports of the donor, and the feasibility and appraisal studies. The consultants felt that in the absence of any managerial controls for them to introduce subsidiary field crops or reduce water wastage in the head-end reaches in other ways, which are essentially managerial problems, they had no option but to choose this engineering solution of enforcement in the physical infrastructure. Because of the disturbed relations between the MEA head office and the project office, the MEA head office (i.e., only one man in practice, the Project Director) relied completely on the consultants. It was only after the first offtakes to distributary channels were demolished by farmers and the MEA staff, IIMI's reporting on these issues, and the consequent pushing of the donor that MEA decided to make a drastic reorganization of the project. At present it is envisaged to interact with water users regarding envisaged peak irrigation requirements.

The MMP's assumptions with respect to the farm turnouts were based mainly on the existing outlets in Uda Walawe. The difficulty for outside consultants to judge these requirements by themselves is demonstrated by the fact that the originally designed 75 mm pipes were "thoroughly impractical," because the too small flow did "not reach the lower terraces at all" as Visvalingam had argued before for Uda Walawe (Visvalingam 1986, 4). It is also demonstrated by the fact that water users in the Ranjangana system requested the designed 150-mm pipes to be replaced by 75-mm pipes to enable continuous issues. During construction of the Walawe Irrigation Improvement Project (WIIP), the designed 75-mm turnouts often appeared to be too small to issue water during the initial land soaking and the farmers requested 100-mm turnouts instead. Only in a few field channels did water users prefer the 75-mm pipes because tail enders of these channels were afraid that head enders would take advantage of the 100-mm pipes. After complaints, MEA decided during construction, to abandon the designs of MMP and CECB and to leave the decision making about this requirement to the water users themselves; most canals then opted for the 100-mm pipe, but this choice could be different for individual field channels.

Controllability of Flow

Technical aspects. The need for increased water level control in the main system was identified by the donor's Project Completion Report, PRC, Wolf, and the donor's feasibility and appraisal studies. Augmentation options like increased utilization of the Chandrikawewa Reservoir and rerouting of the main canal were left outside the scope of the WIIP. Within this framework, SOGREAH and MMP proposed to fulfill this requirement through additional cross-regulators in the main and branch canals. MMP proposed three cross-regulators with radial gates in the Right Bank main canal upstream of the Chandrikawewa Reservoir, and five with slide gates downstream of it. The radial gates were proposed because they were cheaper. In addition, ungated cross-regulators (i.e., duckbill weirs) were envisaged for the branch canals because their costs were identical and operation more simple.

Requirements for the location and shape of the cross-regulators were the full supply level required for the offtakes to branch canals and distributary channels, response time, and pond-level control. For the main canal cross-regulators these requirements could not be traced by the author, because they had been determined by the MMP staff who had left the project by that time. For the ungated regulators the main requirement was an afflux of 0.27 m over the weir for the design discharge (MMP 1987a, 44). The maximum flow variation was set at 0.10 m, but for high flows this variation was allowed to increase because "the required crest length of the weir will become excessive...if water level fluctuations would necessitate extensive bank filling, it would be more economic to improve regulation by providing weirs. If water levels cannot be maintained within required limits by fixed weirs, then gated regulators should be considered" (MMP 1988b, 4). Thus, construction costs, rather than the benefits for water flow regulation or the type and number of cross-regulators, were dominant. In addition, the number and type of cross-regulators were checked on the basis of hydraulic simulations of backwater curves for steady flow conditions. To ensure water flow regulation at flows below design discharge, the water levels for 50 percent and 125 percent of the design discharge were to be checked during the design of main and branch canals.

With respect to the offtakes from main and branch canals to branch canals and distributary channels, respectively, functional requirements are the earlier described peak irrigation requirements and the allowance for water fluctuations in the control water level upstream of the structure. The underlying functional requirements for these offtakes (e.g., flexibility in peak irrigation requirement) are not made explicit except for the 75 percent-125 percent and 50 percent-125 percent fluctuations of the discharges in the upstream canal for distributary channels and branch canals, respectively. The latter is considered for steady flow conditions only, which seems justified within the branch canals and distributary channels with fixed weirs, but not for the offtakes along the main canal. However, the passive control envisaged by the MMP and the MEA head offices through envisaging very low peak irrigation requirements for the well-drained soils was made explicit in the draft operation and maintenance manual and the publication on the rotation planning.

Within the distributary and field channels large quantities of additional control structures were envisaged by MMP (i.e., 1,822 and 13,917, respectively). Lack of gates on farm turnouts and lack of cross-regulators and fall structures in these canals were considered to impede proper control over water flow. The functional requirements for the choices of specific types of structures are not clarified by the consultants at any stage. To ensure water flow regulation at flows below design discharge, the water levels for 75 percent and 125 percent of the design discharge were to be checked during the design. In addition, the rotational issues to field channels and continuous issues to distributary channels were assumed to reduce "the need for cross-regulation on distributary canals" (MMP 1986b, 2.5).

In addition, measurement structures in branch canals were envisaged at the head and block boundaries. In distributary and field channels, measurement structures were envisaged at the head of the canals. In all canals broad crested type weirs were envisaged. The functional requirements for this choice (e.g., required frequency of reading and calibration, submergence ratio, visibility of discharge, etc.) were not clarified by the consultants in any of the manuals, except for the requirement that they would not be influenced by backwater effects.

Managerial aspects. The decision making regarding the system's required functions has been done almost completely by MMP. While formally they have done so in conjunction with CECB as required in their terms of reference, MMP itself did most of the decision preparation in terms of the design criteria, and CECB was involved in the decision making only, i.e., the actual detailed design work. CECB thereby adhered to the design criteria very rigidly. The CECB staff was often not even aware of the underlying assumed functional requirements. For certain aspects where they had different opinions about the design criteria they sometimes gave their opinions to MMP, but they left the responsibility and the decision making with respect to design criteria to MMP. Through this approach, CECB considered MMP responsible for the designs because it was done completely according to the MMP's criteria. However, MMP and MEA considered CECB responsible for the designs. The terms of references of both consultants did not allocate any clear-cut responsibility to either of them in this respect.

Relations between the MEA's project-level staff and both outside consultants were suboptimal, and as far as they tried to influence the design criteria in terms of the underlying operational assumptions laid down in the draft operation and maintenance manual, their comments were considered but not incorporated by MMP and were neglected by the MEA head office. As a result, MMP had an extreme freedom to determine the underlying functional requirements according to its own insights and assumptions.

Most of the MMP's design criteria follow conventional engineering wisdom about what structures do or do not facilitate controllability. This conventional basis allowed them to formulate the standard design criteria during the first months of their assignment (MMP 1986a, 14). Even the MEA project-level staff did not argue with these design criteria. As a result, MMP did not have to justify the proposed criteria in terms of the underlying functions; the main justification given was that the design criteria followed "standard Sri Lankan practice" (MMP 1986a, 18). For example, justifications were neither given nor required regarding the degree to which measurement structures at the head of distributary and field channels were more appropriate than staff gauges, or regarding the long-term utility and cost-effectiveness of the increased number of control structures, the operational utility of duckbill weirs in the main canal, and the utility of the chosen number and location of cross-regulators in main and branch canals. Apparently these criteria are all part of a "rational" engineering approach.

SOGREAH had used the same approach but they at least consulted project-level staff to discuss system requirements in terms of locations and numbers of cross-regulators and offtakes along the main system. MMP and CECB, for example, did not have any interaction with the most knowledgeable and experienced actual main system manager, i.e., the Technical Officer of the project level O&M division. Despite his crucial role, the hierarchical position of the Technical Officer is low and therefore neglected by higher hierarchical MEA levels and by outside consultants.

The only case where CECB actively tried to influence the design criteria was the proposal to incorporate counterbalancing gates in the gated cross-regulators in the head-end reach of the main canal. Because radial gates similar to those proposed by MMP have led to a disaster in another Sri Lankan irrigation system after ad hoc manual operation during a power interruption, the Chairman of CECB proposed to experiment with a combination of counterbalancing and radial gates. This combination was envisaged to reduce this risk and save energy costs for the operation of the radial gates as well. The MASL Chairman supported his proposal, but MMP and ADB opposed it because of the unconventional and experimental nature of the proposal. The donor decided that if CECB and MASL would insist on this experiment, the extra costs involved could not be covered by loan funds. Consequently, the idea was not pursued by MASL or CECB. This is another example of the large influence of "conventional" engineering wisdom in this decision making through its gradual enforcement by donors and consultants, and, at the same time, demonstrates how external and internal pressures have gradually shifted the Sri Lankan water delivery and design concepts away from the actual reality in day-to-day system management (see also Nijman 1991b on Kirindi Oya).

While some of the assumptions regarding managerial requirements underlying the design criteria are reflected in the operational and maintenance manual, most of the managerial, technical and hydraulic requirements are left implicit and thus unjustified. For example, in comments by MMP on an IIMI report, it appeared for the first time that MMP had built visibility requirements into its design concept: "Interviews with farmers have clearly demonstrated that they understand the concept of staff gauges as a method of measuring flow in canals. The introduction of standard measuring weirs at the head of each field canal will give farmers the information to police the system independently from the MEA staff. This will allow them to check the supply to other canals and they can then identify if they are being treated inequitably. This visual and public method of showing that canals are being treated equally is considered paramount in developing farmers' confidence. It is also felt that this will help to promote the establishment of farmers' groups to bring any complaints to the MEA staff" (MMP 1989b, 5). While this reasoning is typical of the theoretical rationale of a design engineer at his drawing table, the least the engineer should do is to make this kind of perceived functional requirement explicit before, during or after the design stage to test the validity of this type of assumption in the field for future designers. Otherwise, this kind of engineering myth will persist without being openly discussed and evaluated.

The fact that these functional requirements and their relation to the chosen design options are not made explicit is a major weakness which prevents a continuous reappraisal of the validity of the chosen design options with respect to these requirements. Such reappraisals are almost non-existent at present in irrigation engineering.

Similarly, the cost-effectiveness of the fulfillment of implicit functional requirements of different options is not made explicit. For example, the utility of measurement structures remains implicit, while, ironically, it appears to be one of the major causes for the cost increases of the project, i.e., unexpected canal bank filling because "no provision had been made to accommodate the higher water levels needed to allow flow measurement" (MMP 1988b, 2).

Communications, Staff, and Water User Inputs and Discipline

Technical aspects. Future information flows, related staff and water-user inputs, and discipline were laid down in the draft operation and maintenance manual prepared by MMP (MMP 1986b). MMP envisaged a completely supply-driven mode of operation for Uda Walawe. The time, quantity, and duration of water allocations to all subsystems were to be calculated and determined at project level, and strictly implemented at field level. Decisions for flow adjustments would have to be taken at block-office level and the project office would have to be informed immediately. Monitoring of actual issues to distributary and field channels was to be done on a weekly basis and information would have to be fed back to the block office by 08.00 hrs on Monday morning. Monitoring of realized allocations to branch canals and distributary channels along the main canals would have to occur on a daily basis, and related feedback to the project office before 10.00 hrs every morning.

A total of 1,500 forms had to be processed weekly in the project office for this purpose, which is supposed to take about one morning a week. Monitoring was envisaged to serve for evaluation of staff performance in implementation of instructions only, and was not meant for weekly adjustment of allocations. Daily rainfall figures recorded in all block offices, however, had to be fed back weekly (i.e., by Monday noon after a meeting in the block office the same morning) to be incorporated in weekly new allocation schedules (to be distributed by Monday afternoon by 14.00 hrs) if rainfall deviated from the assumed 25 percent of the 80 percent probable rainfall.

Allocations were envisaged on a rotational basis. Rotations within field channels had to be organized by water users themselves in a disciplined way because of the average 40 percent lower water duties envisaged by MMP compared to the average water duties during the 1981-1983 period. These rotations were also envisaged during land preparation. Within distributary, branch and main canals strict rotations had to be realized by the MEA staff. In distributary canals to be cultivated with subsidiary field crops, these crops were envisaged to be irrigated during daytime only, while rice would be irrigated in the night to reduce the need for night storages in the system. During the season, the durations of the rotational allocations to all canals would be adjusted to conform to the theoretical water requirement calculations.

To simplify instructions with respect to gate settings, five standard gate settings for maha and three for yala were proposed. No flexibility at all was envisaged for field staff to respond to ad hoc demands from water users apart from a margin of approximately 10 percent in the allocation schedule and the remainder period at the end of the rotation.

The complete closure of the canal system was envisaged after rainfall of 45 mm during maha and 35 mm during yala occurred. These estimates were based on the corresponding 25 percent of the design discharge which was assumed to be covered by effective rainfall rather than on the capacity of the staff to operate the system accordingly. No justifications are given as to why in Uda Walawe the agency would be able to effect such closures while the Irrigation Department uses 75-mm rainfall as the minimum rainfall depth for complete canal closure. Related instructions and procedures (e.g., for operation of the canals during filling and emptying) are not given in the manual.

Certain inconsistencies and gaps can be found in the manual. For example, major deviations in issues to distributary channels or branch canals were to be reported weekly to the project office. How the consequences of such deviations have to be dealt with in the branch canal during the rest of the week are not covered by the manual. No instructions or procedures for operation of gated cross-regulators were provided, except that these operations could be limited to twice or three times a week.

The above described water delivery concept requires much discipline and effort regarding information flows from the centralized project office to the field and vice versa. Flexibility to respond to sudden changed requirements from water users and field staff is limited without intermediate storages and allowances in the discharge. Consequently, the requirements of disciplined on-farm water management by water users are higher as well. This again created requirements regarding the cooperation and association of water users to cope with the allocated and delivered water. MMP has not been very specific in these underlying requirements.

Regarding all the mentioned functional requirements little feedback is available from the beneficiaries, the local community, or the MEA staff responsible for daily management of Uda Walawe with respect to the actual feasibility and desirability of envisaged functions. Thus the sustainability and functionality of these designed operational procedures remain unknown.

Managerial aspects. The aforementioned operational requirements underlying the other functional requirements as described in this chapter represent an increase of the present low level of perfection (20-40%) in Uda Walawe to a higher level. The draft operation and maintenance manual assumes the seasonal allocation concern to increase from an average level to a high level (40-80%), the in-seasonal allocation from an average to very high (40–100%) and presumably the water flow regulation to follow suit. The water flow regulation is not really covered by the manual. Instead the consultants envisage essentially steady-flow conditions in the main canal, and simplified operations through duckbill weirs in the branch canals. This neglect of unsteady flow conditions is also reflected in a reaction by MMP to IIMI observations that the maintenance of constant discharges at the head of each distributary channel has to be done by very accurate adjustment and regulation of flow in main and branch canals (IIMI 1989b, 85): "This comment...is not correct and the reason for this misconception is not clear" (MMP 1989a, 6).

These higher levels of perfection do not depend only on the availability of physical infrastructure, other facilities and staff training as assumed in the Walawe Irrigation Improvement Project (WIIP), but essentially on a commitment of the MEA project and the head-office staff and possibly the national government to increase its managerial inputs to such higher levels. That such commitment is not present in Uda Walawe has been described in chapters 3 to 6, and the WIIP has not contributed to an increase in this commitment either.

The identification of required and feasible management inputs for the different management concerns seems to be rather at the will of the involved consultants. The MEA's input in this aspect has been nil. An extension meeting in 1986 for all O&M staff in Uda Walawe did not give any serious feedback in this respect, except for some objections against staggering of the land preparation. Also the presentation of the O&M manual and design criteria did not evoke any criticisms from MEA or CECB with respect to the assumed managerial inputs. Thus, even while MEA, CECB and MMP were well aware of the MEA's limitations and constraints in this respect the proposed plans were pursued. MEA and CECB did not want to take responsibility for these assumptions, while MMP was not really responsible for them either; according to their terms of reference they assist the project only. MMP as consultant could not be seriously responsible anyway, because of its temporary involvement with the project.

The absence of responsibility and commitment in this respect in Uda Walawe had been noted by PRC and Wolf. PRC proposed longer-term involvement — and thus responsibility — of outside consultants for the development of management procedures and practices in parallel to a heavy maintenance program. Wolf proposed that preliminary improved performance during such a heavy maintenance program should be a condition for financing of further augmentation options, i.e., a sort of enforcement of responsibility through financial incentives. To what degree these approaches would have been sustained in the longer term remains unknown, but, at least, they provided for some measures to enforce some accountability towards the project objectives from one of the involved parties (i.e., consultants or agency). It is unclear why the donor or MEA did not follow up on these recommendations and the WIIP did not provide for any such measures and responsibility, apart from the theoretical or conceptual, towards the success of the project objectives.

MMP was of the view that rotations were traditional in the management of Sri Lankan irrigation systems and thus could be easily envisaged. However, the traditional rotations in Sri Lanka prevail only in temporary water-short circumstances, or in systems where under water-abundant situations the tail-end canals cannot be reached otherwise; physical enforcement in exceptional situations and conveyance along the main system are the main criteria for staff and water users for accepting these rotations. Enforcement of fixed rotations to all canals and even individual allotments in the whole command area under water-abundant situations tries to achieve a high equity and water efficiency which criteria are certainly not traditional in the management of Sri Lankan irrigation systems. Remarks of system managers like "With enough water and a good design, the gate tenders will be able to manage" better reflects the staff's attitude towards the WIIP and the requirements of its own management inputs.

While the donor did not allocate any funds for organization of water users into groups, it made the functions of such groups to be developed by MEA part of the loan agreement covenants: "Within a period of four years from the commencement of the improvement works...establish a network of water user groups...at all strategic levels...to participate and assist in the making of decisions regarding cropping patterns, cropping calendar and irrigation schedule at each level and shall have responsibility to maintain field channels, plan rotation schedules, adjudicate water conflicts and enforce sanctions, and assist in the collection of irrigation service fees" (ADB 1984d, 23).

Despite the MASL's signing of this agreement, the MEA top management preferred to develop in Uda Walawe a water user group network at field level which would interact mainly at unit level. However, this top-level decision making was not compatible with the actual organizational setup in Uda Walawe where, unlike in other parts of the Mahaweli system, the Unit Manager was not involved at all in water delivery decision-making processes. However, without any additional funds the MEA project-level staff implemented a marginal effort to satisfy the donor's requirements in this respect, even when they seriously doubted its feasibility, given the mass encroachment problems and political problems experienced when the RVDB earlier tried to organize water user groups in Uda Walawe. Despite the absence of any role of these groups in the past and present decision-making processes in Uda Walawe, except for some informal supervision of the construction under the WIIP, the donor was apparently satisfied with this level of compliance by MEA: "The Training Unit..has organized 140 water user groups...bringing the total of organized water user groups to 173" (ADB 1988, 3).

The foreign consultants played a facilitating role in this decision making by producing discussion notes on motivators for the organization of water users and on the so-called design walks which had been practiced in Gal Oya. However MMP complied with the above MEA decisions, and did not insist on the design walks because "it would have been presumptuous of a foreign firm of consulting engineers to tell the Sri Lankan authorities how to organize farmers" (MMP 1989b, 9). In the first instance however, even MMP was not very sure about the need for viable water user organizations that evolved from the technical requirements of their own design involving fixed rotations and low water duties within field channels. They argued against an IIMI observation in this respect as being "very doubtful and completely unproven" (MMP

1989a, 8). It was only after the first distributary channel offtakes had been broken by water users that they acknowledged the importance of organizing water users (MMP 1989b, 6).

Thus, while the draft operation and maintenance manual assumes a perfect, rational and efficient on-farm and canal water management (i.e, an increased responsibility of the water users to improve the system's water duties), the directly related requirements of perfect cooperation and discipline of water users and staff have been neglected by MEA, the donor, MMP and CECB. The evolving choices between changing the present behavior of water users and staff or the reconsideration of the appropriateness of the operational assumptions and design criteria have not been addressed by all parties, which demonstrates again the lack of accountability of all involved parties with respect to the project objectives and the involved investments. The extreme freedom of foreign consultants to decide on operational assumptions and design criteria up to the field level is a symptom of this lack of accountability.

Mutual Adaptation of the Technical and Managerial Aspects

Unlike in Kirindi Oya, the operational assumptions and some functional requirements were defined in Uda Walawe before the actual designs. In principle, this would have allowed for interaction between different parties to evaluate these proposals and to adjust them accordingly. In actual practice, the proposals were more of a blueprint approach with little flexibility for real-life requirements, whereby operation and maintenance manuals were developed to a large extent abroad rather than in Uda Walawe. In general, very little system-specific requirements were incorporated. Scientific engineering concepts like theoretical water requirements, rationalization and turnout areas allow such standardization and neglect of real-life problems. Between the moment of the release of water from the head sluice and the application of irrigation water by the water user for irrigating his crop, a complex of internal agency processes and interaction between agency and water users creates irrigation requirements that appear to be quite different in practice from these theoretical water requirements. This difference is not only caused by measurable losses, but to a large extent by managerial losses. This strongly suggests that the use of the theoretical crop water requirements can better be abolished for assessments of system feasibility and for the determination of functional system requirements, or alternatively, their utilization should be allowed only with detailed references and justifications of their relevance in the real-life situation. Mendis (1977) and Visvalingam (1986) have argued in vain against these concepts, with specific references to Uda Walawe, as quoted on page 142. Their observations pointed at a systematic neglect of the planning and design processes in Sri Lanka, which has remained largely undisputed by the responsible agencies even till the present day.

The sparse feedback of requirements from project-level day-to-day system managers was not incorporated, because these requirements did not match the rationalized rehabilitation concept. The MMP's reactions on such feedback were always within this rigid framework. CECB and MMP did not systematically interact with block-level and field-level staff and water users to identify actual functional system requirements.

The application of the MMP's rationalized design criteria became even more rigid because of the use of them as a "bible" by CECB, reinforced by time pressures. The responsibilities of these parties in this respect were vaguely defined in their terms of references. Accountability towards the project objectives has been completely absent, and all parties were working rigidly along the requirements laid down in their own terms of references. Inappropriateness of evolving functional requirements was considered to be related to the donor's overall project objectives which were to extend the command area and improve the EIRR (e.g., irrigation requirements, rotations), and thus to be a mere fact. Consequently, the engineering solution for a managerial problem of controlling water waste by head enders was the ultimate responsibility and problem of the donor only. The yearly missions of the donor's project officers do not allow for any serious monitoring of constraints arising from their project objectives, which is often the reason they appoint foreign consultants "to get the job done." These consultants can ensure the construction and other visible targets, but have little influence on, and understanding of, the required managerial processes. Consequently, nobody has yet attacked the underlying managerial causes which will require little capital, but commitment and considerable time of the agencies and the politicians.

More sustainability requires more gradual development, less time pressures and more incorporation of requirements, preferences, and experiences of the water users, the local population and of the different managing-staff levels. It is only after the water waste by head enders would have been tackled, would a maintenance or rehabilitation program of other areas have served any purpose. The donor's Project Completion and Performance Audit Report concluded that this approach would have been better for the original project also, but this apparently did not have any implications for the recommended rehabilitation project (ADB 1979, 71 and 1982, 19). Clearly, Visvalingam's complaints as quoted on page 142 apply to the donor agencies as well.

Due to the limited and ineffective interaction, consequent heavy reliance on conventional engineering wisdom has led to inappropriate rationalized turnout area layouts, too low water duties to enforce cultivation of subsidiary field crops, and large numbers of inappropriate, abundant, and too costly control and measurement structures. Large construction packages combined with lack of field testing of design assumptions have led to many delays, wasted design efforts, and extra construction costs. It is only during construction, after completion of all designs, that many of these shortcomings became evident and many designs had to be redone by CECB. Many managerial and engineering functions underlying the design criteria and the draft operation and maintenance manual have been kept implicit, which makes them less open to evaluation and improvement for the present as well as for the future projects.

The influence of the donor on the choices with respect to the functional requirements, whether directly or through consultants, is enormous and underestimated. In contrast to this enormous influence, its monitoring of a project like Uda Walawe is very restricted, i.e., officially, it is only once a year that a visit to the project is made by the responsible project officer. A good feeling and understanding about the bottlenecks regarding the functional requirements of a system like Uda Walawe are unfeasible in that way, whatever the quality and motivation of the donor officer involved.

Despite this, he is still expected to monitor and evaluate the project and to intervene in key decision-making processes. He is forced to come up with solutions because within the donor he is responsible for solving the impediments to attaining a sufficient Economic Internal Rate Return till the end of the construction period. In contrast, the government and agency staff do not have such accountabilities and responsibilities.

The unsustainability of this process is that whatever solution this officer will push at a certain moment (e.g., standard rationalized layout with turnout areas, increased numbers of control and measurement structures below distributary channel offtake, cross-regulator gates, etc.), the chance that it is well-adapted to the local situation is very small. As may appear from this paper, the performance problems are very complicated and result from many long-term and ongoing processes, solutions for which, however, can only be identified and implemented by MEA itself. The donor's loans and consultants can play no more than a facilitating role in this respect. However, because agency staff are less concerned with the actual Economic Internal Rate of Return than the donor, and because continuation of the project is more important for them, they will not impede demands from the donor officer and consultants, and consider it feasible and functional as long as the loan will not be endangered.

CHAPTER 10

System Rehabilitation: Opportunities for Improvement

IN THIS CHAPTER it is assumed that MEA has the ambition to improve the water delivery performance and productivity in the Uda Walawe system to enable, for example, further increases in cropping intensities in the existing command area. It is also assumed that, to achieve this improvement, a higher level of perfection of the determination of feasible objectives and functional requirements for system rehabilitation is required. No indications can be given as to which of these opportunities deserves priority, because no comparative data regarding the relation between system performance and the levels of perfection of the different key decisions have been collected as yet. In the absence of such normative values the given opportunities could be used by MEA as a kind of check list.

A higher level of perfection does not necessarily lead to a better outcome. In certain cases it may be necessary to increase the quality of the decision rather than the level of perfection. Similarly, a good decision that evolves from a low level of perfection may be very cost-effective.

Several opportunities for improvement given in this chapter apply to other MEA systems as well. However, the Walawe system is a special system within MEA in terms of the comparatively less support it receives from the head office, and thus the author does not claim that all of these management recommendations will be valid for other MEA systems as well.

DESIRED SYSTEM OBJECTIVES

An evaluation of the levels of perfection and managerial conditions has not been done for this key decision. Chapter 7 demonstrated that most desired system objectives have been specified at the beginning of the project. Consultations with the project-level MEA staff, the local community and the beneficiaries were not done at that time. The actual desirability of the project objectives from their point of view remained unknown. During the implementation of the project there was only very little scope to change the project objectives to make them more desirable from their point of view. The level of perfection was thus very low (0-20%). However, further systematic evaluation of managerial conditions and opportunities for improvement along the lines of the other key decisions have been considered inappropriate given the sensitive political nature of this level of decision making.

FEASIBLE OBJECTIVES FOR SYSTEM REHABILITATION

The Present Management Performance: The Level of Perfection

In this section, the overall level of perfection of the feasibility-level decision-making processes is classified as very low (0-20%) following the classification in the annex. A very low or high classification is not a judgement in itself as a very low level of perfection may lead to a satisfactory performance and may thus be cost-effective. However, in case the performance is considered unsatisfactory, a higher level of perfection is assumed to lead to a higher performance. The quantitative judgement is based on the following process characteristics.

Feedback. No feedback from the project-level staff and politicians, beneficiaries, local community or available publications has occurred with respect to the major assumptions regarding the feasibility of the augmentation options, water delivery concept, improved water duties in head-end reaches of the system and subsystems, maintenance funds, cropping intensities, cost recovery, and implementation schedule: A very low level of perfection (0-20%). However, some obvious experiences with the original investments have been incorporated, like a more gradual introduction of subsidiary field crops and somewhat less ambitious water duties: A low level of perfection (20-40%).

Foreseeing. The long-term sustainability of the assumed water duties, water delivery concept, maintenance over the assumed lifetime of the system (i.e., 28 years), and cropping intensities is unclear. Formally, they are assessed to be sustainable and incorporated as such in the EIRR, but in fact no real assessment of this sustainability has been done. Necessities for extending the lifetime of this system beyond the more likely lifetime of only 15 years before another major rehabilitation is necessary, are not indicated: A very low level of perfection (0-20%).

Integration. The feasibility assessments of available water resources, reservoir capacity, success of cultivation, water duties, cropping intensities and cropping patterns are considered in a somewhat integrated fashion through the water balance studies and EIRR. However, the crucial managerial assumptions underlying these feasibility assessments are considered separately: A very low level of perfection (0-20%).

The feasibility assessment of maintenance, water delivery concept, land settlement, and cost recovery occur separately; the mutual interdependence of these objectives is not taken into account in the different assessments. For example, the consequences of insufficient cost recovery on maintenance, of maintenance on water duties, cropping intensities and subsidiary field crops, of the dam site on the water duties and water delivery concept, etc., are not incorporated or considered: A very low level of perfection (0-20%).

Systematics. Few rules apply to the setting of feasible objectives by the agencies. However, a routine that has developed over time is that the feasibility assessment of a project includes reconnaissance, feasibility and appraisal studies: A low level of perfection (20-40%). No requirements exist with respect to involvement, responsibilities or type and frequency of consultations with different agencies, government and beneficiaries to assess the feasibility of, for example, the reduction of water use by head enders. The absence of any rules led to inconsistencies in sequential assessments, much room for subjective assessments and little matching between the perceived and actual feasible project objectives: A very low level of perfection (0-20%).

Opportunities for Improvement: Requirements with Respect to the Processes

As the project objectives for the Walawe Irrigation Improvement Project (WIIP) appear to be rather unfeasible, it is assumed in this section that more feasible system objectives will evolve from an increase of the level of perfection, from very low (0-20%) to low (20-40%).

Technical aspects. The available water resources should be determined at 75 percent dependable availability, i.e., the 75 percent regulated flow in Uda Walawe, or any other dependability level which is considered feasible to achieve the other envisaged project objectives. Apart from simulating the water balance, an explicit statement on the available regulated volume may prevent confusion in this respect. A feasible level of this assessment is of utmost importance because all other project objectives completely depend on this basic input.

Feasibility of project objectives like improved water duties and related water delivery concept, cropping intensities, maintenance levels and related life span of the project, and the implementation schedule should be related to past experiences and achievements rather than to optimistic assumptions only.

For a low level of perfection (20-40%), obvious experiences with respect to these assumptions of local community, beneficiaries, field, project and head-office level agency staff and the donor staff, whether published or not, should be considered in the decision making. Obvious experiences relate in this respect to suitability of the soils in systems and subsystems, different augmentation options, average achieved water duties or probable improvements, water delivery concept, acceptable cropping patterns, cropping intensities and command area, probable or achieved maintenance levels, probable implementation schedule, and environmental sustainability. Convincing mutual influences between these different assumptions (e.g., dam site and soil suitability, dam site and environmental sustainability, maintenance level and project life, dam site and water duty, managerial capacity or motivation and water duty) are incorporated as well.

For an average level of perfection (40-60%), the most important experiences with respect to the assumptions, of local community, beneficiaries, agency and the donor staff, whether published or not, are considered. Directly related mutual influences between the water duties, related water delivery concept, cropping patterns, cropping intensities and command area, maintenance levels and related life span of the project, implementation schedule, and environmental sustainability, are considered.

Managerial aspects. Most importantly, the assessment of feasible system objectives should be picked up by MASL, MEA and the Government of Sri Lanka as a priority area for improvement. Outsiders will not be able to prescribe feasible objectives for system rehabilitation but can only assist within the priorities set by MEA and the government. MEA should link with the Agricultural and Land Commissioner's (and possibly Irrigation) Departments, national and local politicians and the Ministry of Planning to develop a concept for system rehabilitation which can lead to mutually acceptable feasible objectives for further investments in Sri Lankan irrigation systems. Such a system rehabilitation (or development) concept may consist of more gradual water duty improvement, a more appropriate water delivery concept, feasible maintenance levels, feasible life spans, feasible gradual rehabilitation or improvement programs, feasible resource mobilization, and feasible gradual extension of command area related to improved water duties and cropping intensities.

Any requirements set by donors or the government will become fully successful only if the managing agency takes the lead in the development of feasible and sustainable system-development concepts. In order to be effective in this, the higher hierarchical levels will have to stimulate information exchanges between different levels with respect to the aforementioned feasibility of envisaged system or project objectives and potential remedies or improvements.

More official involvement of water user groups, local community and local politicians on a more (40-60%) or less (20-40%) regular basis in the determination of feasible system objectives is required as well. More interaction will probably create more demands and expectations from them, which will require compromising among these demands and the different attitudes of involved politicians.

To the degree that foreign funding will be required for irrigation investments, potential donors should assess the feasibility of a proposed plan in an objective way, and based more (40-60%) or less (20-40%) on earlier experiences and achievements with the involved agency. The foreign donor should not become involved anymore in the decision-making on the feasibility of project objectives; the proposal of the agency as a whole should be considered feasible or unfeasible. The managing agencies should be made responsible for their actual achievements through this more objective form of feasibility assessment, which strongly relates to reality and actual achievements. Spending pressures of donors should not influence the objectivity of the donor staff and the consultants involved in this assessment.

Opportunities for Improvement: Requirements with Respect to the Managerial Conditions

People. For a low level or an average level of perfection, the technical capabilities of MEA and the donor staff and consultants should become less one-dimensional in terms of their reliance on scientific simulations of reality. More incorporation of experience in the actual day-to-day management of existing systems in feasibility assessment approaches by engineers and other agency staff may be a first step. These capabilities can be initiated only by a change in the entire setup of feasibility assessments by the agencies, the politicians and the donors which will be described hereafter under the heading Organizational Rules.

More problematic may be the required change of attitudes and motivation, especially in view of the present indifference of the MEA staff, that is necessary for the more long-term, complex decision-making processes oriented toward more careful assessment of feasible system and project objectives. More openness in discussing the professionalism of engineers will be required to arrive at a more feasible concept for irrigation system rehabilitation and development. More managerial skills will be required to interact with other disciplines, own staff, politicians, local communities and beneficiaries.

The donor should take measures to make its staff more objective with respect to the feasibility and appraisal assessments and the actual "selling" of loans to enable them to be more realistic with respect to the actual feasibility of project objectives. In the short run, this will probably lead to fewer irrigation investments by the donor. MEA and the government staff should become more accountable and committed to the loan and project objectives in the medium term and long term.

Provision of information. For a low level of perfection (20-40%), information should be provided regarding past experiences in feasible improvements of water duties in different subsystems, water delivery concepts, cropping patterns, suitability of soils in subsystems, maintenance levels, implementation schedules, and environmental sustainability. Such information could be provided by the agency staff, the beneficiaries and the local communities. In addition, it could be derived from publications. For an average level of perfection (40-60%), the most important experiences in this respect are considered.

For a low level of perfection (20-40%), information should also be provided with respect to convincing mutual influences between these different assumptions (e.g., dam site and soil suitability, dam site and environmental sustainability, maintenance levels and project life, dam site and water duties, managerial capacities or motivation and water duties). For an average level of perfection (40-60%), information should be provided on the influences that may effect these assumptions.

For a low level of perfection (20-40%), explicit information should be provided regarding the 75 percent dependable regulated flow, or any other level which is considered feasible to achieve the other envisaged project objectives.

Systems and methods. A more appropriate concept for system rehabilitation or development is needed for MEA which will facilitate the proper identification of feasible project objectives. In addition, the EIRR should be used only if it can determine the opportunity of a feasible project in comparison with other investments. It should not be used for determining the feasible objectives without appropriate justification of the underlying assumptions.

For a low level of perfection (20-40%), the feasible water duty improvements should not be determined with the theoretical water requirements without any further justifications and without calculating the involved risks of the assumptions.

For a low level of perfection (20-40%), the water balance studies will at least have to calculate the number of crop failures and water availability involved. For an average level of perfection (40-60%), it should also indicate feasibility of the envisaged regulated flow in view of the envisaged cropping calendars.

For a low level of perfection (20-40%), the sensitivity analysis should incorporate the risks involved in the assumed water duties, related water delivery concept, cropping patterns, cropping intensities, maintenance levels, implementation schedule, project sustainability, and dependable regulated flow.

For a low level of perfection (20-40%), arrangements have to be made for more effective interaction between the different disciplinary specialists, the beneficiaries and the local community about the timing and feasibility of important project objectives like the soil suitability of areas to be commanded, water duty improvements, augmentation options, water delivery concept, command area, cropping patterns and intensities. For an average level of perfection (40-60%), a planning system should be used for more systematic step-wise decision making and planning of these consultations.

Provision of knowledge. Knowledge about alternative concepts for system rehabilitation and development and related feasible system or project objectives should be developed in MEA and the donor. This can be done, for example, through monitoring, evaluation, and research and pilot projects of different concepts in terms of, for example, more gradual water duty improvement, a more appropriate water delivery concept, feasible maintenance levels, feasible life spans, feasible gradual rehabilitation or improvement programs, feasible resource mobilization, and feasible gradual extension of command area related to improved water duties and cropping intensities.

In the same way, managerial knowledge about different techniques to interact with different groups, stepwise project preparation, the use of criteria in different phases, and the gradual implementation of projects, should be developed by MEA and the government. Experience could be gathered from similar projects in developed countries, or in less developed countries where conditions are probably more similar.

A separate issue is the managerial knowledge on how such interactive processes can be attuned to the requirements or the objectives of the donor as a bank. Prior to this the donor should determine its own, realistic requirements with respect to feasibility assessments which result in feasible project objectives.

Organizational rules. For a low level of perfection (20-40%), MEA should develop broad rules for the determination of feasible options for system rehabilitation of its projects, possibly within the framework of a whole new system-rehabilitation concept. These broad rules should determine the responsible staff members, the different steps to be taken during the rehabilitation, identification and preparation, and the consultations with different groups. For an average level of perfection these rules should become more specific.

The donor should develop more (40-60%) or less (20-40) specific requirements with respect to the feasibility of proposed project objectives, which have to be determined by the Sri Lankan agencies, the local communities and the beneficiaries before the donor becomes involved in this process. Thus, the donor should consider only the quality of the plan and its feasibility or unfeasibility in view of important requirements, for example, related to earlier experiences and achievements. Responsibility and accountability towards feasibility of project objectives should be given to and remain with MEA and the national government; their commitment towards project objectives should be the major focus in future design and development of loan procedures by the donor. The donor staff and consultants should not influence these feasibility assessments of components of projects but should determine the feasibility or the unfeasibility of the overall project proposal submitted to them.

Nonavailability of counterparts of sufficient capabilities and authority should not lead to inappropriate feasibility assessments, but should lead to no feasibility assessments at all, because the government itself, and not the donor staff and consultants, will have to develop feasible plans. This will probably require much longer and more phased project preparation periods, and for larger systems, more gradual implementation. On the other hand, better preparation will allow for less delays in construction, less waste of opportunities, and more sustainable results.

More accountability of agency and government towards the water delivery performance can be enforced, for example, to a certain extent through the incorporation of achievements of the agency in the feasibility assessments for future investments, or to a larger extent through direct accountability of the agency towards the investments towards the government or the donor; i.e., project benefits have to repay part of the loan.

For a low level of perfection (20–40%), in addition to the above requirements, broad rules ("rules of thumb") should be introduced to systemize the decision-making processes, while further perfection (40–60%) will require more specific rules.

The donor should make its staff and consultants fully accountable for the use or misuse of the EIRR. Performance appraisal of the donor staff should be based on the quality of their feasibility and appraisal assessments and monitoring of their projects, rather than on the number and size of realized loans. This implies that the donor staff should be allocated much more time for assessing the feasibility of proposed project objectives and design and evaluation of performance later on. However, they should not be allowed any time for project proposal development and design. Pressures to "sell" loans or reach predetermined loan targets should not be allowed to influence feasibility assessments by the donor staff and consultants.

FUNCTIONAL REQUIREMENTS FOR SYSTEM REHABILITATION

The Present Management Performance: The Level of Perfection

In this section the overall level of perfection of the decision making with respect to the functional system requirements is classified as very low (0–20%) following the classification in the annex. It must be noted that a very low or high classification is not a judgement in itself as a very low level of perfection may lead to a satisfactory performance and may thus be cost-effective. However, in case the performance is considered unsatisfactory, a higher level of perfection is assumed to lead to a higher performance. The quantitative judgement is based on the following process characteristics.

Feedback. The whole rationalized turnout area layout, irrigation requirements, required controllability over water flow and related managerial assumptions are based on assumptions, with little and ineffective interaction with managing staff and water users. The little feedback that occurred on the validity of these assumptions has not been considered on its own merits and validity but within its rigid conceptual and theoretical framework only: A very low level of perfection (0–20%).

Foreseeing. Many of the assumptions often relate more to the medium term and the long term than to the short term. For example, the idea that percolation of upland soils will become similar to lowland soils after ten years due to the formation of a hardpan and that water users will do their land preparation more disciplined in the long run can be considered the long-term necessities of the system: An average level of perfection (40–60%). That, in this example, this argument about the water use of the uplands may be faulty is more a matter of the quality of the resulting decision than of the level of perfection itself.

But the consequences of actions like the overloading of the canals and offtakes (i.e., breakage by water users and staff, too small capacity of main canal to command full area below the Chandrikawewa Reservoir) during the first ten years were not considered. Lack of cooperation of water users, lack of management inputs by agency staff, feasibility of crop diversification and their short-term consequences on the viability of the assumed irrigation requirements, controllability of water flow, etc. were not considered: A very low level of perfection (0–20%).

Integration. The decision-making processes concerning the functional requirements did not consider unsteady flow conditions and, therefore, the required managerial capacities and motivation and realistic intensity of communication. Neither did they consider the need to organize water users to realize the very low water duties within the turnout areas. Neither were the mutual influence of limited peak-design capacities of main system, feasible water duty improvements in the head end and increased allocations to the tail-end areas considered: A very low level of perfection (0–20%).

Systematics. Determination of functional requirements has happened implicitly through the application of scientific engineering concepts, which simulate the actual field reality in an inappropriate way. No rules (e.g., to interact, test or negotiate) applied to this decision making by MMP, CECB and MEA project-level staff brought about a large freedom for MMP; a very low level of perfection (0-20%). Similarly, the evolving design criteria were not meant as rules as such but as guidelines to systemize the designs. However, they are generally used that way by the Irrigation Department, MEA and CECB nowadays because it supports speedy design and construction. The level of perfection implied in these procedures and guidelines is high (60–80%) but they deal less with the determination of the functional requirements and related design concept than with the implementation of the actual design activities as such.

Opportunities for Improvement: Requirements with Respect to the Processes

As the present design concept in Uda Walawe seems to be based on inappropriate assumptions and functional requirements it is assumed that more appropriate functional system requirements will evolve from an increase of the level of perfection from very low (0-20%) to low (20-40%).

Technical aspects. For a low level of perfection (20-40%), improvement of the determination of the functional system requirements and the consideration of at least the most obvious experiences of system managers and beneficiaries in the utilization of the existing Uda Walawe system are necessary. Such experiences refer to, for example, the (peak) irrigation requirements, required controllability of main system, communication requirements, system layout, drinking-water and bathing-water requirements, and other functions of existing village tanks. For an average level of perfection (40-60%), the most important experiences of system managers and beneficiaries have to be considered.

For a low level of perfection (20-40%), necessities for the sustainability of the functional system requirements (e.g., the medium- and long-term [peak] irrigation requirements, the passive and active controllability of flow in case of system degradation, the long-term flexibility with respect to crop diversification) during the lifetime of the envisaged irrigation improvements will have to be considered. For an average level of perfection (40-60%), priorities with respect to the sustainability of the functional system requirements (e.g., in addition to the aforementioned, the managerial and hydraulic responsiveness, the required communications, the required organization of water users) will have to be considered.

Moreover, for a low level of perfection (20–40%), convincing subsidiary influences in terms of mutual influences of requirements like the rationalized turnout concept and organization of water users, or limited peak canal capacities, improved water duties and envisaged command area have to be considered. For an average level of perfection (40–60%), mutual influences of directly related requirements as, for example, unsteady flow conditions and management inputs, have to be considered.

Managerial aspects. A more explicit determination of the presently implicit functional requirements of an irrigation system is required before and during the design and construction of a system. Because MMP and CECB can play a facilitating role only in this respect, the related internal managerial processes in MEA will have to incorporate experiences of its own system managers. Moreover, the matching of engineering and nonengineering functional requirements requires more (40–60%) or less (20–40%) interaction with the local community, farmers, different MEA-staff levels and different disciplines within MEA at an early stage in the planning of improvements.

Given the hydraulic-engineering and structural-engineering aspects involved, only the MEA staff can effectively define functional requirements with respect to their irrigation systems from these different interest groups. A reassessment of the present rigid design concept seems unavoidable. At the same time, no standard new design concept is desired but a more flexible new design concept which is more appropriate to the Sri Lankan management environment in general and which is tailor-made to the requirements of location-specific physical, institutional and human environments.

Such a different attitude is unlikely to come about if foreign funds continue to flow into Sri Lanka without the requirement that the Government of Sri Lanka, MEA and the Irrigation Department become more accountable towards its own design assumptions by developing its own independent professionalism, and determining appropriate functional system requirements for Sri Lankan irrigation. Such requirements from the donor's side — instead of a systematic and detailed intervention in Sri Lanka in an inappropriate design concept — may lead to more sustainable irrigation systems and performance. Development of appropriate functional system requirements for new or existing irrigation systems will only be possible if the government and the donors will allow appropriate time and funds for the required managerial processes.

Opportunities for Improvement: Requirements with Respect to the Managerial Conditions

People. Achieving a low level or an average level of perfection of determination of the functional system requirements and evolving design concept for Sri Lanka in general, and for location-specific systems in particular, will require a different attitude and awareness to "irrigation professionalism" by engineers of Sri Lankan agencies, foreign consulting companies, and donors, because of the necessity to open up the present dominant hydraulic- and civil-engineering orientation for other relevant functions of irrigation systems, like realistic irrigation requirements and related management inputs.

It will also require an increased awareness of staff about the managerial aspects of the planning and design processes. Moreover, a change in communication capacities and attitudes is required of the MEA head-office staff in relation to its own lower hierarchical levels and the different interest groups in society that are affected or that benefit from the irrigation systems.

As mentioned before, such major changes in professional attitudes will come about only if the involved engineers are made more accountable and responsible towards their design assumptions, and evolving system performance.

Provision of information. For a low level of perfection (20–40%), information will have to become available at least on the most obvious experiences of system managers and beneficiaries in the utilization of the existing Uda Walawe system. Such experiences refer to, for example, the (peak) irrigation requirements, required controllability of main system, communication requirements, system layout, drinking-water and bathing-water requirements, and other functions of existing village tanks. For an average level of perfection (40-60%), information will have to be available regarding the most important experiences of system managers and beneficiaries.

Moreover, for a low level of perfection (20–40%), information will have to be available on necessities for the sustainability of the functional system requirements (e.g., the medium- and long-term (peak) irrigation requirements, the passive and active controllability of flow in case of system degradation, the long-term flexibility to diversify the cropping patterns) during the lifetime of the envisaged irrigation investments. For an average level of perfection (40–60%), information will have to be available on priorities in the sustainability of the functional system requirements (e.g., in addition to the aforementioned, the managerial and hydraulic responsiveness, the required communications, and the required organization of water users).

Moreover, for a low level of perfection (20–40%), information will have to be available on convincing mutual influences of requirements like the rationalized turnout concept and organization of water users, or limited peak canal capacities, improved water duties and envisaged command area. For an average level of perfection (40-60%), information regarding mutual influences of directly related requirements like, for example, unsteady flow conditions and management inputs, have to be available.

Systems and methods. The present rigid, rationalized turnout layout will have to be evaluated on its appropriateness for the Sri Lankan managerial and political environment, and, even then, the use of the evolving design concept will have to be restricted to the purely design activities within an appropriate framework of functional system requirements.

Instead, systems directed at facilitating the integration of the point of view of the system managers and local community in the functional system requirements and design concept will have to be introduced. Examples of such systems are checklists, priority lists, cost curves, representative pilot studies, planning systems, trial runs, (open-ended) questionnaires, attitude studies, field visits, rapid rural-appraisal techniques and hydraulic- simulation techniques to determine the appropriateness of design options. Such systems will have to be developed to test the degree to which alternative design concepts fulfill these different functional requirements.

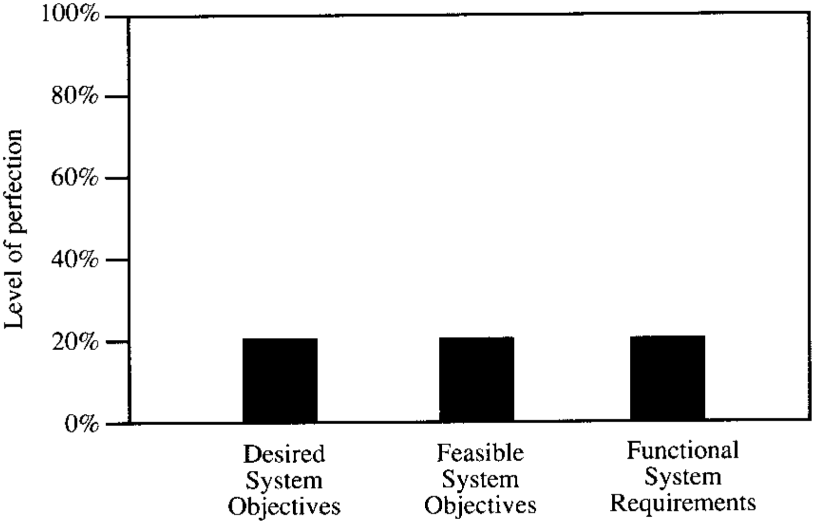
For a low level of perfection (20–40%), operation and maintenance manuals will have to be written before the design and construction, and will have to be fully in line with the above explicit and consistent functional system requirements and related design concept. The latter will have to be defined before and during the design phase rather than "after the meal."

A more gradual development of irrigation infrastructure or its rehabilitations from the head end to the tail end of a main system or catchment area — which conform to the more traditional Sri Lankan way of spontaneous "wild" extension of command areas over time — will allow for field-testing, evaluation and possible improvement of the functionality of system requirements like layout, water duties and controllability. Such a gradual rehabilitation will provide for more flexibility in determining these functional system requirements after the feasibility assessment and will thus prevent costly investments serving no other purpose than justification of the theoretical economical feasibility.

Provision of knowledge. The managing agency will have to develop its own expertise with respect to appropriate functional system requirements and evolving design concepts and managerial processes that will lead to these requirements. To allow the development of such expertise, donor organizations, foreign and, to a certain degree, local consultants in their turn will have to become aware of their limitations with respect to the determination of appropriate functional system requirements and design concepts which for them are unfamiliar physical, institutional and human environments — especially if they have to assess them under time pressures like that for MMP and CECB in Uda Walawe. Politicians who promote construction and visibility at the expense of sustainable and cost-effective processes and outcomes should be made aware of their influence on these decision-making processes.

Organizational rules. Appropriate rules that bring about the incorporation of interests other than hydraulic engineering and civil engineering in the functional system requirements will have to be developed. For example, procedures to consult different levels of system managers, local communities, politicians and farmers about their preferences in the system's functions, opportunities for improvement, and the testing of the envisaged design concept on its compliance with these functional system requirements may be developed. A more important role in this decision making should be given to the managing agency and water users, given their familiarity with opportunities and constraints in a specific system.

Figure 8. The levels of perfection of system rehabilitation processes, Uda Walawe.



PRIORITIZING AMONG OPPORTUNITIES FOR IMPROVEMENT

The levels of perfection achieved in system rehabilitation processes in Uda Walawe are graphically displayed in Figure 8. Higher levels of perfection are assumed to lead to higher system performance. However, it is yet unknown to what degree the different key decisions contribute to the system performance; the relative contributions of the different key decisions have to be determined through comparative research in different irrigation systems before they can be used as normative indicators for the levels of perfection for the different key decisions to reach a certain performance. Such comparative research will be undertaken in the near future by IIMI's performance research. In the absence of such normative values, the given opportunities could be used by MEA as a kind of checklist.

CHAPTER 11

Conclusions and Recommendations

DECISION MAKING AND MANAGERIAL CONDITIONS: AN OVERALL PICTURE

THE FIRST SECTION of this chapter gives an overall analysis of the different key decision-making processes and their managerial conditions in Uda Walawe, which are also valid to a certain degree in other irrigation systems with a similar design concept. This is done by comparing the characteristics of the different key decision-making processes and their managerial conditions which are described and analyzed in this paper. To that end the mutual adaptation of the technical and managerial aspects and the levels of perfection of the different key decision-making processes are compared. The managerial conditions of the different key decision-making processes are compared to the achieved levels of perfection. Finally, a judgement is made regarding the contributions of the different key decisions in Uda Walawe towards the overall system performance.

The Decision-Making Processes

The mutual adaptation of the technical and managerial aspects. The allocation and water flow regulation concerns together cover the system utilization in this paper.

The allocation decision making in Uda Walawe is typified by too little management effort to assess the water users' requirements, i.e., the demand side. Allocation decisions and their actual implementation bear no relation to any of the demand assessments, except in a very broad and inaccurate way. At the same time, a lack of motivation and willingness to put much effort into water flow regulation by higher-level staff have led to a fixed use of the physical infrastructure with very limited utilization of the design provisions for variable flows (e.g., rainfall).

More than a lack of physical control over water flows because of the dilapidated physical infrastructure, a lack of managerial control underlies the perceived water delivery performance problems in Uda Walawe. This supports a conclusion of parallel IIMI research that "the dilapidated state of the physical system is to a considerable degree a function of the failures of the management system; that is, it is a symptom, or intermediate variable, and not the underlying cause of poor irrigation system performance" (IIMI 1990, 27). A complex of reasons is behind this lack of motivation and willingness to increase these management inputs of which the overall lack of institutional support of MEA for improved system management is the most basic and crucial.

System rehabilitation has been split into three key decision-making processes in this paper, i.e., the determination of desired system objectives, feasible system objectives and functional system requirements.

The desired objectives for the Walawe Irrigation Improvement Project (WIIP) were governed by the donor's objective to upgrade the Economic Internal Rate of Return (EIRR) of the original investments from 7 percent to a level above 10 percent (ADB 1979, 64; 1984a, 7; 1984b, 15) which is the donor's main internal criterion for project justification. At the same time, a need for rehabilitation of Uda Walawe was felt to a certain degree by the managing agency's head office, project staff and water users but it was not given any priority by the former Mahaweli Ministry. Therefore, the donor used the leverage of possible loans to Phase II of Kirindi Oya, roads in the Accelerated Mahaweli Project and future development of the Walawe Left Bank to put pressure on the government to accept the rehabilitation of Uda Walawe.

No interaction with project-level agency staff and water users has taken place about desirable project objectives for such a rehabilitation. Because of the lack of participation of the government and the agency staff as well as the beneficiaries, the identification and commitment of these groups to the objectives of the WIIP remained limited; the WIIP was a donor project rather than an agency project. Without such commitment, the required increased management efforts by project-level agency staff and water users to reduce water wastage in the head-end reaches are unlikely to come about. Thus, this managerial approach to project identification does not stimulate a sustainable achievement of the WIIP's objectives.

Similarly, during feasibility assessments by the donor staff and the consultants, limited interaction (i.e., mainly input of data required for the scientific simulations of real-life problems) with agency staff and water users has taken place. None of the involved actors of the donor, the managing agency, and the government were objective in assessing the real feasibility of the investment but focused primarily on developing a feasible proposal in terms of the EIRR to realize the envisaged loan. This approach has led to an engineering, capital-intensive physical solution for a management problem. The real issue in Uda Walawe (i.e., the lack of managerial control to reduce water waste by head-end reaches) has not been addressed in this feasibility assessment by the managing agency, the donor staff or the consultants. Instead, several perceived feasible objectives like the irrigation requirements, the related command area and the implementation schedule were in themselves causes of unfeasibility because they limited flexibility in interacting with the managing-agency staff and water users during the determination of functional-system requirements in the later stages of the project.

Only the managing agency can determine cost-effective feasible solutions for sustainable system rehabilitation. Outsiders can play no more than a facilitating role. If foreign funds are required, a donor should not become involved in designing the actual plan but should only judge a plan prepared and developed by the government and the managing agency. Criteria used by the donor staff and consultants should be used in a more objective way towards "selling" of the loan or grant. The present passive role of the managing agency does not build up a commitment for a sustainable achievement of project objectives.

The functional system requirements were determined by means of scientific engineering concepts like theoretical water requirements, rationalization and turnout areas, which allowed the external consultants and the donors to take these "blueprint" decisions implicitly, without any reference to or assessment of the real-life requirements of managers of existing systems and water users. This lack of interaction was reinforced in Uda Walawe by the feasibility-level requirements to realize improved water duties and an increased cropping intensity in a limited period of time. The managerial requirements from system managers and water users were thereby assumed as a variable parameter at unfeasible levels (i.e., an average to very high level of perfection) without any commitment of the system managers and water users themselves. None of the parties involved in these decision-making processes were accountable for achievement of the project objectives other than the construction and training targets; while being aware of the unsustainability of the blueprint approach, they adhered rigidly to their formal terms of reference.

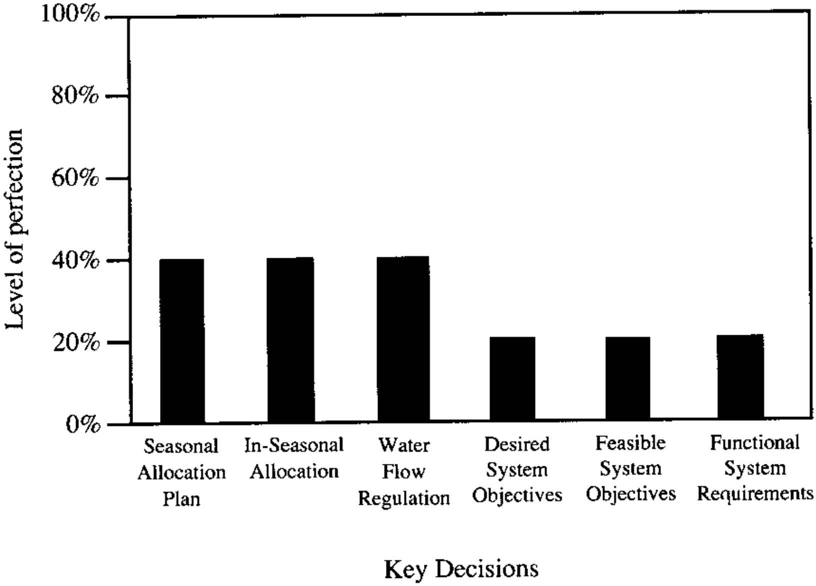
In conclusion, the mutual adaptation of technical and managerial aspects in all the key decision-making processes related to water delivery in Uda Walawe was typified by a lack of interaction between different agency levels, and between agency and water users. Top-down enforcement and little follow-up (i.e., monitoring and evaluation) on the consequent performance comprised the general managerial approach which minimized the required management inputs of the managing agency, the donor staff and the consultants alike. All decision-making processes were characterized by an almost complete absence of responsibility and accountability towards the system's water delivery performance. At the same time, the interaction between the donor staff and consultants and the managing agency was ineffective and biased to "buying" and "selling" of the loans.

The levels of perfection of the different key decisions. The level of perfection of all key decisions for system utilization was low (20–40%). This low level provided for a minimization of management inputs and a reduction of water users' complaints. However, complaints require time of the system managers also, and there is the risk of interference by politicians. The maintenance of a "no-complaint" situation apparently requires a low level of perfection (20-40%). For the water flow regulation, a minimum management input is required for enforcing rotational water issues to the tail ends of the canals. At the same time, the fixing of the gated cross-regulators has reduced the required management inputs for a low level of perfection.

The level of perfection of all key decisions for system rehabilitation was very low (0–20%). Unlike for the system utilization decision-making processes, minimization of management inputs of all involved actors was not balanced by complaints from any party during the time of project planning and design. Only during actual construction and utilization of the system, did complaints arise. This demonstrates again the absence of any accountability in the system rehabilitation decision-making processes. It is only during system utilization that the complaints by water users and politicians resulted in some accountability, however passive.

Improvements in management inputs, managerial attitudes, interaction with water users and subordinates, and information flows all seem to depend on the more basic precondition of more commitment and accountability of all staff levels to the overall system performance, not only to yields. Priority for improvement lies thus with building up of such an overall institutional support to the water delivery performance both during system rehabilitation and during system utilization. This will have to be initiated and developed by the managing agency's head office rather than at project level only.

Figure 9. The levels of perfection of different key decisions in Uda Walawe.



The levels of perfection achieved in Uda Walawe are graphically displayed in Figure 9. Higher levels of perfection are assumed to lead to higher system performance. However, the degree to which the different key decisions contribute to the system performance is yet unknown; the relative contributions of the different key decisions have to be determined through comparative research, before they can be used as normative indicators for the levels of perfection for the different key decisions to reach a certain performance. Such comparative research will be undertaken in the near future by IIMI's performance research.

The Managerial Conditions as a Whole

People. In the *system utilization* decision-making processes, the technical expertise of different MEA-staff levels is not an impediment towards improved performance. However, their managerial attitudes and techniques and the awareness of their influence on the motivation of subordinates and acceptability of decisions to water users are impediments towards improved performance. Training in these aspects may improve such awareness and related skills.

On the other hand, training in these aspects will be of limited avail without more — advance or simultaneous — structural changes to increase the MEA staff's responsibility and accountability towards its water delivery performance. At present, the motivation and willingness of the MEA staff in Uda Walawe to improve its performance are low.

Doing a good job without this institutional support, with water users who are seldom satisfied whatever the performance is and with the constant possibility of interventions by politicians, requires an unlikely individual motivation of staff members. A more likely choice for a responsible decision maker is to maintain a low profile.

Measures to improve the accountability towards water delivery and related motivation may be the pricing of water, special career paths for system managers which relate also to job performance, incentive systems, performance evaluation related to the water delivery for different subsystems instead of to yields only, etc.

In the system *rehabilitation* decision-making processes, the technical professionalism of the irrigation engineers is rather one-dimensional in its focus on the hydraulic-engineering and civil-engineering aspects. The managerial and real-life relevance of this approach is resisted because it would pollute their "pure" science. Implicitly, this is strongly related to managerial attitudes to other disciplines and water users. Training will probably not increase the awareness in this respect because many agency staff members are aware that the acceptance and use of the present scientific approaches (e.g., theoretical water requirements, rationalization and turnout areas), which reduce the need to refer to real-life constraints, are directly linked to the preferences of the donors, politicians and agencies for foreign-funded, capital-intensive system rehabilitations within a limited period of time.

Thus, the present managerial attitudes of the agency, the government, the donor staff and consultants, and the politicians towards the assessment of the desired and feasible system objectives and functional system requirements are not objective. All of them have vested interests in the approval of the loans and tend to pay too little attention to the actual desirable and feasible project objectives or appropriate functional system requirements. A different attitude of agency staff in this respect requires the development of accountability towards the water delivery performance even during the planning and design stages. As long as foreign funds for construction projects become available without any built-in accountability towards the sustainability of project objectives, nothing will change in the present blueprint approach.

Provision of information. For the *system utilization* decision making, the technical and managerial aspects of the present information provision are focused on a "no-complaint" situation at a low level of perfection. For the seasonal and in-seasonal allocation decision making no information is available regarding the demand side. Field staff are stimulated to limit provision of information to higher hierarchical levels and to solve problems by themselves. Average or high levels of perfection (i.e., improved performance) will require more bottom-up information on the demand side, on realized water issues and operational methods. Also more top-down information provision to field staff and water users about allocations and water flow regulation will be required. These bottom-up and top-down processes will require increased management inputs.

As has been mentioned before, increased management inputs can only be expected if the managing agency expects its staff to improve its performance.

The lack of any performance evaluation of the water delivery decision making below the main reservoir sluices is, in this respect, a symptom of the lack of institutional support of the managing agency as a whole for the system management and water delivery performance. At the same time, it causes and reinforces the lack of interest by project-, block- and field-level staffs in improving water delivery performance.

The often-heard argument that water delivery performance is considered situation- and system-specific is valid. However, the use of existing performance indicators (e.g., water duties, cropping intensities, rainfall utilization for different subsystems over different periods of time) by the managing agency in a systematic way is required for monitoring and appraisal of the performance of its staff.

The provision of information to the different *system rehabilitation* decision-making processes is defective; the same type of information mentioned above (i.e., information regarding the preferences, relevant experiences and requirements from the existing local community, beneficiaries and system managers) is required . The lack of this type of information is compensated for by assumptions which are not required to be justified. An average level of perfection will require such information provision on a more regular (40–60%) basis while a low level of perfection will need it on a less regular (20–40%) basis. Provision of this type of information will require time and gradual system development and rehabilitation, and a different professional and managerial attitude of agency staff. These are unlikely to come about without making agency staff more accountable towards the water delivery performance of irrigation investments.

Systems and methods. Most systems used for facilitating the *system utilization* decision making (e.g., the uniform cultivation calendar, the "fixed discharge and fixed duration" rotations and the fixing of the cross-regulators which permits invariable flows only) are in line with the minimization of management inputs. All of them can be implemented without interacting with water users and with limited interaction with subordinates, i.e., the top-down approach.

Systems which will improve the water delivery performance (e.g., staggered cultivation, more flexible rotations, and variable-flow regulation) will necessarily require more management inputs to interact with subordinates and water users. However, without institutional support for improved water delivery performance, such systems will not be used effectively and may even lead to performance deterioration.

Similarly, the scientific engineering approaches used in the *system rehabilitation* decision-making processes (e.g., theoretical water requirements, rationalized layout, turnout areas, soil surveys, socioeconomic surveys) tried to simulate real-life situations and are in line with the earlier-mentioned minimization of management inputs by all involved parties. All can be and are used without interaction with water users and system managers and without references to related experiences. Systems which will really incorporate real-life experiences and requirements will require more interaction with water users and system managers and will thus require more time and, probably, more gradual development of system rehabilitation. This will not happen without an increased accountability towards the water delivery performance during the time of planning and design of the irrigation investments.

Provision of knowledge. Knowledge about experiences with different management techniques and approaches for *system utilization* in different Sri Lankan irrigation systems has not been systematically built up. Also internationally, little systematic knowledge in allocation and water flow regulation decision-making processes, apart from general truths such as monitoring and evaluation, has been built up. Knowledge regarding managerial techniques and attitudes required for effective interaction with field staff, water users, politicians and different agencies during allocation and water flow regulation processes is almost absent. The absence of this knowledge itself is again an indication of the lack of commitment and accountability of MEA to improve its water delivery performance. Without improved commitment and motivation the provision of additional knowledge will not necessarily lead to its utilization and consequent improved performance.

Knowledge regarding the *system rehabilitation* decision-making processes is well-adapted to a very low level of perfection due to the adoption of inappropriate and "blueprint" system rehabilitation and design concepts. These concepts are based on desired and feasible system objectives and functional system requirements which may be desired, feasible and functional in situations where managerial conditions match these objectives and requirements. This is not the case in Sri Lanka.

More appropriate knowledge requires the building up and development of an appropriate engineering profession, which does not rely solely on international reference literature whose design concepts are based on implicit functional requirements and assumptions, but which tests the design concepts for feasibility in Sri Lanka and for validity with respect to the explicitly identified functional system requirements for Sri Lanka in general, and for specific systems in particular. This also requires knowledge on how the desired and feasible objectives and functional system requirements can be identified and tested for the Sri Lankan situation. Moreover, knowledge has to be developed on how such processes can be integrated within the overall setup of lending agencies such as the ADB.

Organizational rules. Within MEA there are very few rules that guide the *system utilization* processes below the main reservoir sluices in terms of required decisions, hierarchical levels to be involved, required information flows, required interaction with water users and their role. Water delivery performance indicators are not used to assess staff performance. Thus, no formal rules for accountability in water delivery performance have been built up within MEA.

Because MEA is a relatively young organization, the absence of such rules has more impact than in the Irrigation Department where informal rules or rules of thumb are often developed and adhered to. In addition, the career of the Irrigation Department staff is to a certain extent protected by existing checks and balances like seniority in the Department, the existence of trade unions, professionalism, etc. The motivation of the Uda Walawe staff to perform well is negatively influenced by the absence of such rules because they feel that promotion in MEA is much less dependent on individual performance than on individual relations with top management in Uda Walawe or politicians. As a result, the managerial control of Uda Walawe's top management over the job performance of its block and unit level subordinates is very limited as well.

As a result of the lack of organizational rules in MEA, the motivation and willingness to improve its performance are very low. This lack of commitment itself is an impediment to any improvement in water delivery performance in MEA. The lack of these rules is not only a symptom of a young organization but also of the lack of accountability of MEA as a whole towards the water delivery performance.

The authority or organizational setup of MEA in Uda Walawe provides for better representation of the agricultural disciplinary interest in the seasonal allocation planning at project level. However, at block and unit level, its impact, if any, is very limited in Uda Walawe. For the in-seasonal allocation and water flow regulation the authority setup has no advantages but, instead provides for a weakening of the lines of authority between different hierarchical levels of the O&M staff. For the present low level of perfection of system utilization decision making, the functions of the block-level Irrigation Engineers and Engineering Assistants are superfluous in Uda Walawe from the point of view of water delivery or agricultural production performance.

The same applies for the Unit Managers from the point of view of the water-delivery performance alone but not from the point of view of the agricultural production given their role in, for example, agricultural extension. This implies that at block and unit level the present authority setup in Uda Walawe has few advantages compared to the normal line-agency setup from the point of view of water delivery and agricultural production performance. From the point of view of the water delivery performance, it even has disadvantages at these levels because of the weaker lines of authority and consequent risks of increased localized interests in in-seasonal allocation processes.

In *system rehabilitation* processes the managing agency should have a more active and responsible role than in Uda Walawe, whereby it should be kept accountable towards the desirability, feasibility and functionality of its irrigation investments. Lack of capacity of the agency to fulfill this role indicates a lack of capacity to be accountable to these investments. The donor staff and consultants should not influence or dominate these decision-making processes but only judge the feasibility and functionality of submitted proposals as a whole without any biases to lending or granting targets. There are no rules that ensure the interaction between agency, local community and water users regarding system rehabilitation. In fact, rules aimed at effective interaction for setting desired and feasible system objectives and functional system requirements between water users, local community, local politicians, donor and agencies at project and national level are completely absent at present in Sri Lanka.

In conclusion, a prerequisite to all these different options for improvement of the managerial conditions is an increased accountability in all key decision-making processes to the water delivery performance. This accountability can probably be developed only when it is incorporated into the mechanisms of raising funds.

The Results: The Contributions of the Different Key Decisions

Seasonal allocation plan. The introduction of a uniform cultivation calendar by MEA has increased adherence to the cultivation calendar of the overall system. Unlike in the RVDB period, this cultivation calendar has provided MEA with arguments to refuse requests for allocation of water to small groups of water users and related interference by politicians throughout the year. In that respect, the seasonal allocation plan appeared to be a very useful decision for obtaining clarity in the rights and entitlements of the overall system with respect to water, and for enforcing intermediate seasons for maintenance activities. On the other hand, its impact below the offtakes to the branch canals and blocks is very limited; especially, head-end water users start whenever they like, and tail enders can always get the season extended. The authorized completion date of the land preparation is not followed. Partly, this is caused by a lack of farm power but to a larger extent it is due to abundant availability of water for head enders and lack of guidance, monitoring and evaluation of the implementation progress of the seasonal plan by the MEA staff (IIMI 1990, 29). The authorized three-month-rice variety for yala has no influence on the related decision making by the water users, who all use three-and-a-half-month varieties. The seasonal allocation plan does not cover the rotational deliveries, or the allocated water duties for the overall system or different subsystems. Overall, this decision contributes to a basic and visible improvement of the water delivery performance and intermediate seasons for maintenance activities with a minimum of management input.

In-seasonal allocation schedules. The rotational in-seasonal allocation schedules in Uda Walawe are intended to enforce some discipline among the head-end water users to enable allocations to the tail enders. Therefore, the schedules serve a clear purpose; they also increase the reliability and predictability of the water delivery service. The degree to which they serve this purpose in different canals in the present Uda Walawe setup depends to a large extent on the integrity and personal motivation of the responsible subsystem manager, i.e., the Technical Officer or Field Assistant. Overall, with limited management inputs the in-seasonal allocation decisions reduce but do not eliminate water overconsumption by head enders. They contribute a certain reliability and predictability of the water delivery as well.

Water flow regulation. The fixed use of the existing gated cross-regulators serves to stabilize the water flows with limited management inputs while achieving rotational allocations. With variable flows the rotational allocations would probably become much more unreliable and unpredictable because of increased management requirements and potential increased interference by water users to increase localized distribution at the expense of conveyance to the tail end. On the other hand, the fixing of the gated cross-regulator makes the effective use of rainfall impossible, apart from storage of some runoff in the Chandrikawewa Reservoir.

Overall, the water flow regulation decisions contribute to a reliable and predictable rotational water delivery with a minimum of management input. However, it does so at the expense of effective use of rainfall and more flexible or variable water flows which would be more in line with actual water requirements.

Desired system objectives. The decisions with respect to the desired system objectives of the WIIP reflected only the desired system objectives of the donor staff and some individual head-office staff of the managing agency. A sustainable system rehabilitation and improved utilization, however, requires a serious commitment of the government, the agency, the local community and the water users regarding the project objectives (e.g., improved water duties, command areas, and cropping intensities). This requires at least consideration of the directly related interests of these different groups at this stage. The present decisions only serve the initiation of the loan acquisition by the Government of Sri Lanka.

Feasible system objectives. The decision making with respect to the feasible system objectives do not at all assess the feasibility of the project objectives but, instead, develop a plan which is feasible in terms of the EIRR. The practice of using unjustified assumptions for the calculation of the EIRR results in an incorrect picture of the economic feasibility of the rehabilitation project. In addition, the EIRR was used for internal donor decision-making processes only. The involved government and agency staff were mainly interested in obtaining the loan and were rather indifferent towards these donor requirements with respect to the feasible system objectives. This makes the application of the EIRR for assessing the economic feasibility for Sri Lanka's situation very doubtful: rather, it became a tool for justifying the desired system objectives and "buying" and "selling" of the loan. As a result, the feasibility assessment has led to several project objectives (e.g., water duties, command area, cropping intensity, and implementation schedule) which themselves are major causes for unfeasibility of the project. The main purpose served by the present feasibility decisions is the donor's internal justification of the loan.

Functional system requirements. The design concept used in Uda Walawe is implicitly based on functional system requirements that are more appropriate for developed countries than for Sri Lanka. Obvious experiences and real-life constraints that influence the functional system requirements are not considered in this design concept. Relevant experiences are in regard to, for example, the managerial capacities and motivation of staff, bathing-water and drinking-water requirements, responsiveness requirements, requirements regarding passive and active controllability of flow in case of system degradation, irrigation requirements and related short-term and long-term flexibility with respect to crop diversification. The main contribution of this key decision is the *theoretical* realization of the perceived desired and feasible project objectives of improving the EIRR by means of improving the water duties and cropping intensities in a short period of time.

CONCLUSIONS: SYSTEM REHABILITATION

Desired System Objectives

1. The desired objectives of the Walawe Irrigation Improvement Project (WIIP) were determined mainly by the donor. The donor successfully used the leverage of other potential loans to pressure the Government of Sri Lanka against its own priorities to accept the WIIP, because the donor wanted to upgrade the EIRR of the earlier investments in Uda Walawe. In addition, preferences and directly related objectives (e.g., the [peak] irrigation requirements, subsidiary field crops) of local community, local authorities, project-level agency staff, resident water users and beneficiaries were not considered.

2. Due to the requirements of the EIRR, little flexibility existed to change these objectives (e.g., water duties, size of the command area, cropping intensity, implementation schedule) later on or adjust them if they would appear unfeasible.

3. Evaluation reports by staff and consultants of the donor's Operations and Evaluations divisions had reported on the lack of managerial control as an important factor for the disappointing returns on earlier investments. However, apart from training, the WIIP did not incorporate any related objectives to improve this aspect and to a large extent the WIIP is identical to the original Walawe project. Individual staff and consultant insights and opinions appeared to play a more important role in the internal donor decision-making processes than consistency between different assessments.

4. The lack of consideration of desirable system and project objectives on the side of the local community, system managers and water users has serious consequences for their commitment to the performance and sustainability of envisaged project objectives. No commitment of the government or the managing agency towards the project objectives had been developed; the WIIP was considered a donor project rather than an agency project by almost all involved parties.

5. There are no requirements of the government, the agency and the donor with respect to the sustainability of the desired system objectives.

Feasible System Objectives

1. Through improper use of the EIRR for feasibility assessment, the feasibility of the WIIP objectives was not determined. Consequently, solving the main problem in Uda Walawe, i.e., the water waste in head-end reaches, has not been addressed.

2. The estimated EIRR of Uda Walawe was based on too optimistic assumptions regarding water duties and managerial inputs of agency staff and water

users. These assumptions were not justified or relevant for real-life experiences and requirements of agency staff, water users in Uda Walawe or in Sri Lanka, in general. This implied that related assumptions of project benefits in terms of size of the command area and cropping intensities were also unjustified.

3. Other serious bottlenecks for the project feasibility like feasible levels of maintenance funds, cost recovery and organization of water users were used as loan covenants, while the donor and the government staff were well aware of the ritualistic nature of these covenants.

4. The EIRR is used for internal donor decision-making processes only. The Government of Sri Lanka and the agencies do not use it for determining the feasibility or opportunities of the investments.

5. The government, the agency, the donor staff and consultants were not objective in assessing the feasibility of possible project objectives. A priority existed with all parties for fast and visible project results with foreign financial assistance. The managing agency did have an interest to get this major rehabilitation project funded because it would provide funds to the agency and Uda Walawe which would be difficult to obtain otherwise. Moreover, it felt a certain obligation to rehabilitate Uda Walawe because of the system's reputation as a failure. The donor staff appeared to be biased to approving the loan, rather than assessing its real feasibility, because of the disappointing 7 percent EIRR of earlier investments. The consultants were biased because they were hired to develop a feasible plan, not to assess the actual feasibility. Because of these biases the interaction between the donor staff and consultants, the government officials and the managing agency staff appeared less effective for assessing the feasible system objectives than for adjusting project objectives (i.e., irrigation requirements, command area, cropping patterns, implementation schedule, organization of water users organizations) to make the project appear feasible in terms of the EIRR.

6. Vested interests of the government, the agencies, the local community and the water users in obtaining outside financial assistance make it extremely difficult for external consultants to assess feasible project objectives in a reliable way.

7. In contrast to these constraints the donor staff and consultants appear to have a very large influence on the decision-making processes due to the leverage used by the donor to push certain aspects which it considered indispensable for ensuring project feasibility. However, this type of "remote-control" project management by the donor staff and their consultants led to very unfeasible project objectives. The leverage used by the donor made an effective interaction between it, the government and the agency staff even more unlikely given the priorities of the government and the agency for obtaining the loan funds.

8. In addition, the present large role for outsiders (i.e., the donor staff and the consultants) reinforces the lack of commitment and accountability of the agency staff and the water users to the sustainable achievement of the project objectives. The donor considered more external consultants a solution for insufficient capacity of the managing agency, which is by definition an unsustainable solution, because of the extremely low chances that the managing agency will perform better during system utilization than during this feasibility assessment.

9. The risks implied in the optimistic assumptions were not acknowledged by the donor, apart from the problems arising from the existing mass encroachment or the envisaged organization of water users. Risks of saving less water than the assumed 40 percent were not represented in the sensitivity analysis of the EIRR. Neither was the expectation of 40 percent water saving explicitly stated in the feasibility and appraisal reports. Consequently, the risks for the cropping intensities in the tail-end blocks and overall economic feasibility of a likely limited peak capacity of the Right Bank main canal for smaller water savings than the expected 40 percent were not considered either.

10. National or regional economic or social opportunities of the loan money appeared to be near zero. There was no difference in opportunity for the loan for the government and the agencies if the Uda Walawe system would be rehabilitated for US$8 million (ADB 1979), US$13 million (ADB 1984a) or US$25 million (ADB 1988); whatever the donor was willing to fund was considered a gain to the agency, the involved individuals and Uda Walawe.

11. The economic feasibility in terms of the EIRR of proposed cheaper options for rehabilitation (e.g., US$4.7 million [Wolf 1983 or PRC 1982]) were not calculated or considered, even though the EIRRs of such low-budget options can be as high as 60-80 percent (Kikuchi and Aluwihare 1990, 16). This neglect of consideration of less capital-intensive options with much higher EIRRs (i.e., the main donor criterion) demonstrates a definite bias of the donor's assessments to capital-intensive solutions in line with its main objective "to administer the transfer of capital to less-developed countries" (Evans 1984, 76).

12. This priority for capital-intensive solutions has direct implications for possible interactive processes. Interaction between the donor staff and the consultants, the agency staff, the local community and the water users was very limited. The role of agency staff was limited to the delivery of required data to the donor feasibility and appraisal staff. Regarding certain aspects, the agency's top management was involved in decision making (i.e., not the decision preparation). More interaction with these groups or more responsibility for the agency staff and the water users would take more time and requires a gradual system rehabilitation, which would make capital-intensive solutions less feasible in terms of the EIRR. The donor apparently had not built up any capacity to cope with feasibility assessments of the capital-extensive aspects (e.g., requirements related to management input and participation of the clients and the agency staff) of its investments. One of the main underlying reasons for this is probably the necessity for the donor as a bank to schedule loans several years in advance which creates loan targets for its staff with its consequent effects on the objectiveness in feasibility assessments.

13. Assessment of the real feasible project objectives requires more long-lasting decision-making processes by the Sri Lankan authorities and the target population, to incorporate a matching of requirements of different interest groups regarding water and management inputs. This implies that the abovementioned short-term priorities and biases presently prevent an appropriate determination of feasible project objectives.

14. Chapters 3 to 6 showed the crucial role of the level of managerial inputs and motivation of the managing agency for the water delivery performance.

However, during feasibility assessment this management factor is considered a variable parameter. Data supplied by the managing agency —itself not an objective actor towards donor funding — during 1982-1984, indicated that MEA had increased the water delivery performance. These data were apparently considered a sufficient reason to justify assumption of a further 40 percent water saving.

15. Instead of using the EIRR for assessing the economic feasibility of a technically and managerially feasible plan of the Uda Walawe project, it is used for prioritizing among different objectives for the project. This misuse of the EIRR led to the dropping of options like the organization of water users and water supply augmentation options which would have made it more feasible to reduce water wastage by head-end reaches and augment supplies to the tail-end reaches than the present theoretical solutions. Thus, the adjustment of project objectives to make the project feasible in terms of the EIRR have resulted in project objectives (e.g., low water duties and extension of command area in a short period of time without funds for organization of the water users or additional augmentation of supplies to the tail-end reaches) that in themselves have become major factors of unfeasibility of the proposed project.

16. With the average annual water duty of 5,850 mm between 1981 and 1983 in Uda Walawe, the 75 percent dependable regulated water resource of 665 mcm was only sufficient to reach a cropping intensity of 200 percent in 11,367 ha. This area corresponds approximately to the envisaged Right Bank command area only.

17. With the average duty of 3,673 mm recorded by MEA over the period 1983-1989 (or a further 38% improvement compared to the 1981-1983 period), a total area of approximately 18,105 ha could be irrigated, or the total area envisaged in the Walawe Irrigation Improvement Project (WIIP). However, the MEA's data on issued volumes from the head sluice as well as on the irrigated extents are not very reliable and especially the latter seem to have been overestimated. While further improvements of duties and irrigated extent must have taken place since 1982, their extent is unclear due to lack of calibration of the measurement structures and apparent changed

measuring and calculating methods of MEA. Therefore, the overnight improvements of 30 percent in water duty and 2,000 ha in irrigated extent in the periods of yala 1982 and maha 1982/83 have to be treated very carefully.

18. The use of theoretical water requirement calculations for estimation of improvements during the feasibility assessments gives highly variable outcomes (i.e., between 25% and 200% in reports on Uda Walawe) and seems irrelevant and even misleading in view of the high variability of underlying assumptions.

19. The donor and the government do not maintain explicit criteria regarding the reliability of the available regulated water resources (e.g., the 75% dependable annual regulated volume) for assessing the feasibility of large irrigation investments. The consequences of this lack of criteria can be enormous; the difference between the 75 percent and 50 percent inflow figures and the present regulated volume figures is considerable, i.e., approximately 200 mcm and 70 mcm, respectively. Consequently, the donor itself (and possibly the managing agency as well) got confused about these values in their projections for the future Left Bank development. Neither do they require any references to the functionality of the available regulated volume for the envisaged future cultivation seasons.

20. The turnout concept is inconsistent. It assumes that water users in a turnout will cooperate in sharing water to save water for other subsystems. Instead, one can observe that the water users will often work together to get more water to their own turnout. The required organization of the water users to cooperate in the envisaged way will also require more management inputs by the managing agency staff to limit water issues to these turnouts. As described in chapters 3 to 6, these inputs seem unfeasible in the Sri Lankan managerial context without increased institutional support of the managing agency as a whole. Another related inconsistency in Uda Walawe was that the improved water duties were to a large extent based on this turnout concept but the funds for organizing the water users were not budgeted by any party.

Functional System Requirements

1. The present design concept of rationalized system layout, turnout areas, and high density of flow and measurement structures used by the Sri Lankan agencies is inappropriate for the Sri Lankan situation because it implicitly assumes an increase of the managerial level of perfection from a low (20-40%) level to an average to very high (40-100%) level. The motivation and willingness of the agency staff to increase its management inputs correspondingly are absent. Without specific commitments of the managing agency's top management or the Uda Walawe staff to improve it to an average level of perfection, functional requirement for an appropriate design concept should have been oriented on the existing low level of perfection (20-40%).

2. Despite the early availability of a draft operation and maintenance manual, which implicitly defined underlying required levels of management inputs and operational criteria, no effective interaction occurred between the consultants, the system managers and the water users regarding the feasibility and related functionality of the proposed design criteria.

3. The draft operation and maintenance manual envisages the introduction of fixed rotations to all canals and even to individual allotments in the whole command area under water abundant situations. It places great emphasis on equity and water efficiency criteria. However, these criteria are not traditional in the allocation processes of Sri Lankan irrigation systems.

4. Despite the availability of results of field measurements of actual seepage and percolation rates, which appeared much higher than previously assumed, the related assumptions underlying the irrigation requirements were not changed during the design stage. The related feasibility-level requirements to extend the command area, and the insufficient capacity of the Right Bank main canal did not allow for such adjustments according to the involved consultants. Thus, this very basic function of the irrigation system was adapted to the overall feasibility-level project decisions even if unsustainable in view of real-life requirements. More generally, the design concept applied (in terms of increased numbers of control structures,

rationalized layout and turnout areas) for Sri Lankan irrigation systems is linked to the necessity to assume a very efficient water management to justify the economic feasibility of a capital-intensive irrigation investment like Uda Walawe.

5. To a certain extent, this design concept has evolved directly from the donors, the politicians and the agency's priorities on using foreign funds for major irrigation investments. The donor used its leverage to push the introduction of this design concept because it provided, theoretically, for more control over water flow. The institutional constraints were acknowledged in broad ways but were not linked to the design concept and underlying functional requirements. The agency staff tend to accept requirements of the donor staff in this respect, even if they are less appropriate, because of the agency and the political priorities of the acquisition or continuation of the loan.

6. Identification and determination of design criteria and underlying functional system requirements were dominated by "conventional engineering wisdom" and related "standard Sri Lankan practice," resulting in structures and operational practices which would facilitate controllability over water flow. Justifications regarding the degree to which measurement structures at the head of distributary and field channels would be more appropriate than staff gauges, the long-term utility and cost-effectiveness of the increased number of control structures, the operational utility of duckbill weirs in the main canal, and the utility of the chosen number and location of cross-regulators in main and branch canals were neither given nor required but were apparently part of this "rational" engineering approach.

7. The general practice of irrigation engineers to keep the underlying functional requirements implicit when proposing design criteria and operation and maintenance manuals impedes discussion, evaluation and adjustment of these requirements. No learning processes can evolve and all kinds of myths about the functionality of control and measurements structures persist.

8. The persistence of this "conventional engineering wisdom" allows the determination of most functional system requirements by engineers on their

drawing tables — whether in Sri Lanka or abroad — instead of relating them to real-life requirements.

9. The "blueprint" design concept was enforced by the donor staff and consultants through the abovementioned feasibility-level requirements. Discussions between the different external consultants, and between the consultants and the system managers were always within this rigid framework. While these design criteria did not allow much scope for adjustment to field-level requirements during the actual detailed designing, the responsible consultant did not try this either. Instead, he applied the design criteria rigidly, even while available blocking out plans and related soil proportions deviated much from the field reality. This rigid use of the design criteria was reinforced by time pressures exercised on the consultant by the managing agency, despite the enormous quantity of encroachments and other legal land issues in the field.

10. Consequently, almost no interaction at all has occurred between the consultants, the system managers and the water users regarding the sustainability and actual functionality of the design criteria and evolving designs. Thus, this functionality and sustainability remain unknown.

11. The use of theoretical estimates of the irrigation requirements seems to be irrelevant in view of the high variability of the seepage and percolation rates in different locations.

12. The determination of the irrigation requirements of a turnout area requires very accurate estimates of the proportions of lowland and upland soils during the design stage. However, an accurate assessment appears difficult in Sri Lanka due to the difficulty in obtaining reliable survey and field-measurement data. Furthermore, accurate measurement of lateral seepage can probably be determined only during system utilization which requires more gradual system rehabilitation.

13. In Uda Walawe, rehabilitation of the whole system was planned to be implemented simultaneously by means of large packages without any testing of the appropriateness of the designs and designed irrigation

requirements. Designs of large parts of the command area were completed without prior serious field-testing of the assumptions. It is only after the first distributary channels were finished and offtake structures were broken because peak requirements of the water users appeared higher than assumed, that designs were revised in line with more realistic irrigation requirements. Thus, much time and effort have been wasted on designs and construction based on unjustified assumptions. In addition, extra costs evolved from frequent iterative mobilization of contractors.

14. As in the feasibility assessment, it is very hard for outsiders such as the donor staff and consultants to accurately determine required functions for an existing irrigation system because of their unfamiliarity with the managerial practices of the managing agency. Moreover, hiring outsiders like the foreign and the local consultants at high costs for system rehabilitation of Uda Walawe introduced time pressures, which conflict with the requirements for interactive processes between these outsiders, the system managers, the local community and the water users.

15. The donors' practice of hiring external consultants "to get the job done" may have some validity for construction and training targets. However, external consultants cannot ensure the required performance during system utilization, because this is not their responsibility and is beyond their control. Disappointing performance due to inadequate management cannot thus be solved by external consultants, whatever organization structures, manuals or training are provided.

16. The consultants and the managing agency were not made accountable for the sustainability and actual functionality of their assumptions. Instead, the consultants kept themselves strictly to their terms of references. While the consultants and the agency staff were to a certain degree aware of the theoretical, unsustainable nature of envisaged irrigation requirements and the rationalized design concept, this did not lead to major adjustments in the design concept till the first structures were demolished and the donor intervened. The ultimate responsibility for applying an engineering solution to a managerial problem was thus considered the donor's problem and its responsibility only, at least in the short term.

17. No responsibility or accountability for cost-efficiency or effectiveness had been built into the WIIP. In general, the consultants and the agency are not accountable in this respect to the donor or the Government of Sri Lanka as long as either remains within the feasibility-level funding limits. The extreme freedom of the foreign consultant to decide on operational assumptions and design criteria is a symptom of this lack of accountability.

18. This absence of responsibility towards the short-term construction targets and medium- and long-term project performance of the WIIP was reinforced by unclear task division and confusing responsibilities of the different consultants in their respective terms of references.

19. The only identified managerial issues were the training and organization of the water users groups which, to a large extent, were left to the responsibility of the managing agency through the loan covenants. The managing agency adhered in a formal but not serious way to these loan covenants. Similarly, the consultants adhered strictly to their terms of reference, though in a more serious way.

20. In contrast to these crucial responsibilities implicitly left with the donor staff, their monitoring and supervision of the project are limited to occasional interventions of a rather ad hoc nature.

CONCLUSIONS: SYSTEM UTILIZATION

The abovementioned section on system rehabilitation has given several arguments against the present design concept used by the Sri Lankan agencies and the donor staff and consultants. As shown by the results of this case study, the motivation and willingness of the agency staff do not correspond to the underlying functional requirements and design assumptions. However, many systems have been built in Sri Lanka following this design concept and they are being utilized. Specific conclusions for the different key decisions during this utilization follow.

Seasonal Allocation Plan

1. Since 1982 the top-down enforcement of a uniform cultivation calendar along the main system in Uda Walawe has led to a saving of at least 12 percent of the annual issues from the reservoir compared to the RVDB practice of issuing water throughout the year. This uniform cultivation calendar is a "minimum-management" solution with a relatively high water-saving potential.

2. This example shows the quick and relatively sustainable results which can be achieved if some form of institutional support is built within the managing agency towards improved water delivery performance. In the Uda Walawe case, this institutional support was directly or indirectly linked to the pressure of the donor for performance improvements and prospects for an additional loan for system rehabilitation. After these initial water savings were achieved, this institutional support for further improvements stopped completely because the donor funds had become available by that time. Without this institutional support further improvements stopped.

3. Further reductions of the cultivation periods by better monitoring and evaluation of the actual progress of the land preparation could lead to additional annual water savings of 9 percent for each week per season. The related cost-benefit ratio could be as high as 192 for two weeks per season, provided that the water saved would be used for additional cultivation (Kikuchi 1990, 2). The related benefits could be as high as "a 3-month-salary-worth bonus...to all employees, or a 12-month-salary-worth bonus to the water management related employees" (ibid., 3).

4. The present seasonal planning of MEA in Uda Walawe does not assess the demand side (i.e., the preferences and requirements of the water users) until the formal cultivation meetings. During these meetings no effective assessment of the demand is possible, nor are the requirements brought forward by water users in these meetings ever considered in the seasonal allocation decisions.

5. Effective exchange of views between the MEA management and the water users during the cultivation meetings appears impossible, and therefore the divergent expectations led to clashes during these meetings and frustrations on both sides. The function of the cultivation meeting as a decision-taking body (i.e., its legal status) is confused with that of a decision-preparation body — decision making involves decision taking as well as decision preparation — which creates problems and frustrations for all parties.

6. Because of the lack of interaction, the water users do whatever they like; within the blocks and branch canals, farmers start up the cultivation whenever they like, grow the varieties they like, and use as much water as they want at the expense of many tail enders in the system who often can start their cultivation only one month later, if at all. Without exception the cultivation season is extended for these tail enders.

7. Thus, it is not MEA but water users who decide on the actual starting and completion dates for the cultivation within the branch canals. Progress monitoring and evaluation of the land preparation within the block are absent. Given the lack of intervention by agency staff within the branch canals to realize timely water issues to the tail-end distributary channels, refusal of extension of the water issues at the end of the season would also be unjustified.

8. Further improvements in the seasonal allocation planning and implementation will require more interaction between the agency staff and the water users.

9. While MEA plays a relatively active role in agricultural extension in Uda Walawe, its actual role in the provision and facilitation of inputs and credits at the start of the cultivation season is rather limited. This means that one of the main ideas behind the "unified command" setup of coordinating this input provision to facilitate better adherence to the cultivation calendar is not achieved in Uda Walawe.

In-Seasonal Allocation

1. Since 1982, rotations were developed and improved upon over the years, mainly by the Technical Officers of the different blocks with some support of the Technical Officer of the project-level O&M division. These changes were not aimed so much at an equitable allocation of water over the command area as to allocate enough water earlier to the tail ends of the different branch canals and blocks within the allocation limitations set by the size of the Right Bank main canal and the rotational allocation set by the project-level O&M division to the branch canals and distributary channels taking off from this main canal.

2. These rotations were a direct result of the enforcement of more adherence to the cultivation seasons and the creation of intermediate seasons in Uda Walawe; the rotational issues ensured that tail enders could start earlier with land preparation and thus could complete the season earlier.

3. These allocation schedules thus represent water allocations developed over time and represent a certain compromise between head-end and tail-end interests but do not incorporate necessarily any water saving per se, except in terms of the duration of cultivation.

4. Nobody is really responsible for reducing or limiting water waste within a distributary channel or field channel or on-farm. Gate tenders are involved to some degree in it to cope with the total allocation within their subsystems but it is not their responsibility. Higher-level staff seldom intervene in the allocation at field level unless specific problems arise in which case the Field Assistant or the Technical Officer may visit the field. However, since the improvements of 1982, reduction of water waste has never been their responsibility.

5. A lack of pressure by higher-level staff to economize on water use in the system is prevalent in water abundant years, which are common in Uda Walawe. The only pressure in this respect is the short-term availability of water at a specific location; for head enders this pressure usually does not exist, which results in water wastage.

6. Apart from developing these rotational issues and monitoring their implementation, the involvement of higher-level staff is limited to interventions after complaints by water users.

7. The localized matching of supply and demand by the gate tenders in the past has led to oversupply at the head and may lead to undersupply at the tail of a system or subsystem, for example the main canal, even in water abundant situations as in Uda Walawe. The only way to resolve this problem is through the involvement of higher levels of management in this matching of supply and demand to make it less localized. Saving water is in the interest of the tail-end blocks only, and is thus represented only to some degree in the allocation processes by the project-level O&M office.

8. In Uda Walawe, the line authority of the project-level O&M division regarding the allocation at block level by the Technical Officers seems to be weakened by the block-office organizational setup. The prevalence of localized block interest over the overall system interest is thus reinforced by the organizational structure in the absence of any accountability for the water delivery performance. Separate organizational structures for conveyance and distribution along the main system (e.g., the project and block O&M divisions in Uda Walawe) are often perceived as a solution to reduce localized favoring of demand, at the expense of conveyance to the tail. However, this is not true without accountability of these organizational structures for the water delivery performance.

9. Superiors at the project site and headquarters seldom guide, monitor, evaluate or stimulate their subordinates with respect to in-seasonal allocation and water flow regulation processes. This demonstrates the weak institutional support or institutional disinterest in the performance of staff in water delivery and in the resulting actual water delivery performance. Performance of staff in this area of concern depends mainly on their individual motivation.

10. Assessment of the actual demands of water users does not take place at any level. Instead, the rotational issues provide for rather abundant allocations to the different head-end subsystems, which make complaints by water users and related interaction less necessary.

11. Further improvements will require more management inputs and efforts from the different staff levels which will happen only if the managing agency as a whole attributes value to such improvements.

12. Individual motivation of staff members to do a good job is constrained in various ways: a lack of institutional support, opposition of colleagues if construction and cultivation interests conflict, water users who are seldom satisfied whatever the performance, and the constant possibility of interventions by politicians. A more likely choice for a responsible decision maker is to maintain a low profile.

13. The MEA staff argue that the dilapidated physical infrastructure prevent further improvements, which is correct to a certain extent. However, the physical infrastructure is used as an excuse for minimizing their management input in further improvements in matching supply and demand, i.e., to match the allocations better with the actual demand of the different subsystems.

14. Water user groups can be viable only if they play a meaningful role in the allocation decision-making processes. This requires increased management inputs from staff to interact with these groups, which is unlikely to come about without more accountability of the staff towards the water delivery performance. Enforcement of this accountability through the organization of the water users into groups is unlikely to be successful because of the inaccessibility of the daily allocation and water flow regulation processes between different staff levels for people outside the managing agency. This inaccessibility makes it easy for agency staff to obstruct accountability towards water users.

Water Flow Regulation

1. Staff levels higher than the Technical Officer level have limited knowledge in this area of concern and, therefore, do not contribute much to further professionalization and improvement of the water flow regulation. The

motivation and willingness of staff levels higher than the Technical Officers to become involved in the water flow regulation is limited. This impedes their expertise and further involvement in this area.

2. By using the existing gated cross-regulators in Uda Walawe as fixed weirs the management requirements have been considerably reduced. Further water flow regulation has been covered to a large extent by the development and improvement of the rotational issues.

3. The system is operated under invariable flow conditions with little flexibility for changing requirements or utilizing rainfall.

4. This lack of flexibility has led to interferences by the water users in the water flow regulation by blocking of canals and building of cross-regulators. Such interferences are due to inflexible allocation decision making rather than to water flow regulation anomalies per se.

5. Like the allocation concern, the water flow regulation decision making is characterized by a minimization of management inputs by responsible staff.

RECOMMENDATIONS FOR THE DIFFERENT IRRIGATION-MANAGEMENT CONCERNS

Opportunities for improvement of the managerial levels of perfection have been indicated for all key decision-making processes in the respective chapters in terms of requirements with respect to processes and their managerial conditions. In this section, specific recommendations for the different key decision-making processes for all involved actors, i.e., the government, the agencies and the donor are added to the opportunities for improvement given in the different chapters. These recommendations evolve from the conclusions given above.

Desired System Objectives

1. Desired system objectives should not be fixed at an early stage of a project in a too detailed form in terms of the water duties, area to be commanded, cropping patterns, cropping intensities and the period of time required for realization of these objectives. Flexibility with respect to all these factors should be maintained during planning, design and construction and actual utilization of the system through, for example, gradual system rehabilitation.

2. The EIRR should not be used for determining desirable project objectives but, instead, should be used only for judging their economic viability.

3. The donor should not play an influential role in this decision making but leave it to the national government, the agencies, and the public. Without a more active role of these parties, no commitment or accountability towards the project objectives is developed in them. Making such accountability towards project objectives in the medium term and the long term a requirement of the loan agreement should become a major area of concern for the donor in general. The donor should limit its role to judging the feasibility within a framework of its other funding criteria (e.g., economic and environmental criteria).

4. Desirability of project objectives or system objectives in view of the relevant interests of the local community, system managers, and water users should be considered in this decision making to increase their commitment and identification with project objectives.

Feasible System Objectives

1. Conditions have to be created for the donor staff and consultants to become more objective regarding the approval of a loan if a project is unfeasible. Staff and consultants should focus on the quality of their feasibility and appraisal assessment and the long-term feasibility of approved loans, rather

than on the quantity of loans and adherence to loan targets. The bias towards capital-intensive solutions should be replaced by a bias towards, for example, the highest economic feasibility.

2. Outsiders should not play an influential role in the decision *preparation* of the feasibility-level decision making. Instead, the national government and the agencies should determine and develop complete plans and, if required, submit these to funding agencies. Distrust of the objectivity of this assessment by national parties — reflected also in the reduced opportunities attributed by them to the loan funds — is probably justified, but the funding agencies and their consultants cannot play any other role for sustainable project development and implementation than assessing locally developed plans in a way which is objective towards the actual "selling" of the loan or grant. Influencing of project components by outsiders has high risks of leading to unfeasible project objectives, and reduces the identification and commitment of the national government and the agencies with the project objectives.

3. Accountability and commitment of the national government and the agencies should be built into feasibility and appraisal processes for future loans, because so far these new investment opportunities are given priority by managing agencies at the expense of sustainable project achievement. This can be done, for example, through comparing the water duties proposed in funding requests with water duties actually achieved by the same agency, and limiting improvement assumptions to 10 percent at most, unless past performance of the agency allows for more. Because of their crucial importance, the data on achieved performance should be cross-checked by specially assigned objective consultants or "water budget accountants" (e.g., checking of flow and yield measurements, calibrations of measurement structures, and remote sensing of irrigated areas). Similarly, all other assumptions involved in the feasibility assessment (i.e., implementation schedule, cropping intensities, yields, maintenance levels) can be related to past performances of the same agency, with, for example, 10 percent improvement margins. Only through such a link between project funding and project performance will at least some value be attributed to water by the managing agency and the donor, which is a basic prerequisite for

improved management inputs by the managing agency during system utilization.

4. The donor's leverage should not be used for pushing certain projects, project components or project concepts — which have led only to less appropriate objectives and less commitment. This leverage should be used for making the government and the agencies accountable towards sustainable achievement of project objectives.

5. Certain requirements should be developed for the use of the most important assumptions underlying the EIRR (e.g., water duties, cropping patterns, cropping intensities, command area, agricultural prices, yields and implementation schedule) to reduce their potential manipulation and resulting inconsistencies between different assessments. Examples of the most obvious requirements in this respect are explicit statements regarding the size of assumed improvements of water duties, cropping intensities and yields, as well as a sensitivity analysis of the EIRR which reflects all explicitly stated performance improvements and involved risks (e.g., reduced or delayed levels of water saving, reduced or delayed benefits, lack of maintenance funds and shorter life span, delays in the implementation schedule, cost overruns), as well as the quantified combined effects of optimistic assumptions (e.g., Table 5.2.1 in IIMI 1990, 174). Justifications and references to earlier real-life experiences with respect to their feasibilities should be explicitly stated in the Feasibility and Appraisal Reports. Risks used in the sensitivity analysis should represent all similar experiences of other donors in the same country or region or with the same managing agency.

6. The donor should develop internal quality control mechanisms for feasibility assessments along the lines mentioned under item 3, e.g., separate divisions or staff members in the Operations and Evaluation Division who also become accountable to the quality of the involved assessments. Also, the donor should develop internal mechanisms to evaluate the consistency in sequential feasibility, appraisal, monitoring and evaluation assessments with respect to key parameters like "with" and "without" management inputs and capacities of the agencies, water delivery performance, com-

mand areas, cropping patterns and intensities, implementation schedules, etc.

7. The EIRR should not be used as the only indicator for assessing the feasibility of project objectives, because this allows for unfeasibility and manipulation of the underlying assumptions. Instead, the feasibility of, for example, the availability of water resources, the improved water duties, the envisaged cropping patterns and intensities, the area to be commanded, the agricultural prices, the maintenance funds, the life span of the project, and the "with" and "without" yields should be carefully assessed as well.

8. The EIRR should not be used as a major guideline for identification of feasible project components which allow for making any project proposal economically feasible. Instead, it should be used only for the assessment of the economic feasibility of a plan feasible in other aspects.

9. Theoretical water requirements can better be replaced by gross water duties for specific locations. This also makes it easier to recognize the size of the assumed improvements compared to achieved gross values in the system or region. The theoretical water requirements should not be used for the assessment of feasible improvements of water duties without very explicit justifications of and references (e.g., gross water duties achieved by the same agency) to all involved assumptions.

10. The reliability of data used (e.g., data of soil, topographic and other surveys, hydrological and climatological data, water and soil suitabilities) should be assessed and stated in Feasibility and Appraisal Reports.

11. If more than one option exist for a specific project, the economic feasibility and other advantages and disadvantages of these options should be reflected and their EIRR quantified in the feasibility and appraisal assessments. While this does not mean that the donor should interfere in political choices by the national governments, this procedure at least would permit that "politically-inspired decisions should only be taken up in full knowledge of its economic consequences" (ADB 1979, 79).

12. A mechanism should be developed by the donor or the national government to determine if the 10 percent EIRR cutoff rate really represents the opportunities of the investments in the country at the time of major investment decisions.

13. The use of loan covenants by the donor for a "ritual" allocation of responsibility to the national government to solve major constraints in project feasibility should be abandoned.

14. Feasibility assessments should make explicit statements on the degree to which proposed project objectives have been discussed with the system managers, the local community and the water users.

15. The reliability of the assessment of the water resources should get priority for assessing the feasibility of an irrigation system. The 75 percent, rather than the 50 percent, dependable regulated volume (i.e., not inflow) should be used. The functionality of these water resources in terms of the related cultivation risks should be made explicit and incorporated in the economic feasibility of the system.

16. The sensitivity analysis should reflect all the risks implied in the assumptions.

Functional System Requirements

1. The managerial requirements should no longer be considered a variable but should form an integral part of the other perceived system functions. The envisaged managerial inputs should be explicitly related to the required commitment, motivation and willingness of the agency at head-office, project and field levels. Similarly, the assumed management or labor inputs by the water users and the assumed irrigation requirements should be related to their acceptability to the water users. All these perceived management requirements should be established prior to and parallel to the establishment of other functional system requirements, and evolving design concepts and criteria.

2. Because of their crucial influence on irrigation requirements the seepage and percolation rates of different subsystems should be assessed more carefully. Actual field conditions would be ideal, which would require a much more gradual rehabilitation of a command area.

3. The feasibility-level estimate of the irrigation requirements, the command area and the cropping pattern and intensities should not influence the decision making about the corresponding design-level values if these do not correspond to realistic requirements. More conservative feasibility-level estimates are required to allow more flexibility during system design, development and rehabilitation.

4. "Blueprint" type approaches (i.e., theoretical water requirements, rationalized layout, turnout areas, increased densities of flow control and measurement structures) to establish functional system requirements and design criteria should be abandoned because they do not reflect the system and sub-system specific requirements of the local communities, the agency staff and the water users. Neither should design criteria be copied from international text books or "conventional engineering wisdom" without explicit reference to their functionality within the Sri Lankan context in general, and in the envisaged system or subsystem in particular. More explicit references should be made to the subsystem-specific requirements and envisaged design solutions in view of the requirements of different staff levels of the managing agency, the local community and the water users.

5. The donor staff and consultants can and should play a facilitating role only in the decision-making processes about the functional system requirements. The managing agency itself should take the lead and play the major role in this decision making to increase the functionality and sustainability of the perceived requirements and to increase the related feeling of responsibility and accountability of this agency. Inability of the agency to play such roles should be considered as the cause of a priority of the government and the agency for outside project funding at the expense of project functionality and sustainability.

6. Functional system requirements and design criteria should be determined on a representative pilot basis and adjusted to these experiences or, even

better, should be related to real-life requirements while gradual rehabilitation of the command area takes place.

7. Time pressures will favor "blueprint approaches" and will reduce the need and the utility of interactive processes required for assessing the system's required functions. Expensive outside consultants will probably always experience such time pressures.

8. Accountability towards the sustainability and functionality of the system requirements should be built into these decision-making processes. This requires more explicit references to the functional requirements behind the design concept and criteria, related past experiences, and their acceptability, feasibility and sustainability for the local community, the agency staff and the water users.

9. Similarly, accountability for the cost-effectiveness and efficiency of the design solutions should be built into these decision-making processes. This may be done by comparing the proposed solution with some other possible options.

10. The donor should not enforce anything on the government or the agency (e.g., cost recovery, organization of water users) if they have no time to monitor and evaluate these activities. Instead, they should leave the determination of functional requirements to the agencies themselves, and limit their own involvement to an unbiased feasibility assessment.

Seasonal Allocation Planning

1. Reduction of the duration of the cultivation seasons in Uda Walawe will lead to a 9 percent annual water saving per week. This can be achieved through better monitoring and adjustment of the implementation of the seasonal plan within the block. The water saved can be used for further extension of the annual cropped areas, which was the ultimate objective of the Walawe Irrigation Improvement (WIIP).

2. Further improvement will require a less top-down approach through more interaction and improved relations between the agency staff and the water users. Demand assessment regarding staggered cultivation between and within blocks is required at an early stage of this planning to enable early adjustment of expectations and plans to what is feasible; allocation plans should be consistent with these requirements. Such improvements will require more management inputs in interaction between different staff levels and between the MEA staff and the water users. Because of the large number of water users in a smallholder system like Uda Walawe, effective interaction will only be possible if the water users are organized into viable groups with representative group leaders.

3. The "myth" that the cultivation meeting is a decision-preparation instead of a decision-taking body should be exposed to all involved parties. The persistence of this myth leads to confusion about the degree to which water users are involved in the seasonal allocation planning. Therefore, the meeting could be formalized as an extension and decision-taking meeting with an additional function to hear remaining (i.e., unrepresented in the final decisions) water user discontent, which may be fed back to the MEA head office.

4. The MEA staff should be made aware and stimulated to consider that the seasonal allocation planning is a managerial challenge rather than a technical problem.

5. Improvements in management inputs, managerial attitudes, interaction with water users and subordinates, information flows and allocation strategies all seem to depend on the more basic precondition of more commitment and accountability of all staff levels to the seasonal-allocation performance other than yields. Priority for improvement lies thus with building up such an overall institutional support to the seasonal allocation performance. This will have to be initiated and developed by the MEA head office rather than at project level.

In-Seasonal Allocation

1. Economizing on water use and improvement of the water delivery service will only be possible if higher-level staff members of MEA will become more involved in the in-seasonal allocation and water flow regulation processes below the head sluice. Their involvement will improve the co-ordination of these decisions over the system, will allow for improvement of these decisions themselves and will motivate the field-level staff.

2. Improvement of these processes will require a change of the present institutional support by MEA for staff members at different levels involved in in-seasonal allocation and water flow regulation. Moreover, accountability and responsibility of these staff members at different levels towards the water delivery performance have to be built up within MEA. This improved institutional support and accountability should be initiated at the head-office level rather than at project level.

3. The present organizational structure with localized water delivery responsibility for the block office facilitates the lack of representation of system-wide interests to save water at the block level. This is reinforced by the absence of any accountability to the water delivery performance. Therefore, sufficient financial and hierarchical authority should be allocated to the O&M office which is representing system-wide interests in comparison to more localized interests.

4. Improvements in water delivery will require regular demand assessment during the season. This requires more management inputs and more interaction with water users. Therefore, and because of the large number of water users in a smallholder system like Uda Walawe, water users will have to be organized into viable groups with representative group leaders.

5. The "fixed discharge and variable duration" rotation seems to be the most feasible water delivery method under a water-tight supply compared to the present "fixed discharge and fixed duration" rotation in Uda Walawe; it would require more management input from the agency staff, but would allow the water users to standardize the rotation within the distributary and

field channels to a certain extent. The "variable discharge and variable duration" rotation could be used for the transition period. Under a more water abundant supply any rotation method would do, and the presently used "fixed duration and fixed discharge" is the least management-intensive option.

Water Flow Regulation

1. Improvement of the water flow regulation requires more involvement of staff of levels higher than the Technical Officers to guide, monitor and evaluate field staff in this area of concern.

2. Improvement in the water flow regulation requires a change in the present "approximate" to a more accurate water flow regulation.

3. More accurate water flow regulation will require more accurate discharge measurements, which require staff gauges or measurement structures that are calibrated more regularly.

4. If gated cross-regulators are to be used for more flexible water flow regulation, more and faster information exchanges will be required. For example, information regarding flow changes at the head of the main canal will have to be fedback faster to higher-level staff to instruct and inform gate tenders about required changes in the operation of gated cross-regulators and offtakes along the main canal.

5. On the other hand, using these gated cross-regulators mainly as fixed weirs will considerably reduce the required management inputs. This might therefore be an appropriate operational method within the present water delivery setting in Sri Lanka. The stop log-type cross-regulators were probably aimed at this type of water flow regulation as well.

6. With or without gated cross-regulators, an increased level of perfection of the water flow regulation seems unlikely without any overall institutional

support and accountability to the water flow regulation performance of the MEA staff. As for the seasonal and in-seasonal allocation concerns, this accountability will have to be initiated and developed by the MEA head office or the highest-level policymakers rather than by project-level management only.

RECOMMENDATIONS FOR THE RESPONSIBLE ORGANIZATIONS

Priorities for Improvements in Irrigation Management

Prioritizing among these areas of concern and the given opportunities for improvement should evolve from internal decision-making processes, strategic exercises or the like within and between MEA, MASL and the Government of Sri Lanka rather than from outside. In addition, the donor could derive some opportunities for improvement with respect to its role in these decision-making processes.

The earlier section of this chapter on the overall picture of irrigation management shows the inconsistencies between the different key decisions in irrigation management. That these inconsistencies are so excessive has been made possible through the almost complete absence of any accountability for the water delivery performance in all these key areas of concern. This lack of accountability and responsibility in system rehabilitation and utilization for the water delivery performance is the crux of the whole irrigation management problem; it dominates all key decision making with respect to the water delivery.

The lack of motivation and willingness of agency staff to increase its management efforts in the water delivery aspects of system utilization and rehabilitation is due ultimately to this lack of accountability and responsibility of the managing agency as a whole towards its water delivery performance.

The agency-wide priorities for construction activities and related funding make these system creation and rehabilitation processes the most, if not the only, likely starting point for building such accountability through the leverage provided by these funds. A more objective assessment of the *potential* irrigation-management performance during the system creation and rehabilitation processes can be a first step in giving some value to the only resource which is not attributed any value in irrigation at present, i.e., water.

The involved agencies, the donors and the politicians should develop more long-term commitment to improve the contribution of the system rehabilitation decision-making processes to the long-term system performance and sustainability. The present decision-making processes attribute very little value to system sustainability and performance. This last section gives recommendations for the different actors involved.

Managing Agency

In all cases, it will be the managing agency that has to play a major role in improving processes of all management concerns. This also includes possible improvements in the level of perfection of the determination of feasible system objectives and functional system requirements because of its familiarity with the managerial situation in its own irrigation systems. It should also be the leading agency for prioritizing among the given opportunities for improvement for the different areas of concern as described in chapters 3 to 10.

Many chances of success exist if the managing agency itself would initiate such processes: For example, processes to make its feasibility assessments and design concepts more appropriate, which may require strategic planning exercises of different levels of staff, and possibly other relevant actors, and processes to evaluate the appropriateness of many internationally accepted techniques (e.g., EIRR, theoretical water requirements, operation studies, rationalized layouts, parallel field canals, "one-off" concept) for the Sri Lankan situation. System rehabilitation should become more appropriate and cost-effective, for example, by approaching it on a smaller, less capital-intensive and more gradual scale; integrated watershed management (e.g., reuse of drainage water, suitable command areas and smaller dams) should replace capital-intensive large-scale blueprint approaches which are based on unfeasible management requirements. The required management inputs should be matched with feasible levels and opportunities for investments assessed in a more objective way.

At the same time, improvements in the utilization of existing systems can be initiated which may require a similar, and partly overlapping, strategic exercise by different levels of staff and possibly other relevant actors. Or, working groups may be started to deal with specific management concerns like the system-rehabilitation concepts, the seasonal allocation, the in-seasonal allocation and water flow regulation. In general, it may be that MEA would require additional professional support staff in its head office to initiate and sustain such processes. The required critical mass of professionals might also be reached through a cooperative effort in this respect with the Irrigation Department, the Irrigation Management Division, the Mahaweli Engineering Construction Agency and CECB.

Thus, more explicit definitions of generalized functional system requirements for the Sri Lanka situation will be required (e.g., motivation and managerial capabilities of staff, management intensiveness, desired degree of controllability over water flow and related costs, vulnerability to political intervention, and ecological, cultural and other functions of the system, etc).

The Government of Sri Lanka

It seems, however, that improved performance and related increased management inputs during system utilization are hard to achieve within the present managerial situation in Sri Lanka, and without more political priority for improved water delivery performance.

Therefore, the managing agency may not be willing to initiate the aforementioned processes without specific requirements of the Government of Sri Lanka to the managing agency to become more accountable for the water delivery performance of the system, especially at the time of investments. The aforementioned recommendations for the desired and feasible system objectives and functional system requirements may be picked up by the government to make the managing agency more accountable. The government may focus in this respect on the more explicit definition of the desirability, feasibility and functionality of a specific system rehabilitation and design concept by the managing agency and other relevant agencies before approving it to be submitted to external funding agencies. If the government does not require such explicit statements, it will be very difficult to judge the desirability, feasibility and functionality of a proposed investment in this professional domain of the engineers.

In addition, the government might consider it desirable to implement changes in the organizational setup of the agencies through, for example, making the agencies financially more independent (e.g., corporation) and thus more directly accountable to investments and the evolving water delivery performance. Such aspects will be the subject of other IIMI research in the near future.

With respect to the existing systems, the government may want to develop accountability for the investments made within the managing agency by requiring changes from the managing agency to develop responsibility, accountability and institutional support for staff involved in allocation and water flow regulation processes.

The Donor

Because of the major opportunities presently provided by the donor funds for politicians and involved agencies, it is not unlikely that politicians, the government and the agencies lack the will to initiate such required processes as long as these funds continue to be available in an unconditional mode. In this situation, the donor has a major responsibility in enforcing more accountability of the agencies towards their irrigation investments.

Political priorities in all countries are often oriented to the short term. The donor funds allow the politicians to start up projects that have high visibility and prestige in the short run, despite reduced opportunities in the short, medium and long terms as has been the case for the WIIP. The donor bears a responsibility in this respect as far as it provides an external assessment of the economic feasibility of the envisaged irrigation investments. Given the short-term political and agency priorities to obtain these funds it seems to be of utmost importance that the donor should give an objective and reliable picture of this feasibility. Only in that way will the donor allow itself, the politicians and the agencies to make decisions on irrigation investments which are essentially always politically inspired, in the full knowledge of its economic consequences. Several ways to improve the present feasibility assessments by the donor have been given earlier in this chapter.

This paper strongly suggests that the donor itself cannot be involved in the design of system objectives and requirements which are so detailed that desirability, feasibility, and functionality assessments and their monitoring and evaluation become a major problem. Rather it should restrict itself to general but very clear and explicit performance objectives and requirements, and use these to assess the feasibility of proposed projects and their performance.

Specific requirements for the donor to use indicators can be derived from the aforementioned recommendations for the desired and feasible system objectives and functional system requirements. As long as the donors fund irrigation investments without such requirements, the required responsibility and accountability processes within the government, irrigation and other agencies seem less likely to occur, because of the very limited value attributed to water by any of the involved parties.

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ANNEX

Levels of Perfection of the Irrigation Management Concerns

THE ANALYSIS OF an irrigation organization with respect to irrigation management concerns or key decision-making processes will probably lead to the conclusion that conditioning is required for improvement of the mutual adaptation of their technical and managerial aspects. However, these concepts do not provide for criteria to choose among different conditioning alternatives. Kampfraath and Marcelis (1981) have identified four criteria for that purpose that together form the basis for the concept of "levels of perfection."

These four criteria are derived from the decision-making processes: systematics, feedback, foreseeing and integration. Decision-making processes are essentially processes of transformation of the "resource" information into decisions. The quality of the decision is then determined by two dimensions, namely 1) what information is taken into account and 2) how that information is processed. The first dimension can be split up into three criteria:

* In fact, a decision is a position with respect to future action, so that for making that decision "foreseeing" (i.e., the degree to which decision making foresee the scope of the decision) influences the quality of the decision.

* Another element is the influencing through and of other processes. A position in the area of seasonal planning has consequences for the area of maintenance, for example. "Integration" (i.e., the degree to which problems are seen in a wider context before the decision is made) is used as a criterion for this aspect.

* The position will only have actual consequences if the de facto action has commenced. Up to that moment the position can be revised based on information of the past; the quality of the position depends on the level

of "feedback" (i.e., the degree to which the decisions made are tested continuously for appropriateness).

The second dimension refers to the first criterion, "systematics" (i.e., the degree to which decisions are made following a more or less fixed pattern).

These four criteria can be used for describing the quality of decisions and thus of the management concerns. The level of perfection is derived from these four criteria through the attachment of an estimated quantitative label to different qualitative levels of those four criteria, as shown in Table 1 on page 13 of Chapter 1. The levels of perfection of the different irrigation management concerns and key decisions used in this paper have been derived from Table 1 and are listed in this Annex.

STRATEGIC CONCERN: DESIRED SYSTEM OBJECTIVES

0–20%/VERY LOW: The establishment of the desired system objectives is ad hoc without considering the likely sustainability of these objectives during the lifetime of the envisaged investments. No feedback from the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors with respect to the desirability and acceptability of the identified desirable system objectives takes place. No rules support this decision making, but a certain routine may exist.

20–40%/LOW: Necessities for the short-term sustainability of the desired system objectives during the lifetime of the envisaged investments are incorporated. Irregular feedback from the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors with respect to the desirability and acceptability of the most important desirable system objectives takes place. Broad rules support this decision making.

40–60%/AVERAGE: Priorities for the short- and long-term sustainability of the desired system objectives during the lifetime of the envisaged investments are considered. Regular feedback from relevant parties like the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors with respect to the desirability and acceptability of (for them) relevant system objectives takes place. The preferences and requirements of these groups with respect to the system objectives are considered. Rules support important aspects of this decision making, e.g., the determination of the district and national social and economic opportunities for the investments.

60–80%/HIGH: Foreseen developments that will affect the short- and long-term sustainability of the desired system objectives during the lifetime of the envisaged investments are considered. Frequent feedback from relevant parties like the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors with respect to the desirability and acceptability of (for them) relevant system objectives takes place. Important preferences and requirements of these groups with respect to the system objectives are incorporated. Procedures in terms of combinations of mutually attuned rules support this decision making.

80–100%/VERY HIGH: Expected developments that will affect the short- and long-term sustainability of the desired system objectives during the lifetime of the envisaged investments are reviewed and considered. Continuous feedback from relevant parties like the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors with respect to the desirability and acceptability of (for them) relevant system objectives takes place. All relevant preferences and requirements of these groups with respect to the system objectives are incorporated. Balanced systems of mutually attuned procedures support this decision making.

STRATEGIC CONCERN: FEASIBLE SYSTEM OBJECTIVES

0–20%/VERY LOW: The assessment of the feasible system objectives is ad hoc without considering their likely sustainability during the lifetime of the investments. No feedback is obtained from relevant agencies, publications, local communities or beneficiaries regarding the appropriateness of the feasible objectives. The mutual influences between different feasible objectives as watershed management, dam sites, command area, suitability of soils, water delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, and environment are not considered; mono-disciplinary feasibilities dominate the decision making. No rules exist regarding the determination of the feasible objectives but a certain routine may exist.

20–40%/LOW: Necessities for the short-term sustainability of the feasible system objectives during the lifetime of the envisaged investments are incorporated. Obvious experiences of relevant agencies, publications, local communities or beneficiaries regarding the appropriateness and the feasible objectives are processed. Convincing mutual influences between the different feasible objectives as watershed management, dam sites, command area, suitability of soils, water delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment, etc., are incorporated. Broad rules (e.g., steps to be taken, criteria to be used, consultations required, level of agreement of different groups) support the decision making.

40–60%/AVERAGE: Priorities for the short- and long-term sustainability of the feasible system objectives during the lifetime of the envisaged investments are considered. Regular feedback of important information regarding the appropriateness the feasible objectives is considered. Directly related mutual influences between the different feasible objectives as watershed management, dam sites, command area, suitability of soils, water delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment, etc., are considered. Rules (e.g., steps to be taken, criteria to be used, consultations required, level of agreement of different groups) support important decision-making processes regarding the feasible objectives.

60–80%/HIGH: Foreseen developments that will affect the short- and long-term sustainability of the feasible system objectives during the lifetime of the envisaged investments are considered. Frequent feedback of most relevant information regarding the appropriateness of the feasible objectives is considered. Important mutual influences between the different feasible objectives as watershed management, dam sites, command area, suitability of soils, water delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment, etc., are incorporated. Procedures in terms of combination of mutually attuned rules support important decision-making processes regarding the feasible objectives.

80–100%/VERY HIGH: Expected developments that will affect the short- and long-term sustainability of the feasible system objectives during the lifetime of the envisaged investments are reviewed and considered. Continuous feedback of all relevant information regarding the appropriateness of the feasible objectives is considered. All mutual influences between the different feasible objectives as watershed management, dam sites, command area, suitability of soils, water delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment, etc., are incorporated. Balanced systems of mutually attuned procedures support important decision-making processes regarding the feasible objectives.

STRATEGIC CONCERN: FUNCTIONAL SYSTEM REQUIREMENTS

0–20%/VERY LOW: The decision making about the functional requirements is ad hoc and does not foresee the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. No feedback from the local community and system managers regarding the appropriateness of the functional system requirements takes place. The decision making about the functional requirements does not try to integrate the irrigation and nonirrigation preferences and requirements of local community, water management staff, politicians, future settlers, and (national or regional) agricultural interests with the engineering interests. No rules exist regarding the determination of the functional requirements. A certain routine may exist.

20–40%/LOW: The decision making about the functional requirements considers necessities regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. Feedback of obvious experiences of the local community and system managers regarding the appropriateness of the functional system requirements takes place. The decision making about the functional requirements considers convincing subsidiary influences in terms of irrigation and nonirrigation preferences and requirements of local community, water management staff, politicians, future settlers, (national or regional) agricultural interests, and engineering interests. Broad rules exist regarding the determination of the functional requirements.

40–60%/AVERAGE: The decision making about the functional requirements considers priorities regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. Most important experiences of the local community and the managing agency regarding the functional system requirements are considered. The decision making about the functional requirements considers directly related influences in terms of irrigation and nonirrigation preferences and requirements of local community, water management staff, politicians, future settlers, (national or regional) agricultural interests and engineering interests. Important decision-making processes regarding the functional requirements like the number and sites of intermediate reservoirs, the determination of peak irrigation requirements to certain subsystems, the required controllability over water flow, etc., are supported with rules.

60–80%/HIGH: The decision making about the functional requirements considers foreseen developments regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. Most experiences of the local community and the managing agency regarding the functional system requirements are considered. The decision making about the functional requirements incorporates important influencing factors in terms of irrigation and nonirrigation preferences and requirements of local community, water management staff, politicians, future settlers, (national or regional) agricultural interests and the engineering interests. Most decision-making processes regarding the functional requirements like the number and sites of intermediate reservoirs, the determination of design and peak irrigation requirements to certain subsystems, the required controllability over water flow, etc., are supported with combinations of mutually attuned rules.

80–100%/VERY HIGH: The decision making about the functional requirements considers and reviews expected developments regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. All relevant experiences of the local community and managing agency regarding the functional system requirements are considered. The decision making about the functional requirements incorporates all influencing factors in terms of irrigation and nonirrigation preferences and requirements of local community, water management staff, politicians, future settlers, (national or regional) agricultural interests and the engineering interests. Decision-making processes regarding the functional requirements are supported by balanced systems of mutually attuned procedures.

ALLOCATION CONCERN: SEASONAL ALLOCATION PLAN

0–20%/VERY LOW: Seasonal allocation planning regarding water duties, cropping pattern, cultivation calendar, irrigable area and cultivation risks for different subsystems takes place ad hoc. A certain routine may exist. Few rules guide this planning. Related decision making by the Department of Agriculture, the water users and the maintenance planners are not considered. Performance evaluation through complaints.

20–40%/LOW: Seasonal allocation planning considers to some degree the available supply during the season for the different subsystems. Cultivation risks are not quantified. Rules of thumb are used for the seasonal assessment of supply and demand, and allocation planning. Convincing influences of decision making by the Department of Agriculture, the water users, the politicians and the maintenance planners are incorporated. Performance evaluation through complaints and registration of final seasonal plans.

40–60%/AVERAGE: The available supply during the season for the different subsystems is assessed and priorities are made regarding the allocation parameters (i.e., irrigable areas, cropping pattern, cultivation calendar, water duties and cultivation risks). Cultivation risks are quantified. The consequences of this season's allocation decisions on future expectations are to some degree considered; a more active allocation strategy. Rules support this decision making. Directly related decision making by the Department of Agriculture, the water users, the politicians and the maintenance planners are considered for the matching of supply and demand. Performance evaluation is through registration of final plans and comparison with important earlier experiences, and regular monitoring of actual implementation.

60–80%/HIGH: The available supply during the season for the different subsystems is assessed and priorities are made regarding the allocation parameters, considering their consequences for future expectations for important subsystems in view of the allocation strategy for these subsystems and the overall system. Cultivation risks and water duties for subsystems are quantified. Procedures of mutually attuned rules support this decision making. Important influences of decision making by the agricultural department, the water users, the politicians and the maintenance planners regarding the different subsystems are incorporated in the matching of supply and demand. Performance evaluation is through comparison of final plan with earlier experiences for the different subsystems, and frequent monitoring and evaluation of actual implementation.

80–100%/VERY HIGH: The available supply during the season for the different subsystems is assessed and priorities are made regarding the allocation parameters, considering and reviewing expected developments during the season and their consequences for future expectations in view of the allocation strategies. Balanced systems of mutually attuned procedures support this decision making. All relevant decision making by the agricultural department, the water users, the politicians and the maintenance planners regarding the different subsystems are incorporated in the allocation decisions. Performance evaluation is through comparison of final plan with earlier experiences for all subsystems, and continuous monitoring and evaluation of actual implementation.

ALLOCATION CONCERN: IN-SEASONAL ALLOCATION

0–20%/VERY LOW: Little effective planning of the in-seasonal allocation is done; actual in-seasonal allocation with respect to operational targets for conveyance and distribution, cropping pattern, cultivation calendar, irrigable area and cultivation risks for different subsystems takes place ad hoc, while incorporating urgencies. A certain routine may exist. Few rules guide this planning. Decision making by the water users and the Department of Agriculture is not considered in the official allocation decisions, if any. Gate tenders determine to a large degree the actual allocations, whereby often the conveyance along the main system is neglected. Performance evaluation is through complaints. No reliable or effective feedback to higher hierarchical levels on the actual realization of the operational targets for distribution and conveyance for the different subsystems.

20–40%/LOW: Short-term planning of in-seasonal allocation considering necessities and urgencies. Rules of thumb are used for the in-seasonal assessment of supply and demand, and allocation planning. Convincing influences of decision making by the water users, the Department of Agriculture and the politicians for different subsystems are incorporated. Gate tenders take allocation decisions partly independently, and partly on instructions. Operational targets for distribution and conveyance only for urgencies separately considered. Performance evaluation is through complaints and registration of final allocation plans (i.e., water schedules). Feedback on realization of the operational targets for distribution and conveyance for the different subsystems takes place for obvious points in the (sub)system.

40–60%/AVERAGE: Regular (e.g., weekly or biweekly) planning of in-seasonal allocations. The consequences of allocation decisions on future expectations are to some degree considered. Foreseen supply and demand changes during realization of the operational targets for distribution and conveyance for the different subsystems are considered in the allocations. Rules support this decision making. Important targets for conveyance to the tail end of the main canal and other important subsystems are incorporated in the matching of supply and demand. Directly related decision making by the water users, the Department of Agriculture and the politicians are considered for the matching of supply and demand. Gate tenders take allocation decisions which conform to water schedules and related instructions. Performance evaluation is through the registration of water schedules and comparison with important earlier experiences, and regular monitoring of actual implementation of most important operational targets. Regular feedback of effective rainfall for most important subsystems is considered in allocation schedules. Experience with allocations is laid down in records (e.g., database, seasonal reports).

60–80%/HIGH: Planning through frequent scheduling of allocations to different subsystems. The consequences of allocation decisions on future expectations are considered. Foreseen supply and demand (e.g., probable effective rainfall) changes during realization of the operational targets for distribution and conveyance for the different subsystems are considered in the allocations. Combinations of mutually attuned rules support this decision making. Most relevant decision making by the water users, the Department of Agriculture and the politicians are incorporated for the matching of supply and demand. Gate tenders take allocation decisions which conform to water schedules and related instructions. Part of the instructions include standard practices in terms of operational methods and procedures. Operational targets for distribution and conveyance are considered separately. Performance evaluation is through frequent comparison of actual implementation with the scheduled operational targets for conveyance and distribution for different subsystems. Frequent feedback regarding demand includes effective rainfall for all important subsystems.

80–100%/VERY HIGH: The actual allocation is laid down in the water schedules. The gate tenders allocate accordingly, which conform to standard practices. Expected developments regarding supply and demand for different subsystems during the actual realization of the operational targets for distribution and conveyance for the different subsystems are reviewed and considered. Most sudden demand changes are thus covered in a consistent and reliable manner. Balanced systems of mutually attuned procedures support this decision making. All relevant decision making by the water users, the Department of Agriculture and the politicians are incorporated in the matching of supply and demand. Performance evaluation is through continuous comparison of actual implementation with the water schedules for conveyance and distribution. Deviations and delays are reported and registered.

WATER FLOW REGULATION CONCERN

0–20%/VERY LOW: Hardly any preparation and calculation with respect to operational methods and plans take place; they are established ad hoc and hardly foresee the consequences for upstream and downstream water levels in the main system. No rules support this decision making, but a certain routine developed through on-the-job experience may exist. No feedback takes place regarding operational methods used. There is hardly any coordination of the operations of different structures along the main system. Time required for the operations is not determined in advance. Division of work is done by gate tenders themselves. Performance evaluation is by complaints and by some monitoring of time spent.

20–40%/LOW: Some preparation and calculation with respect to operational methods and plans are done by supervisors (e.g., determination of approximate time and size of flow variations along the main system). Necessities with respect to the conveyance of resulting upstream and downstream water levels are considered in the operational methods and plans. Irregular feedback takes place regarding the most obvious experiences with operational methods and stabilization. Convincing influences of the operations of the different structures along the main system on the stability of the water levels are incorporated in the different operational methods. Broad rules support this decision making. Time required for the operations is estimated in advance. Division of work is done partly by gate tenders themselves, partly by their supervisor. Performance evaluation is by complaints and by monitoring of time spent by supervisor.

40–60%/AVERAGE: Part of the preparation and calculation with respect to operational methods and plans is done by special staff of higher hierarchical levels. Priorities with respect to the conveyance of resulting upstream and downstream water levels are considered in the operational methods and plans. Regular feedback takes place regarding the important experiences with operational methods. Relevant influences of the operations of the different structures along the main system on the water levels are incorporated in an operational plan. Rules support this decision making. Time required for the operations is calculated by means of historical data. Division of work is done through tasks and instructions. Performance evaluation is by regular monitoring of actually implemented operational methods and time spent by supervisor.

60–80%/HIGH: Systematic preparation and calculation of operational methods and plans by special staff. Frequent feedback takes place regarding practiced operational methods and resulting water flow regulation. The operational plan incorporates all control structures that influence water flow regulation along the main system. Combinations of mutually balanced rules support this decision making in all subsystems. Time required for the operations is calculated, partly by means of calibrated norms. Division of work is done through tasks and instructions. Part of the instructions constitutes standard operational methods. Performance evaluation is by monitoring and evaluation of actually implemented operational methods and comparison of time spent with norms.

80–100%/VERY HIGH: Complete systematic preparation and calculation of operational methods and plans by special staff. Most operational methods have been standardized. Expected developments regarding upstream and downstream water levels are reviewed, evaluated and incorporated in the operational methods. Continuous feedback takes place regarding practiced operational methods and resulting water flows and levels. Balanced systems with mutually attuned procedures support this decision making in all subsystems. Calculation of time required for the operations is based on unit time calculations (e.g., UMS). Performance evaluation is by monitoring and evaluation of actually implemented operational methods and time spent.