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PROFESSIONAL MANAGEMENT IN IRRIGATION SYSTEMS: A CASE STUDY OF PERFORMANCE CONTROL IN MAHAWELI SYSTEM H, SRI LANKA

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Summary: Taking System H of the Mahaweli Program in Sri Lanka as a case study, this paper investigates a field still largely unexplored — the agency and its capacity to manage an irrigation system.

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TABLE OF CONTENTS

ILLUSTRATIONS v

TABLES vii

PREFACE ix

FOREWORD xi

EXECUTIVE SUMMARY xiii

ACKNOWLEDGEMENTS xix

Chapter I: INTRODUCTION 1

Management Concepts 1
The Mahaweli *Ganga* Irrigation and Power Project: The Organization 5
Research Strategy: Focus, Methods, and Boundaries 12

Chapter II: SYSTEM MANAGEMENT: THE PLANNERS AND THE SEASONAL OPERATING PLAN 17

Preparation of the Seasonal Operating Plan (SOP) 17
The SOP and System Operation 19
Workplan and Resources 21
Water Management: Anticipated and Unanticipated Constraints 22
Maha 1986/1987 in System H 23
The System H Water Management Coordinating Panel 24
Crisis Management: Saving the Season 26
Discussion 27

Chapter III: GALNEWA PROJECT AND KALANKUTTIYA ADMINISTRATIVE BLOCK 31

Kalawewa Left Bank Main Canal, Galnewa Project: Main System Operations 31
Kalankuttiya Administrative Block: Management Structure and Functions 34

Rotations During Maha 1986/1987 at Kalankuttiya 36
Conclusion 46

Chapter IV: MATRIX MANAGEMENT: PROBLEMS AND POTENTIALS 55

Evolution of the Management of System H 55
Project Management with a Matrix Framework 63
The Resident Project Manager and Matrix Management 65
The Administrative Block and the Unit: The Crux of Matrix Management 71
Matrix Management: Counter Strategies at the Unit and Distributary Levels 72
Matrix Management Below the Unit Manager 78

Chapter V: TOWARDS AN INDEX FOR PERFORMANCE MONITORING AND EVALUATION 81

Water Management: The Analysis of a Management System 81
Main System Management: The Search for an Index of Management Efficiency 84
Conclusions and Recommendations 85

GLOSSARY 91

REFERENCES 93

APPENDIX: Measures 97

ILLUSTRATIONS

Figures

1. The Mahaweli organization 7
2. The Mahaweli Economic Agency 8
3. Project-level organization: Mahaweli Economic Agency 9
4. Location Map of Mahaweli Systems 11
5. Mahaweli Ganga Development Project: Subsystems H1-H12 of System H 13
6. Kalankuttiya Block of Mahaweli System H 14
7. Water delivery system of LB/MC: Kalankuttiya branch canal 32
8. Organization for irrigation control in Kalankuttiya Block 35
9. The four components of MEA management 59
10. Contrasting matrix organizations for managing agriculture and irrigation in Kalankuttiya Block 66

TABLES

1. Date of actual water deliveries for maha 1986/1987 36

2. Anticipated and actual water use, maha 1986/1987 46

3. R6 at Kalankuttiya, 16-25 January 1987, including daily rainfall and tank levels 47

4. Water duty computed at the unit level at the end of maha 1986/1987 48

5. R6 water issues, maha 1986/1987: MEA and IIMI calibrations 49

6. R8 at Kalankuttiya, 13-24 February 1987, including daily rainfall and tank levels 50

7. R8 water issues, maha 1986/1987: MEA and IIMI calibrations 51

8. Kalawewa Tank issues, maha 1986/1987 52

9. Incidence of sales, leasing and mortgaging of allotments in selected Kalankuttiya units in yala 1987 62

PREFACE

The field research for this study and the preparation of the report were supported by a postdoctoral fellowship (1986/1988) awarded to the first author under the Professional Development Program of the International Irrigation Management Institute.

The study on which this paper is based derived from the insights and experience of previous research conducted on decision making within the public organization of the *kachcheri* (district-level administration) in Sri Lanka, (Raby 1985) as applied to a different type of public organization in Sri Lanka, one organized on a project basis to manage a large-scale irrigation system. The field data collected has been translated from Sinhala, which as the official language is the medium of communication in public agencies in Sri Lanka. Some trade-offs have been made between an acceptable translation of meaning and the search for polished grammar. For information gathered in English, for example in interviews with senior officials, an attempt has been made to preserve the emic flavor of the transaction by retaining as far as possible phrases and usages prevalent in Sri Lankan English.

As the joint work of two anthropologists, one with research experience and training in the field of decision making in public organizations and the other on irrigation systems with particular reference to farmer participation in the decision-making process, this work presents first, an ethnography of an agency managing an irrigation system and second, an attempt to integrate a multidisciplinary perspective in studying irrigation agencies. There is little off-the-shelf theory that can be imported wholesale from any one discipline into the domain of irrigation agencies in developing countries, so we have taken a rather eclectic approach and used bits and pieces of several bodies of theory based on their relevance. Thus, the use of integrated management within a matrix framework as a yardstick for evaluating the irrigation agency under study was adopted not because of a preconceived desire to introduce management concepts which we know are now *passé* in business management, but because this is the formally accepted operational principle of the agency concerned. The appropriateness or otherwise of this framework is not within the scope of this study.

As for the impact and relevance of this research, we are pleased with the positive response of the agency under study as shown in the interview with the Managing Director

(IIMI Review 2[2], August 1988). We hope that this will be the forerunner for further research on agencies managing irrigation systems within Sri Lanka and elsewhere.

A Sinhala translation of the executive summary of this paper was done and circulated by the Mahaweli Economic Agency within the agency as well as outside of it.

A workshop based on the findings of this paper, targeted particulary towards the system operators was requested of the authors by the Managing Director/General Manager, MEA, and this is still pending.

NAMIKA RABY
DOUGLAS J. MERREY
1989

FOREWORD

The Mahaweli Economic Agency (MEA) is engaged, amongst its many other functions, in managing the irrigation systems that have been set up in the different project areas of the Accelerated Mahaweli Development Programme (AMP). The ultimate objective of this exercise is to ensure that each farmer gets an equal share of the water that is available for each cultivation season. Careful plans and strategies are mapped out to meet this objective. In operation, however, everything does not go according to these plans. Changes in the weather, poor performance of the irrigation system, political requirements, breakdown in communications are some of the reasons that necessitate changes in the original plan of operation. In a number of these instances operational decisions have to be taken quickly and these too by those not "authorized" to do so. This has happened each season and will continue to happen. Most of these changes and decisions are not communicated to higher management nor are they recorded in a manner to be of use later on.

As soon as one cultivation season has been completed, planning for the next season is started. There is no time therefore for the staff of the MEA, either at head office or at the system level to evaluate the performance of a season that has been completed. It is in this respect that the study done by Namika Raby and Douglas Merrey becomes important to the MEA. I am sure that this study will be of much use to every one else involved in the management of irrigation systems — especially larger systems. In the absence of proper in-depth assessment and evaluation of a season's operation the tendency is, if the season has been even partially successful, to believe that the original plan that was worked out has been successful. This plan is then duplicated the following season, reasoning that the partial success (if that was the case) was due to one or more of the factors given above.

What planners and managers may not realize is that a different irrigation management system may be evolving at the field level, which is what really contributes to the success of the seasonal operation. This study looks at the field-level operation very closely from a management point of view and tries to show its advantages and disadvantages. It attempts to spotlight the shortcomings of the present management system imposed from the top, and to highlight the realities that obtain at the field level which render that management system difficult to operate. It also tries to show the adaptations and changes that have been made in the field to make the best of the situation.

Another objective of the MEA is to try to transfer the management of the systems to the farmers at least up to the distributary channel level. This study helps to identify their potential as groups to manage the system and the resources available. It also identifies some training needs for better management of the system.

The lessons that are to be learnt from this study will be given careful consideration by the MEA when planning out its future management of the systems.

The Mahaweli Economic Agency (MEA) was pleased to be associated in this study with the International Irrigation Management Institute (IIMI). I am very thankful to Drs. Namika Raby and Douglas Merrey for a job well done.

JAYANTHA JAYEWARDENE
Managing Director/General Manager
Mahaweli Economic Agency
18 April 1988

EXECUTIVE SUMMARY

In this study we document the management system of the Mahaweli Economic Agency (MEA) of the Mahaweli Authority of Sri Lanka (MASL), focusing on Kalankuttiya Block in Galnewa Project in 1986/1987, during a water crisis resulting from a severe drought. Taking a systems approach to the study of an irrigation system that is large-scale, multipurpose, and agency-managed, we have documented the formal organization—the *structure* for allocating authority to individual functionaries for the realization of objectives — and the *process* which emerges out of this and results in an adaptive, self-regulating system of behavior.

This managerial process is the product of the hardware—the nature and state of the physical system—and an environment within which the system is embedded and open to its influence. The environment includes the goals of the national government, the desires of politicians, the interests of donor agencies, and the demands of the electorate. Whether the physical system and the environment are constraints or opportunities depends on the capacity of the management system, in particular its strength at the interface between the agency and the political environment.

The strength of management at this interface rests ultimately on the capacity and strength of the professional manager. This in turn depends on the *management control system*. The management control system, as we use the term, includes five integrated dimensions: 1) a workplan and resources, 2) standards of performance, 3) a system of monitoring actual performance, 4) comparison of actual performance against planned targets, and 5) corrective action. The performance of a management system hinges upon all five elements for the optimum realization of objectives. Taking the management system as the dependent variable, and the severe shortage of water in 1986/1987 as the independent variable, we examine the capacity of the agency to respond to the crisis by analyzing the role of management at crucial points in the irrigation system, focusing on the strength and capacity of the management controls in place, or the impact of their absence.

This is a study of descriptive decision making. We examine the idealized goals, the limited alternatives, the formal and informal dimensions of the managerial process within the agency, and the outcomes. This case study thus investigates a field still largely unexplored, "the black box" of irrigation management—the agency and its capacity to manage an irrigation system. Hitherto in Sri Lanka, research efforts have focused on the

construction and rehabilitation of the physical system and the creation and enhancement of the capacity of the water users to manage their resources below the turnout. These projects have taken the agency and the professional capacity of those who manage it as given because it is the least understood and somehow most sensitive —hence the black box metaphor. However, the degree of success of all large public irrigation projects rests ultimately upon the performance of the implementing agency.

Further, this study while labeled as an exercise in crisis management, may be equally labeled as decision making under uncertainty, and at times, even decision making under risk (in contrast to decision making under certainty). We contend this is the norm rather than the exception in irrigation management in Sri Lanka and perhaps elsewhere. Thus, even though this is *not* a study of "routine" management, it is in fact "normal" in many large systems for the agency to be forced to manage under the pressure of a crisis.

Following from the above, in borrowing from management science, models of decision making under uncertain conditions are better suited to studying irrigation systems in the Third World than models based on fixed assumptions. We have adopted the commonly accepted distinction between the administrative and entrepreneurial management modes of operation. Briefly, these are characterized by a distinction between implementation of rules having a normative basis, and the vigorous manipulation of pragmatic rules to respond to changing opportunities. We argue that at the higher levels of the irrigation system (i.e., the system and project level), the agency was "successful" in dealing with a severe water crisis by adopting a special innovation, the System H Water Management Coordinating Panel (WMCP), which legitimized the application of a strict allocation principle using an administrative mode of management. This mode involved issuing only as much water from the reservoirs as was received in a given period, in order to stretch the supply to the end of the season. Thus, while control defaulted upward under conditions of stress (Levine 1987), it did so efficiently in an administrative mode and within a large proportion of the system, which was successfully administered as a conveyance rather than a distribution system.

However, problems arose at the lower levels of the system, at the block and unit levels, because the agency did not clearly recognize that different management principles apply. At these levels, it is necessary to shift to an entrepreneurial mode of management in order to distribute the water supply to the users. The agency was unable to maintain the water levels at intermediary reservoirs necessary to insure reliable water delivery, and it was unable to control excess use of water by head-end farmers. At this level, there was a lack of adequate and appropriate performance monitoring and control of the block- and unit-level staff —the point of interface with the users. Thus, when a unit manager acts in an entrepreneurial mode, as is required at this level, the legitimacy of this behavior is questioned by higher-level management. We conclude that the modern entrepreneurial style of management is better suited to smaller systems and to lower-level sections of larger systems, which deliver water directly to consumers (distribution systems), than the administrative or bureaucratic

mode. The latter mode is most appropriate for higher levels of large systems where water is allocated among smaller subsystems according to clearly defined rules.

This case study leads to some practical conclusions and recommendations for the agency under study. These include:

* The MEA is an open and flexible organization with a willingness to incorporate change — as evidenced by its history of responsiveness to the recommendations of consultants as well as the response to our own suggestions in the course of our ongoing dialogue with the agency during this research.

* Despite an impressive list of consultancies, and frequent references to the *people dimension* of management, this has not been implemented as effectively as it could be. It has not been a high priority because of the temporary "project nature" of management. But the agency has simultaneously gone ahead with implementing "integrated management," certainly an advance over the preceding system. At the present time, when the agency is going through a reorganization phase with amalgamation of projects, blocks, units, and a transfer of personnel, it is opportune to evaluate what it has achieved and assess what needs to be done. As it stands, the *management* of the project, as distinct from the physical operation of the system, is in a perennial transition phase and this has an impact on whether or not the project can evolve to a further stage of economic and social development.

* At the system level, this transitory nature of management has concentrated simply on construction, development, and settlement as measures of performance, and much of this monitoring is left to the individual discretion of project staff. The question asked in this type of monitoring is what is the return on investment, and not whether it is the optimum return, or whether it is sustainable.

In our examination of microsystem management controls we find a strongly developed set of control tools for financial and production control, and a more than adequate presence of control through rules, orders and procedures, control by reports, and the sporadic presence of "control by exception" — written inquiries seeking justification after the fact.

However, appraisal of performance of managers against predetermined standards, the identification of their areas of strengths and weaknesses, and the use of strengths to tap employee potential are conspicuously absent. Officer and farmer training is an area in which the agency has focused some attention. However, we believe that training alone, irrespective of its adequacy or appropriateness, is not a solution to these problems, and will not motivate personnel to give their best performance.

Adequate and timely feedback of information and swift corrective action are also absent, as are preventive and warning controls. For instance, warning controls would

have alerted the management that the existing arrangement for allocation of water from the Kalawewa Reservoir was unsatisfactory before MEA/Colombo, too late to have an impact, exercised control by exception. In the absence of key preventive and warning controls, other controls do not perform at optimum levels.

* As a multipurpose project with *macro-* and *microsystem* goals, and a microsystem dependent on diversion of water from another river basin, management at the interface between the macrosystem boundary of MEA and the microlevel at System H is essential, to exercise strategy in planning and system in implementation. However, microsystem planning seems to be ad hoc in character. Systematic communication of changes to the system operators is required, so that they can take these into account in their decision making *before*, and not after the fact. A telephone and computer link with the Colombo-based Water Management Secretariat (WMS) computer seems an easy and obvious suggestion.

* Within the boundaries of the project, effective communication of decisions will, by assuring a predictable supply of water, strengthen the hand of the agency in coming to terms with the political environment, and will enhance the agency's credibility in the eyes of the farmers. Together with performance-monitoring controls, this will also strengthen the role of the resident project manager as project monitor not only for water but for the integrated monitoring of all key areas. In the case of System H, the mode of operation best suited for the project level is the administrative mode, that is, *management in a bureaucratic style.*

* The picture shifts radically at the hydrological boundaries of the Kalawewa Left Bank Main Canal (LB/MC). Here, water is the single focus and the main system functions for allocation and distribution. However, it is evident that as a management exercise the agency views the system only as the former and not the latter, leading to serious distribution problems. The impact of the lack of a coordinating mechanism at this level, similar to the System H WMCP with the project engineer at the helm, and the absence of performance-monitoring controls, was apparent. We recommend establishing a coordinating mechanism and effective performance-monitoring procedures.

* The absence of performance monitoring and control at the LB/MC, which was also evident at the reservoir and branch canal, in turn has an impact on the administrative block. Given that the financial budget, the water budget (weekly releases), the targets of the cultivation program, and progress monitoring are all focused on the block, this is the core of the main system. It is here that the Mahaweli block manager has a challenging opportunity to mediate between the administrative bureaucracy and an entrepreneurial style of management by systematically manipulating management controls and translating them within the context of the Mahaweli goal-oriented work culture to guide his unit managers. Instead, we find an absence of performance monitoring and control, dominance of administrative routine, and lack of independent authority of the block manager.

Furthermore, because it is a distribution system, conflict resolution is a key managerial task. It was originally envisaged that participative management with the farmers would logically begin here. The block manager while managing the unit managers, must, through them, manage the interface between the agency and farmers through participative management, trying out innovations and taking occasional risks. The goal should be divestiture at the turnout and the distributary, as originally envisioned by the planners, because the agency has been unable to deal with conflict resolution among water users at these levels. This could perhaps be done through a management by objective (MBO) approach.

Participative management training, and not simply training in agriculture extension or water management, is indicated here. Further, in this age of microcomputers, it is not too far-fetched to suggest that MEA install a computer in the office of the block manager and train him in its use. Then he may construct trade-off curves among selected performance measures, by examining the set of possible optimal solutions for any objective function. With this information he may select the preferred schedule making the best trade-off between cost and optimum solution.

* Given the managerial arena of the block and the objectives for settler development, it is the unit manager who must translate the goals set at the block level into action. A unit manager is ideally a miniversion of the block manager. In practice we find that the problems which ail the block also affect the unit, only more so. This is because the unit is the lowest level of management and yet the point of maximum impact on field operations. As in the block, though the physical system is primarily a distribution system for water, water management cannot stand alone. To make sense it must be functionally integrated with agricultural inputs, credit, and marketing. It is the task of the unit manager not to be a bureaucrat or extension agent, but to be a *manager* at this point of the interface. In the MASL/MEA management structure, a form of management by results (MBR) would be most appropriate.

We recommend that the agency recognize and define what the unit-level officials are best able to do, given the incentives and the pressure from above and below, and evaluate their performance by results. The unit manager's credibility hinges upon the success of managers at other points in the main system, but because he must himself face the farmers, it impinges on him directly. The absence of performance monitoring and controls is most acutely felt here, as is the lack of managerial skills and training. Additional water is issued by the irrigation laborer and the unit managers to reduce complaints, and to compensate for failures above them. This is written off by management as operational or managerial losses.

It is often said that crop production in an irrigation system depends on water as the crucial independent variable. In System H during a drought year, the total amount of water made available was more than adequate. Some problems arose

because water was not delivered in a reliable and timely manner. Our conclusion, then, is that *management*, broadly defined, and not water *per se* is the key independent variable determining the productivity of irrigated agriculture. Agencies responsible for managing public irrigation systems therefore have a unique opportunity to contribute to achieving the twin goals of increasing agricultural productivity and raising farmers' incomes by improving the performance of their own management systems.

ACKNOWLEDGEMENTS

First, we must express our appreciation to the management of the Mahaweli Economic Agency (MEA) of the Mahaweli Authority of Sri Lanka (MASL) both in Colombo and in the field for opening their doors in more than one sense with that typical Sri Lankan graciousness and hospitality, to make this study possible. Particular mention must be made of the accessibility of and assistance given by Jayantha Jayewardene, General Manager, MEA, as well as T.H. Karunatilleke, Managing Director, MEA, at the time this research was done. Both took the time to review an earlier draft and provide comments and suggestions as well as discuss possible follow-up actions in which the International Irrigation Management Institute (IIMI) could assist MEA. We are particularly grateful to Mr. Jayewardene, now General Manager and Managing Director of MEA, for consenting to write the foreword to this study. In System H, those who came to our assistance at all levels are far too numerous to mention. However, we wish to acknowledge the help of Piyasena Jayawickrema, Resident Project Manager (RPM), Galnewa; S. Yatawara, Irrigation Engineer (IE), Flow-Monitoring Unit, Galnewa; and M.W. Silva, Block Manager, Kalankuttiya.

Then, there are individuals who were at one time the "movers and shakers" of the Mahaweli organization but have since gone into other walks of life, who unhesitatingly gave us their time and expertise to help us gain insight into the management philosophy of the Mahaweli. In this context N.G.P. Panditharatna, former Director General, MASL; M.J.W. Wickremaratna, formerly Executive Director, Mahaweli Development Board (MDB)/MEA; and Walter Abeygunewardena, former General Manager, MDB are gratefully acknowledged for their help.

Here at IIMI, the sage counsel of P.S. Rao, Systems Scientist, gave direction and tighter focus as well as style and strategy to the original and later drafts of this work; Chris Panabokke, Agronomist, who was himself part of the advance guard that nurtured the Mahaweli Project in its early phase, helped us get in touch with individuals and sources of information in addition to giving us the benefit of his advice. Senen Miranda, Agricultural/Civil Engineer and Coordinator, Professional Development Program, who helped us interpret the flow data and also provided very useful advice as a reviewer of the final draft. Hilmy Sally, Civil/Water Resources Engineer, joined us in probing the multidimensional Seasonal Operating Plan (SOP) and often proved to be a source of inspiration as well as support in bouncing off ideas. Hilmy Sally and David Groenfeldt,

Economic Anthropologist and Coordinator, FMIS (farmer-managed irrigation systems) Network, assisted us in checking the final draft, for which we are grateful.

In System H, L.R. Perera, Research Assistant, IIMI, helped us gather field data, particularly at the block and unit levels, and S. Pathmarajah, Research Assistant, IIMI, assisted in calculating the flow rates based on the staff gauge readings we had collected from the agency and the rating curves available at IIMI for Kalankuttiya.

We wish to acknowledge the very useful comments and suggestions of other reviewers who were kind enough to spend time and effort to help us improve this monograph. These reviewers include David Seckler, M. Moore, Anthony Bottrall, and particularly Norman Uphoff, who provided very thoughtful and detailed suggestions.

We greatly appreciate all the comments, criticisms, and assistance received. Nevertheless, it must be noted that the authors of this work take sole responsibility for the data, interpretations, and analysis presented here, including omissions and errors.

This report has two audiences, the professional irrigation managers, in particular, but not only those in Sri Lanka, and the broader professional and academic community working on irrigation management problems. We hope that this report, supplemented by various personal contacts and other follow-up activities, will prove useful to Sri Lankan irrigation managers. However, we have included far more detail than they may require. This is because there are very few detailed studies of how irrigation agencies work. Thus, as a detailed case study, we hope this report will be a contribution to the general topic of irrigation management agencies, and will stimulate further work in this area.

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CHAPTER I

INTRODUCTION

MANAGEMENT CONCEPTS

Scenario 1: 20 March 1987

> "Inflows to the major reservoirs in System H . . . during 1986/87 *maha* were the worst on record for the last 36 years . . . efficient water management in System H saved the crop. . . . in November (1986) more water was used than that allocated in the Seasonal Operating Plan (SOP). [but] . . . at the end of the (cultivation) season the total water usage in System H was below the quantity allocated in SOP."[1]

Scenario 2: 28 September 1987

> "The Block Manager, Kalankuttiya, in System H, is asked to explain why the crop-cut survey done by the Department of Census and Statistics showed that Kalankuttiya had a yield of 92.6 (low, compared to the rest of System H, the highest yield being 115 bushels) bushels per acre for maha 1986/87 which is the lowest in the system as well as in a few systems outside the Mahaweli, and the steps he proposes to take in order to avoid this situation in the future."[2]

Presented above are two contrasting scenarios from a single cultivation season, maha 1986/1987, from the perspective of high-level management at the Mahaweli Economic Agency (MEA) of Mahaweli Authority of Sri Lanka (MASL). What went right at the system level and what went less than right at the subsystem level? In this paper we

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[1]From a letter of congratulations sent by the General Manager, MEA, to the members of the System H WMCP.

[2]Letter sent by the General Manager, MEA, to the Project Manager, Galnewa.

address this issue by analyzing the *operational plan* of the agency at the macro-, micro-, and subsystem levels as it responded to the crisis created by the drought in the North Central Province of Sri Lanka. This crisis condition prevailed over two cultivation seasons — maha 1986/1987 and *yala* 1987.[3] We examine the overall operational plan of the management throughout this period with particular emphasis on maha 1986/1987, and analyze two crisis irrigation water rotations during this season.

This is a case study of an exercise in crisis management where control defaulted upward (Levine 1987), to permit maximum equity in an irrigation system. This system is dependent primarily on diversions of water from a separate river basin and in most cultivation seasons begins with a two-thirds full tank. The physical system is designed for flexibility. The study examines whether there is a direct relationship between the adequacy, timeliness, and volume of water available, and the choice between two modes of operation, administrative-bureaucratic, and entrepreneurial management. "Administration" as used here emphasizes a routine operation of the system, governed primarily by normative rules, while "entrepreneurial management" implies a more vigorous manipulation to achieve specific objectives.

Taking a systems approach to the study of a large-scale, multipurpose irrigation system, the key focus of observation is the management system, which has two components: 1) a formal organization, that is, a *structure* with systems and procedures allocating authority to individual functionaries for the realization of objectives; and 2) a *process* which emerges out of this structure and results in an adaptive, self-regulating system of behavior. This managerial process is the product of the physical system, and an environment, within which that system is embedded. The environment includes the goals of the national government, the desires of politicians, the long-term plans of donor agencies, and the demands of the electorate. Whether the physical system and the environment are constraints or opportunities depends on the capacity of the management system, particularly at the interface between the agency and the political environment.

The strength of the management system at this interface rests ultimately on the capacity and strength of the professional manager himself. This in turn depends on the *management control system* which results in the smooth functioning of management for the optimum realization of its objectives. The management control system integrates five components: 1) a workplan and resources, 2) standards of performance, 3) a system of monitoring actual performance, 4) comparison of actual performance against planned targets, and 5) corrective action. The operational plan of a management system hinges upon all five elements for the optimum realization of objectives.

[3] *Maha* is the "wet" season roughly October-March, while *yala* is the "dry" season, roughly May-September.

In the remainder of this chapter, we discuss the concept of management control, the Mahaweli Project organizational structure, and the research methods used in this study. Chapters two and three provide a detailed discussion of the planning process, and what we observed as actually happening during the 1986/1987 maha season, focusing on the responses of various levels of the agency to a serious water crisis. Chapter four analyzes the problems and potentials for improvement within the "matrix management" structure presently used by the agency.

Two themes emerge: 1) an analysis of how a large bureaucratic system attempted to manage scarce water under crisis conditions — this is not a study of "routine" management; and 2) how "success" at one level of management was not necessarily replicated at other levels, and why. Chapter five reviews the main findings of the study and presents our conclusions and some action recommendations based on these conclusions.

Several reviewers have noted the extensive use of management science and organizational theory in the study. We believe the use of the insights and concepts derived from these disciplines to analyze the internal workings of an irrigation agency is one of the contributions this study makes to the field of irrigation management. We have tried to provide explanations of these concepts in the text, and brief definitions of management terms and local terminology in the glossary to assist readers unfamiliar with them.

The Management Control System

We use the term "management control system" in a specialized way, based on the management literature. "Controls" and "control" are not synonymous. As Drucker (1977:400) explains, "the synonyms for controls are measurement and information and the synonym for control is direction." The "controls" function in management measures the progress of the enterprise toward objectives in accordance with the established plan. "Controls" pertains to means, and "control" to an end. Therefore there is an element of control in management controls. However, too much control, by a single individual for instance, will result in the enterprise going out of control. The control function is not synonymous with supervision or discipline functions. Supervision is intended to minimize deviation while controls measure the deviation from the standards of performance and take corrective action.

The success of management depends on the strategic use of management controls. These fall into the following categories:

* *Preventive controls.* These are based on the premise that it is better to prevent a fire than to acquire skills to put it out. They basically ensure a performance standard, not a list of duties, set in advance for every employee so that he knows what results are expected and what constitutes a good job. For every job there

must be some observable factors specified for measurement and the levels of quantity, quality, time, and cost that will indicate a satisfactory performance.

* *Warning controls.* These alert management if things are off-schedule. This is achieved when a plan is broken down into parts and check points are established at various points according to a time frame.

* *Control by reports.* Reports constitute the backbone of control and a manager must depend on them for feedback of information. To be effective, reports should be timely and provide enough information, and the feedback mechanism, as the term denotes, should work upward and downward in the system.

* *Control by rules, orders, and procedures.* This type of control specifies activities permitted and prohibited as well as the sequence of activities to be followed under certain conditions.

* *Control by exception.* This is a strategy which seeks to control only temporary deviations rather than all key areas. If the manager concentrates on a few key areas, his subordinates will do the same, and if the former concentrates on trivial areas and ignores key areas, his subordinates will do likewise. Used alone, this concentrates on the exception, but for the best results it must be used in conjunction with periodic and systematic controls.

* *Production control.* This involves the planning of production targets and then following them through to completion by assisting management in their execution. It aims at producing the right product in the proper quantity and quality, at the right time, and by the best and most cost-effective methods.

* *Performance control.* Drucker (1977:411) suggests that "people decisions are the ultimate control of an organization." As Drucker says, controls are needed for measurable and nonmeasurable events and a balance between the two is a central and constant problem in management. The danger in quantifying the measurable areas is the temptation to put all emphasis on it and what looks like better control may in fact result in less control. The quality of the people functioning in the organization is the key to the success of a plan. Thus, any appraisal of performance should determine standards of performance, compare actual performance against these predetermined standards, identify areas of strength and weakness, and use the employees' strengths to tap their potential.

Appraisal methods may be individual-centered, job-centered, objective-centered, or result-centered. Graphic rating scales, ranking, paired comparison, forced choice, weighted checklist, critical incident, field review, management by objective (MBO), and now management by result (MBR) are some of the commonly used methods of appraisals. There is no one best method for appraising performance. This will vary with the organization and the level of staff the success of performance appraisal

will depend on the manager's perceptiveness and ability to translate it into meaningful indices by a combination of the quantitative with the qualitative. Ultimately, performance control, like other types of control, "is making sure that what is done is what is intended" (Koontz and O'Donnell 1968:639).

The participatory approach current in the western management literature implies that performance control must not be exercised by just one superior, but at all levels of management, with *self-control* as the ultimate objective to motivate the worker for better performance. To achieve self-control, two other criteria are of paramount importance: feedback and corrective action. Feedback implies a loop and not simply feeding upward. Downward communication may be difficult but is necessary (Drucker 1977). For the worker, feedback information is the tool for measuring and directing himself and such information must be timely, relevant, and operational; it must focus on the *job* and not on the worker.

Corrective action implies two phases (Putti 1987:154-155). The first includes prompt investigation of the cause of deviation, deciding on the required corrective action, prompt correction of the situation in accordance with the decision, and close supervision of the corrective action to ensure that it is conducted in accordance with instructions and is effective. The second phase includes further investigation of recurring difficulties to determine the basic human or physical facts that are responsible, positive or negative disciplinary action required, creative planning to prevent a similar situation, and the introduction of the planned measures. In the final analysis, the control process is incomplete without follow-through, where the manager establishes specific procedures and assigns clear responsibility to carry out the corrective action.

THE MAHAWELI *GANGA* IRRIGATION AND POWER PROJECT: THE ORGANIZATION

The Mahaweli Ganga Development Scheme

The Mahaweli Authority of Sri Lanka Act of 1979 established the MASL as "the authority responsible for the implementation of the Mahaweli Ganga Development Scheme, to provide for the establishment of corporations to assist in such implementation, and to provide for matters connected therewith or incidental thereto" (MASL 1979:1). This Act replaced previous arrangements to facilitate the Accelerated Mahaweli Program (AMP), a 30-year program compressed into 6 years.

At the national level, in the political and policy domain, the project has its own ministry, the Ministry of Mahaweli Development. The Minister in charge is also the Minister of Lands and Land Development. The MASL Act empowers the Minister to exercise authority within it. In performing this function, he may co-opt the services of particular departments and corporations mentioned in the Act.

Heading the central administrative hierarchy is the Director General, MASL with the Secretary General, MASL below him (Figure 1). The Mahaweli Engineering and Construction Agency (MECA) and the MEA are under the latter with the Chairman and Deputy Chairman, MECA, and Managing Director and Additional Managing Director, MEA, as the next set of officials in the hierarchy. Below these two sets of officials are the Project Director, MECA, and General Manager, MEA. On par with them are the Director, Water Management Secretariat (WMS), and Director, Performance-Monitoring Unit (PMU), among others, each heading their own units under the Secretary General, MASL.

At the MEA (Figure 2), below the general manager are the project coordinators for the different systems of the Mahaweli and next to them in the organizational hierarchy are managers for finance, lands, community services, administration, and public relations, the senior agronomist, two chief irrigation engineers (CIEs), and the chief equipment engineer. These officials are all based at the head office in Colombo.

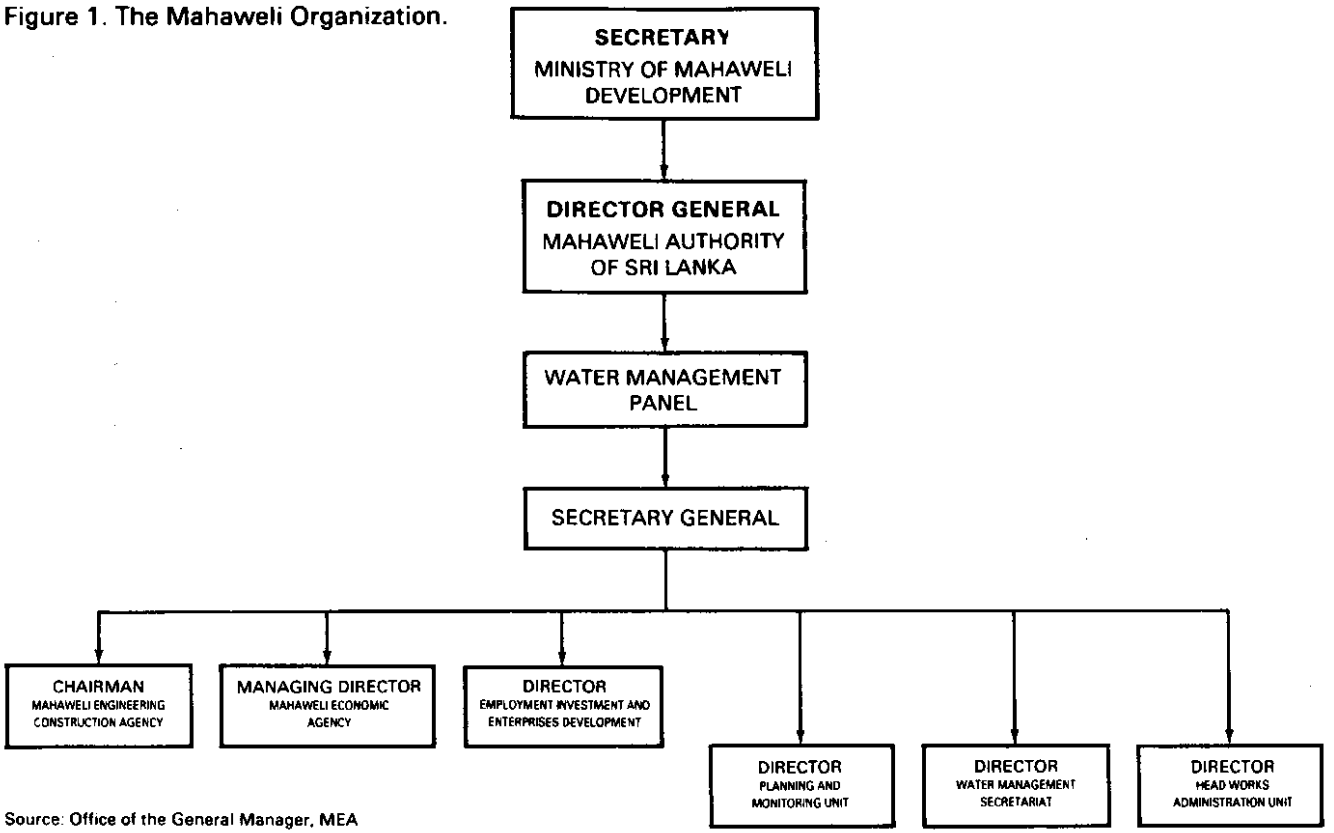
At the field level this complex, multifunctional, hierarchical, organizational setup is replicated. There is no overall system-level official at the field level. Systems are divided into projects, each under the supervision of a resident project manager (RPM). Projects generally cover an area of 8,000-12,100 hectares (ha) and each project area is inhabited by 8,000-10,000 people. The RPM is assisted by specialized deputy resident project managers (DRPMs) for administration, agriculture, water management, community services, lands, and marketing (Figure 3).

Each project is in turn divided into administrative blocks, covering about 2,000 ha and having 2,000-2,500 families, under the supervision of a block manager. He too is assisted by various specialized officers as shown in Figure 3. Each block is further subdivided into units, under unit managers. These cover 200-265 ha and have 200-250 families. The unit manager is assisted in his work by field assistants (FA). The unit manager is supposed to act as the interface, or buffer, between the bureaucracy and the farmer. The roles of the RPM, block manager, unit manager, and the officials specializing in irrigation are analyzed in later sections of this study.

There are three types of settler families who have been allocated land in the H area under the AMP — resettlers, new settlers, and evacuees. These include displaced persons from upstream development areas, those displaced as a result of downstream work in the major reservoirs, and landless cultivators and agricultural laborers. Each settler is given an irrigated allotment of one hectare (two and a half acres) and a highland allotment of 0.2 ha (half an acre) for the homestead.

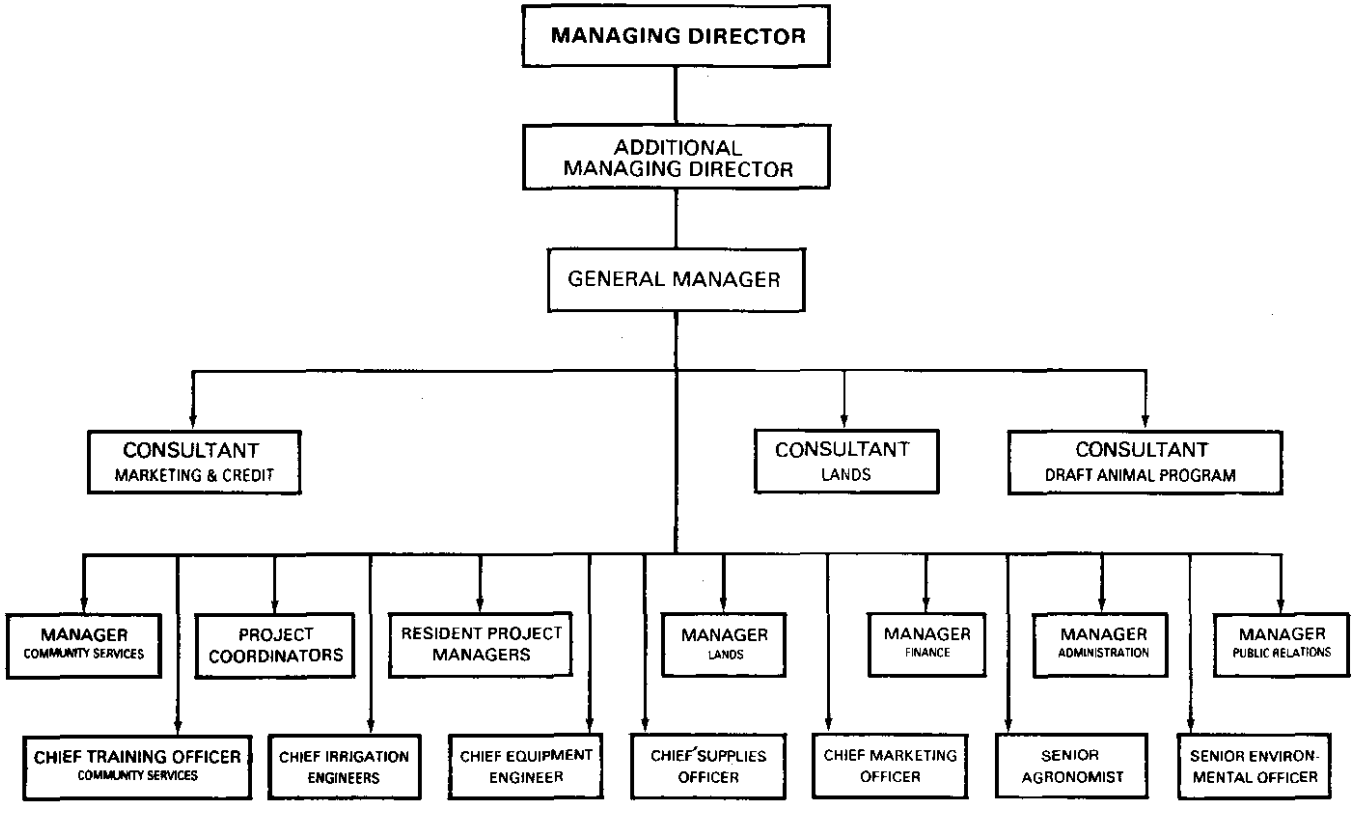
As a macroproject with a large-scale financial investment, the Mahaweli Ganga Development Program has its own styles and strategies of management, which are discussed below. Under this program, it was envisaged that nearly 100,000 ha of newly developed land would be irrigated in addition to supplementing supplies for about 75,000 ha already irrigated. Five new dams on the Mahaweli River or its tributaries

Figure 1. The Mahaweli Organization.



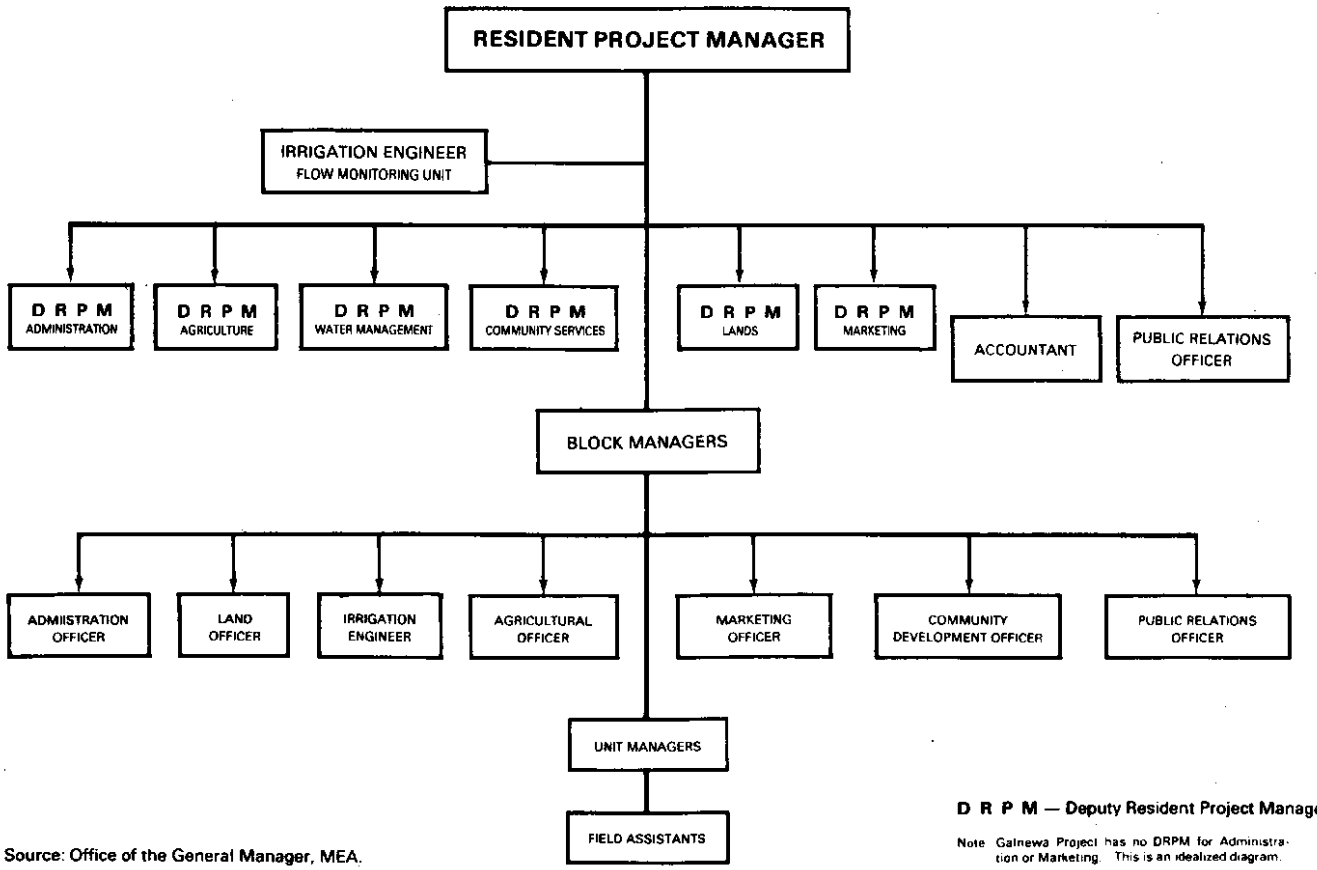
Source: Office of the General Manager, MEA

Figure 2. The Mahaweli Economic Agency.



Source: Office of the General Manager, MEA

Figure 3. Project Level Organization - Mahaweli Economic Agency.



Source: Office of the General Manager, MEA.

D R P M — Deputy Resident Project Manager

Note Gainewa Project has no DRPM for Administration or Marketing. This is an idealized diagram.

would generate 540 megawatts of hydropower (Jayewardene 1987). The objectives of the "Mahaweli Project" as listed by Jayewardene are: 1) the generation of hydropower to add to the national grid, 2) the provision of land for landless people, 3) increased rice production to attain self-sufficiency, and 4) reduced unemployment.

Under the umbrella authority of MASL, the construction of the head works came under the supervisory charge of the Central Engineering and Consultancy Bureau (CECB) as consultants to MASL. Lands developed for irrigated agriculture were zoned as systems, each identified by an arbitrary letter of the alphabet, hence, Systems A, B, C, D, E, G, and H (Figure 4). Work began in 1974 on System H, the oldest system. It lies within the Kala Oya Basin, in the dry zone North Central Province, about 16 kilometers (km) southwest of Anuradhapura. It includes 14,200 ha of "old irrigated areas" (MEA 1985) and 28,750 ha of new land developed as a result of the diversion. About 12,425 ha were developed by the Government of Sri Lanka with its own funds and the balance with foreign aid.

As part of the first stage of the project, a diversion dam on the Mahaweli River, a tunnel at Polgolla (Figure 4), a hydropower station, a reservoir, and a tunnel at Bowatenna to divert the water to the Kala Oya Basin were constructed. This water is diverted into three main storage tanks serving the H area—Kandalama, Dambulu Oya, and Kalawewa. The limited capacity of its reservoirs in comparison to the large extent of irrigable land makes cultivation in System H vulnerable to any alterations in the pattern of diversions of the Mahaweli waters first at Polgolla, and then at Bowatenna. The limited capacity of the Bowatenna Reservoir and mechanical problems at the Bowatenna Tunnel make diversions unreliable at times. This is compounded by the limited catchment area of Kalawewa Reservoir.

Kalawewa Reservoir

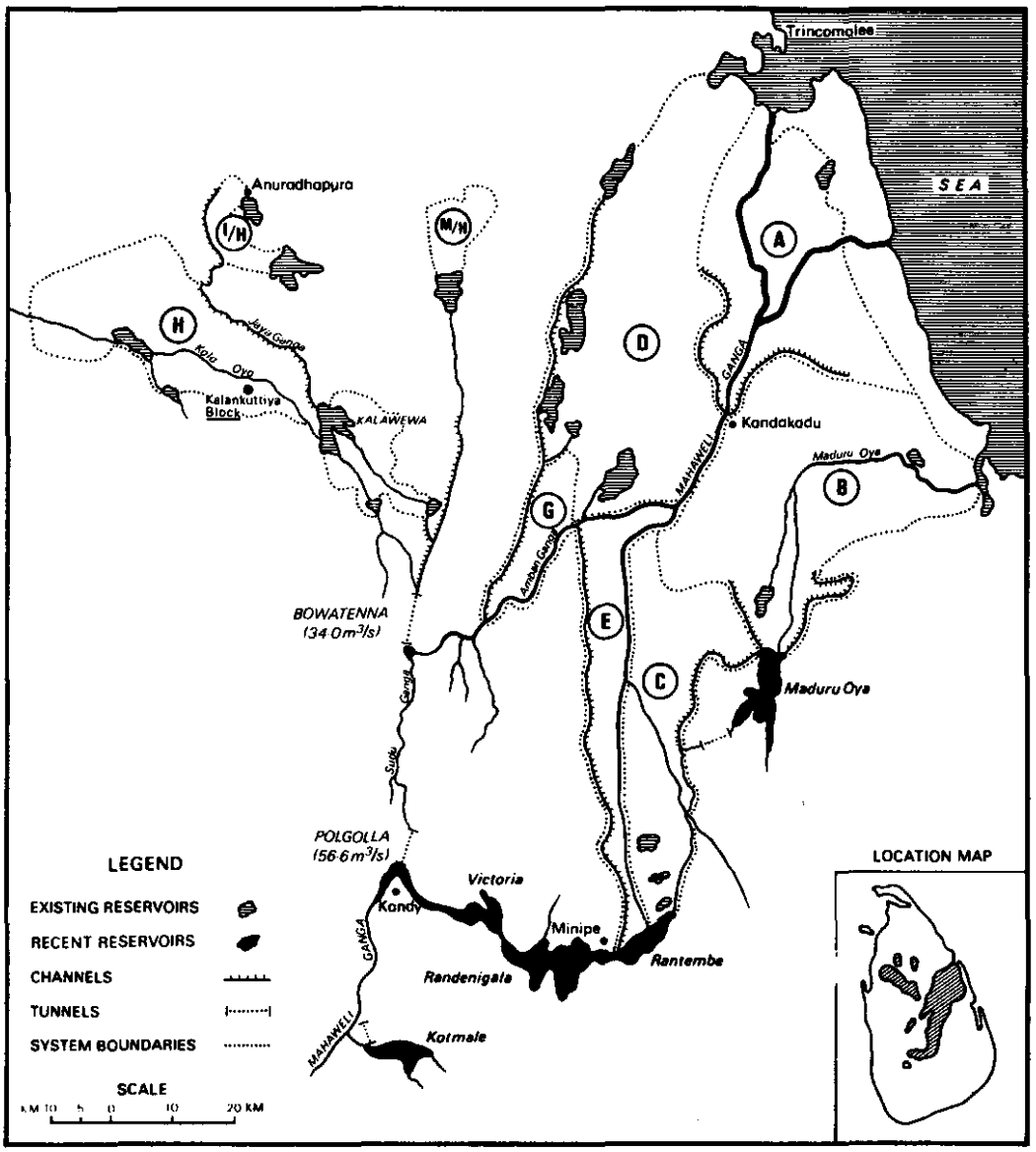
The catchment area of the Kalawewa Reservoir is 57,024 ha (MEA 1985: annex iii) and the active storage is 117 million cubic meters (MCM). The command area is 38,462 ha, divided between the left bank (LB) (12,146 ha) and right bank (RB) (26,316 ha) (MEA 1985).

At the time of this study, System H was divided into three projects, each under the overall supervision of a RPM. Two projects, Tambuttegama and Nochchiyagama, were on the Kalawewa RB. The third project, Galnewa, included five administrative blocks, three on the Kalawewa LB, Galnewa, Meegalewa, and Kalankuttiya. The other two blocks were under the Kandalama RB and Dambulu Oya RB (Figure 5).

Kalankuttiya Administrative Block

Kalankuttiya refers to the branch canal and the administrative block (Figure 6). Kalankuttiya Block officially has a population of 11,050, with 2,125 one-hectare paddy allotments. But the description of the system below this level is not as simple.

Figure 4. Location Map of Mahaweli Systems.



Kalankuttiya administrative block includes within it 5 "irrigation blocks" which crosscut 8 administrative units (under unit managers), and includes 20 distributary channels. The boundaries of the irrigation blocks are the drainage lines. To a great extent they overlap with the territorial boundaries of the units. Then there is the unit of settlement — the 22 hamlets. The office of the unit manager is located in a place as convenient as possible to all the settlers in the hamlets.

RESEARCH STRATEGY: FOCUS, METHODS, AND BOUNDARIES

Managers, irrespective of the type of organization they serve, must make decisions. The quality of these decisions depends on the manager's ability to access, monitor, and analyze information in a timely manner. This in turn determines the success and eventual survival of the organization. In modern organizations, decision making is a systematic and scientific rather than a disjointed activity. This implies the building and operation of a decision-making system based on observation, data analysis, synthesis, and models and their application. Managers must recognize the form and not simply the day-to-day content of their decision problems. In order to achieve this, the tools and techniques of modern management become relevant.

Research Focus

The focus of the field study was one administrative block in System H, Kalankuttiya Block, consisting of 2,125 ha irrigated by the left bank main canal (LB/MC) from Kalawewa Reservoir, and divided into 8 administrative units. Less intensive research was conducted at the next level, the project, including the coordination and monitoring of major operational tasks including agriculture, irrigation, community development, and land-related activities. However, particular emphasis was placed on water management.

At the next highest level, the system, the weekly proceedings of the System H Water Management Coordinating Panel (WMCP) were monitored for one project, Galnewa. Galnewa receives water from the LB/MC of the Kalawewa Reservoir, and includes three administrative blocks — Galnewa, Meegalewa, and Kalankuttiya. Particular emphasis was placed on the impact of the WMCP's decision making at the system level for water management in Kalankuttiya.

Research Methods

The field observations, interviews, and archival research were conducted by participant observation and nondirective interviewing. Field observations were completed for two cultivation seasons — maha 1986/1987 and yala 1987. Attention

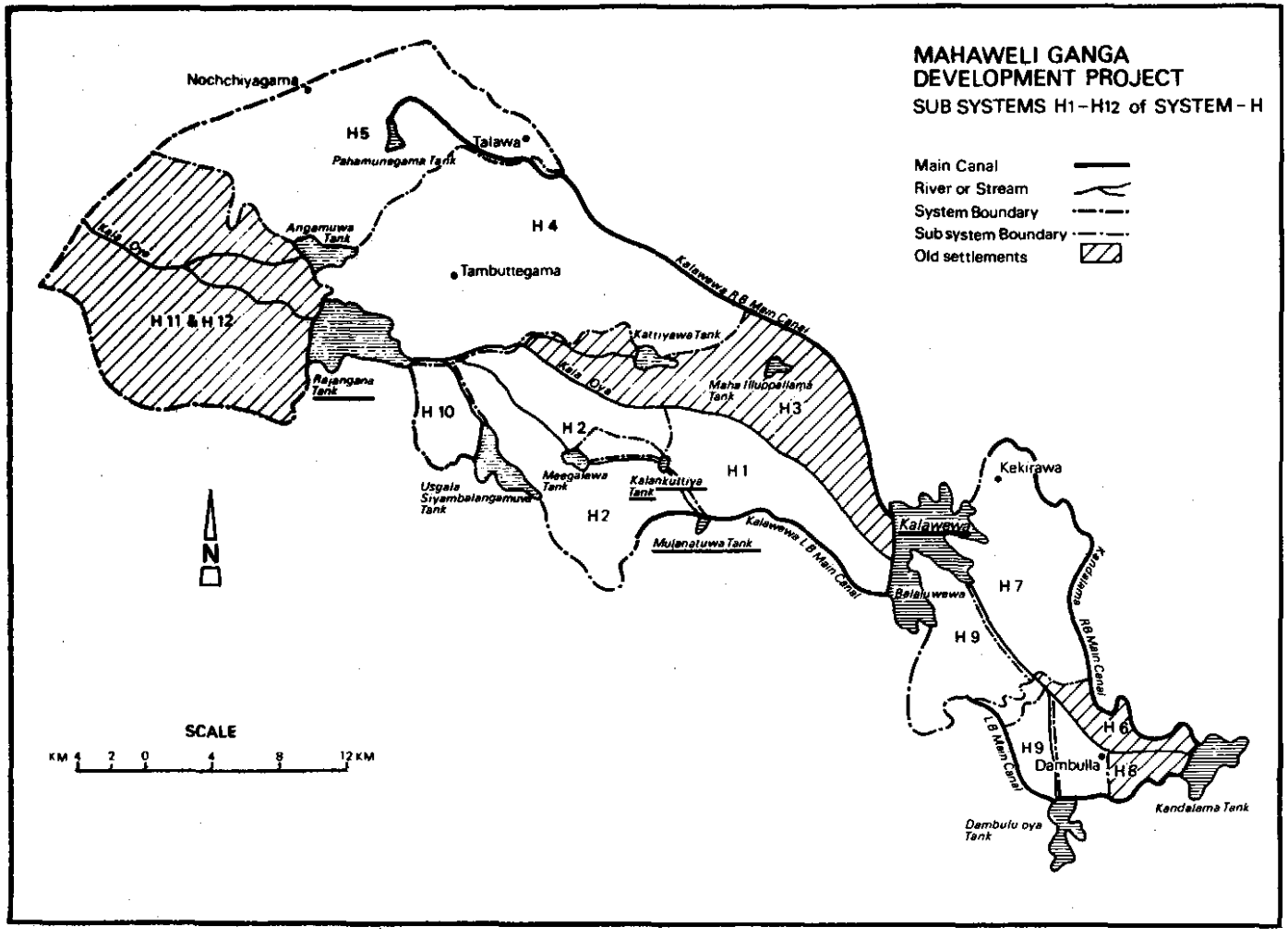
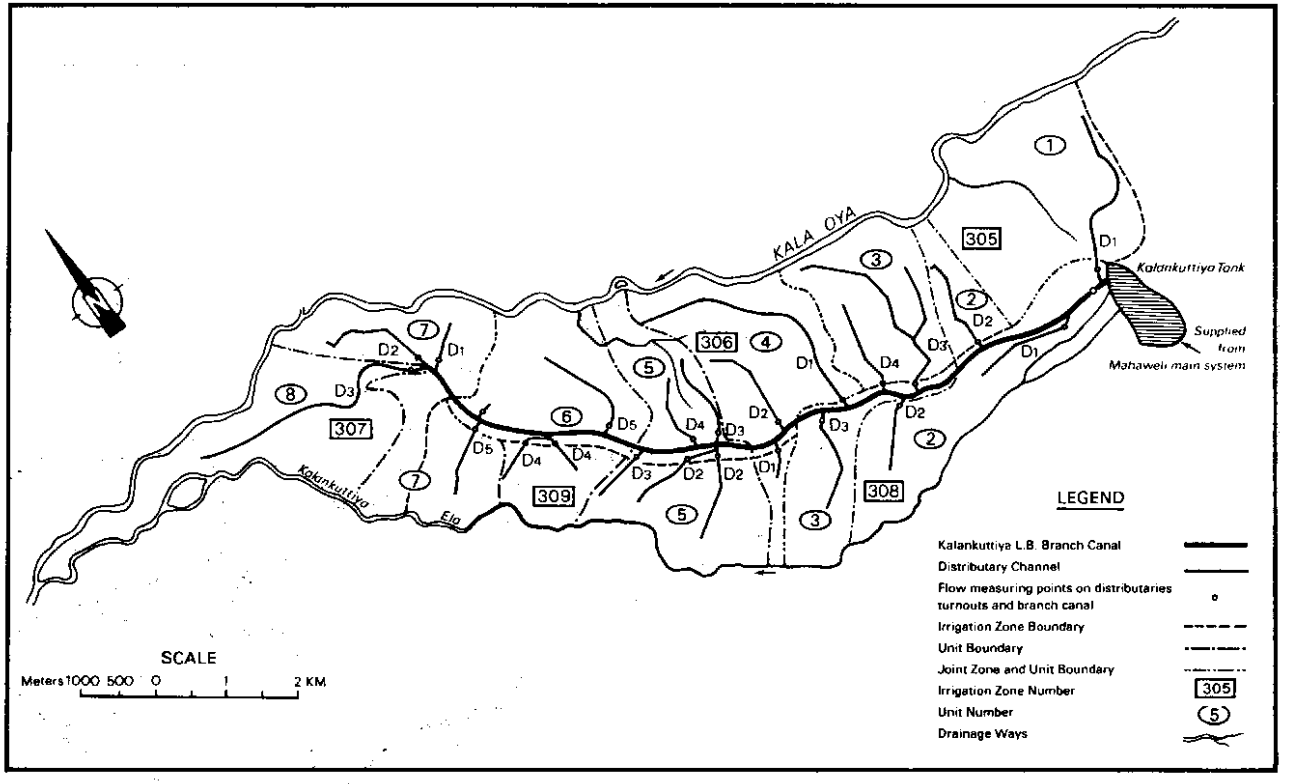


Figure 5. Mahaweli Ganga Development Project: Subsystems H1-H12 of System H.

Figure 6. Kalankuttiya Block of Mahaweli System H.



focused initially on formal meetings for managing irrigation and cultivation. It is here that documented and binding decisions are made. Meetings range from the preplanning of the cultivation season — the pre-*kanna* meeting, the cultivation or kanna meeting which formally and legally begins "the season," and meetings monitoring progress throughout the season.

The nature and scope of these meetings as well as their composition are broad ranging. The pre-kanna meeting is conducted by MEA at the unit level with the unit manager and his FA for agriculture and the farmers, together with the agriculture officer (AO) and sometimes the irrigation engineer (IE) from the block office. For the kanna meeting at the block level, Kalankuttiya is divided in half and has two meetings for the head and tail ends. Key officers at the project, block, and unit levels meet the farmers and propose dates for the commencement and conclusion of the season. In addition, dates for water issues, crops to be cultivated, fines for violators of deadlines for cleaning of irrigation channels, and deadlines for bank loans, crop insurance, etc., are finalized.

Under the Mahaweli Authority Act of Sri Lanka (1979), this meeting is convened by the RPM in his capacity as additional government agent (AGA) to conform with the national legal framework for cultivation under the Irrigation Ordinance 22 (1) and the Land Development Ordinance. For maha 1986/1987, there were 19 decisions made regarding the cultivation schedule and these were certified by the RPM. Copies of the minutes were circulated to 24 associated officials within and outside the boundaries of the project. The minutes of the kanna meeting constitute the calendar of key dates of the cultivation season.

Other formal meetings observed include the bi-annual program and progress evaluation meeting convened by the RPM to cover the entire project (a total of six blocks); the RPM's meeting to monitor the progress of the cultivation program in each block (typically scheduled on a monthly basis); the weekly "block meeting" chaired by the block manager and attended by his principal staff and the unit managers within the block; agriculture extension meetings in the field — typically between farmers in a selected turnout or distributary channel and the AO and FA; agency meetings (at the unit, block, or project levels) with members of farmer organizations; the weekly meetings of the WMCP; monthly staff meetings at MEA/Colombo for monitoring and coordinating intersystem planning and operations; and the beginning-of-season meeting of the Water Management Panel (WMP) in Colombo with the Director General, MASL, as chair. This inaugurates the seasonal operating plan (SOP) which sets the overall cultivation program for the irrigated areas served by the Mahaweli System (including areas outside the management of the MEA).

Data from meetings were supplemented with information from other sources. These included handouts, for example minutes of meetings and statistical information; agency files, such as policy decisions over time; correspondence between different levels of the agency; and in-house reports submitted by agency officials, such as reports on seasonal

water usage by block or on cultivation planning. Other documents were borrowed for copying.

Interviews were done to enhance our understanding of important issues. These ranged from the open-ended freewheeling type to those specifically issue-focused. The synchronic data were put into perspective through an excursion into management philosophy and its evolution over time by examining documents and articles written by key designers and implementors of the Mahaweli management style (Abeygunewardena n.d., Wickremaratne 1981, Jayewardene 1984, Panditharatna 1984, and Bandaragoda 1984, 1987) and by interviews with these individuals.

Research Boundaries

The issue of multiple boundaries is a persistent problem in irrigation management research. First, taking water management as the objective, there is the hydrological boundary. For our purpose, we have drawn it at the Kalawewa Reservoir. Decision making at the WMCP ultimately reflects actual and anticipated tank levels and operational factors associated with conveyance at such levels. However, because the objective is water management to meet the deadlines for implementing the cultivation calendar, there is also the legal boundary imposed by the kanna meeting decisions, which are legally binding.

This legal boundary must be taken in conjunction with two others—the financial boundaries of the annual calendar year budget for operation and maintenance (O&M), as well as the seasonal water budget as reflected in the SOP. The latter reflects choices between irrigation and hydropower, taking into account the land extent and the crop or crops to be irrigated. Finally, there is the project boundary which in this case is the Galnewa Project. It includes the LB/MC and the Kalawewa Yoda Ela Sluices as well as another tank, Kandalama. The Kalawewa RB/MC comes under two other projects.

In mediating between the conceptual borders of the physical and management systems, we have chosen the project boundary as our effective boundary. These boundaries are constraints within which the irrigation management agency must operate. From this perspective of system-level operations, the MEA/Colombo and other MASL organizations are part of the environment. Structural problems interfering with diversions, or the absence of anticipated rainfall upstream, are also part of the environment. Managers at all levels must contend with the constraints imposed on them by these boundaries, and depending upon their location in the organization (i.e., unit, block, or project), must mediate at the interface of these boundaries in order to deliver the goods (mainly water) to their clients, the farmers.

The ability of managers to achieve their objectives will depend largely on the strength and capacity of the *management control system*. Thus, the boundaries for emphasis in this case are the boundaries of the management control system, which must take into account the other boundaries in its operation, but which may not be reduced to or subsumed under them for the sake of management efficiency.

CHAPTER II

SYSTEM MANAGEMENT: THE PLANNERS AND THE SEASONAL OPERATING PLAN

In this chapter we describe the normal planning process for each cultivation season at the system level, with particular reference to System H. We then discuss the innovations introduced by MEA management to cope with the crisis created by a severe water shortage at the beginning of the maha 1986/1987 season.

PREPARATION OF THE SEASONAL OPERATING PLAN (SOP)

The Water Management Panel (WMP), located within MASL, makes operational policy decisions and sets overall cultivation programs for the irrigated area served under it. Its members include representatives of Mahaweli agencies, political representatives of the areas receiving water, and representatives of projects formally under the Department of Irrigation but receiving water from the Mahaweli Project. During a particular season the WMP is advised by the technically specialized Water Management Secretariat (WMS), also a unit of the MASL (Figure 1). The WMS provides information and recommendations to the WMP to assist it in reaching its decisions, and for coordinating the implementation of these decisions through the diversion and distribution of water, and the monitoring of the total program. The first set of functions is related to the two SOPs prepared each year. Reservoir operating rules, diversion policy (rules to govern the spatial distribution of water), and irrigation planning policy (priorities and assumptions for planning of dry-season cropping) are examined using computer simulation techniques. The second set of functions involves the collection and analysis of data on system performance, the modeling of system performance for alternative future hydrological and electrical system conditions, and the preparation of routine reports dealing with both subjects.

The project-level water management in System H is the responsibility of MEA. At its head office in Colombo, the Chief Irrigation Engineers (CIEs) and agronomists coordinate with the WMS in preparing the SOP before each season and in monitoring

water issues. Results obtained from the field are analyzed and presented to the WMS to enable it to prepare more realistic SOPs in the future. The SOP indicates the monthly issues for each sluice, monthly diversions to various systems, etc. It is not assumed that seasonal operations will exactly follow the SOP because actual inflows and rainfall may differ from the original assumptions. Monitoring of operations at the System H level is the responsibility of the Flow-Monitoring Unit (FMU) located at Galnewa (Figure 3). This is a description of the role of the agency in charge of system planning at the macrolevel as given in the literature (Wickremaratne 1986, World Bank 1985). However, the reality of the SOP is somewhat different.

Competing demands for water are made by two main interests, irrigation and power, especially during times of water shortage. To establish policies for allocating water resources between alternative uses, the MASL has developed a computerized macromodel. This macromodel uses historical stream flow data in the Mahaweli and Kelani River systems to evaluate alternative policy options so as to optimize the use of resources. Rainfall data for 32 years are used to simulate 32 scenarios for a water budget which must fully accommodate demand for electrical power.

The macromodel has several criteria for defining "failure" applied to irrigation needs. Irrigation failure occurs when, for a given year and for a given system (System H in this case), WMS cannot meet the target set by another agency in the Mahaweli family of agencies, as measured by the volume of water required for the area to be cultivated. There are two parameters, the percentage deficit in a given year, and the frequency of such deficits (reliability) over a long period of time. Thus, if 95 percent of the demand can be met, it is considered normal, but a 10 percent deficit is a "significant" irrigation failure. Next, the frequency of such failures over the 32-year period is modeled before a policy is adopted or rejected—this is a test for reliability. An 80 percent likelihood of meeting 95 percent of the demand, or a 90 percent chance of meeting 90 percent of the demand, satisfy the reliability criterion.

A micromodel developed for use in System H is for the simulation of irrigation scenarios only—for evaluating the response of the system, tank, canals, and irrigation areas—and is said to guide the officials in water distribution within the system.

This simulation modeling is used to formulate a draft SOP. With this in hand, the meeting of the WMP is held about one month before the cultivation season. Based on the information provided by the WMS, the WMP ratifies the SOP for the cultivation season. Due to the rainfall patterns in the catchment area it is possible that in the interim, the extent to be cultivated, the cropping pattern, or the first date of water issue, may be changed.

Once the cultivation season begins, other problems may interfere with water issues (e.g., mechanical problems with diversions from the Mahaweli River to System H). However, at this stage, attempts are made, as far as possible, to adhere to the targets of

the SOP. Here the seasonal, monthly, and daily values associated with system operation become important. The system operators have the flexibility to adjust the daily and monthly values as long as they remain within the seasonally targeted values.

THE SOP AND SYSTEM OPERATION

"SOP" in the context of operations at the field level is a misleading label. In field investigations as well as in discussions with key officials in the WMS the following three interpretations of the use of the SOP emerged.

1. At the WMS, it was clear that the two models upon which the SOP is based are intended to be a guide for selecting policy options for irrigation and hydropower in the sense that they define the boundaries within which, for example, a seasonal cultivation plan may be undertaken under what are termed as "average" and "dry weather" conditions. *For the WMS, the SOP has no bearing on day-to-day system operations.*

2. The system-level officials present a different scenario: to quote one,

   > the monthly or seasonal values don't mean a thing; . . . if sluice issues are for example 40 MCM under 80 percent dry conditions, it simply means that 80 percent of the time sluice issues should be more than 40 MCM. What is important is the operating policy adopted and the assumptions behind it. They (the WMS) will say, go ahead with a plan, then they must tell us what the assumptions are and they must abide by it every day or not at all. Then they must check to see if the season was a success or not by looking into the operations of the project. Simply checking the values given in the tables won't help. Having formulated an SOP, they then have the Friday meetings at the WMS where they make ad hoc changes while the season is progressing without any reference to the SOP. If some MP demands water they give in. **First there is a plan and then there is interference with the implementation of that plan** [emphasis added]. *For system-level officials, then, the SOP does provide system operating policies and assumptions.*

3. As evidenced from the quote at the beginning of this paper, SOP values are also used by the top management of MEA to monitor the success or failure of the management of the system. *Thus, the SOP is used as a performance-monitoring device for management.*

It is evident from the data that the SOP is intended to be nothing more than a guide for choosing among policy options. This still begs the question as to the basis for the other two perspectives expressed above. We believe that there is a general common-sense understanding of the SOP, as an operational plan intended for field-level implementation and monitoring. This belief is reinforced in documents (MEA 1985, World Bank 1985) and reflected in the thinking of the system operators. This is further strengthened by the top management's use of the SOP as a monitoring device.

However, an additional observation emerges from point number two above: why is the SOP associated with operational policies and assumptions? We believe that this association with the SOP comes not so much from the SOP itself but from the implications of the outcome of the weekly meetings of the WMS. From the perspective of the officially accepted cultivation schedule for the microsystem, the decisions made on a weekly basis are perceived as ad hoc and due to the political lobby for hydropower. At the same time, it is also evident from discussions with the management at MEA and WMS that some decisions taken at the weekly meetings are intended to correct assumptions made at the time of the formulation of the SOP but which have now been found wanting.[4] The basis for these decisions is often unclear to the field-level management.

Improved communication is therefore needed within MEA, between Colombo and the field, through systematic and timely modes of information exchange between the FMU at Galnewa and Colombo. An independent telephone for FMU and a computer linkage by telephone for FMU with WMS and MEA/Colombo would be very useful.

Further, there is some validity to the belief that there is an ad hoc attitude towards water for cultivation. System-level officials have often used the analogy of a man who is promised his regular meals but is starved for days, and then given an overabundance in one large meal to make up for it. Thus, at the meeting of the System H WMCP for the week of 16 July 1987, it was discussed that about 17 cubic meters per second (m^3/sec) (600 cusecs)[5] expected for Kalawewa Reservoir for the week had not arrived because of an additional 28.3 m^3/sec (1,000 cusecs) diverted to Randenigala for power, whereas 19 m^3/sec (670 cusecs) had been calculated as the quantity required to irrigate the land under cultivation in System H.

This particular week, the situation was further complicated by the fact that some small tanks on the RB had dried up and approximately 243 ha which had not been included previously as part of the extent to be irrigated also had to be supplied water. Further, because of the drought, water had to be supplied for domestic use as well. The fact that the anticipated 17 m^3/sec (600 cusecs) had not come complicated the situation. At the same time, the WMCP was concerned about the low reservoir levels and the need to stretch the water till the end of the cultivation season. They had to consider the possibility of cutting back water issues for the week by 10 percent through a policy of 7-day issues from the main sluice and a 10-day rotation in the field. These are the

[4]Such decisions are not always in favor of hydropower. For example, at the height of water shortage in yala, the WMS commissioned an in-house study of the Economics of Irrigation and Power Trade-Off at Polgolla which showed that under certain conditions irrigation should receive precedence.

[5]One cusec is one cubic foot per second, equivalent to 28.3 liters per second. Mahaweli officials normally discussed volumes of water in "cusecs," apparently meaning cusecs per day. The imprecise usage thus reflects informants' and officials' usage. Within the text we have converted cusecs to cubic meters per second, except when actually quoting informants.

operational difficulties at the system level which are perceived as being the result of "interference with the operation of the plan for the system."

These operational difficulties are not expressed in the SOP Seasonal Summary Report completed at the end of 1986/1987 maha. From the perspective of the timing of the cultivation program, there is little indication as to whether the estimated volume of water arrived on time, and if not, what were the implications at the field level. The creation of the WMCP has resulted in a system-level operational plan. But the implications of the absence of an operational plan to distribute this water within the system has negative implications which will be described in the following pages.

WORKPLAN AND RESOURCES

If the SOP provides the seasonal water budget at the system level, in a discussion of the workplan and resources, it must be viewed in the context of three other plans. These are the financial budget for construction and maintenance, the cultivation calendar embodying decisions made at the kanna meeting, and the "agricultural plan" for each block.

The budget is for the calendar year. Once it is approved, the unit managers develop workplans primarily capitalizing on the off-season for cultivation, avoiding the rainy season, to complete construction and maintenance works. The water budget as well as the kanna calendar of deadlines and the financial budget are monitored by the monthly modules submitted by the block to the PMU.

In maha, there is no true agricultural plan. The total extent of cultivable area under the command is cultivated with a single crop, rice, and water is issued for this purpose. Progress reports are submitted on a weekly basis by each unit manager and his assistants during land preparation on the extent of land being prepared, to coordinate and monitor water issues. Once land preparation is over, this progress monitoring is stopped. Again, at harvest time, to enable reducing water issues, the extent ready for harvesting is estimated by the unit managers.

There is no operational plan at the block level, nor are there management controls to monitor the performance of those who are simultaneously in charge of operations and supplying the information about operations. Because of this logical conflict of interest (the objects of monitoring themselves providing the data for monitoring), the RPM, as well as members of the System H WMCP, have often questioned the validity of the data from the field (e.g., on the extent cultivated, the crop cultivated in yala, and its synchronization with the amount of water used).

There is a set of targets, which are the first and last dates of water issue, the total volume of water to be issued in the interim, and a target for crop yields. These are used as performance indicators to monitor the system. But effective monitoring of field-level management and an operational plan at the field level are absent. While this study

examines only the scenario for water management, it must be noted that *management control* needs to be exercised in an integrated manner, including water management, agricultural inputs, credit, and marketing, *vis-à-vis* the agency staff at the block level. It is clear who is given what functions, and a list of duties is on file at the agency. What is missing is a clearly established and understood system of monitoring the performance of personnel—*a people-management dimension.*

Using system performance indicators as indices of personnel performance can be self-defeating. Thus, the block manager at Kalankuttiya was asked to explain why the officially recognized crop cuts for his block showed the lowest yields, and inform the MEA what steps he plans to take to ensure this will not happen in future. One response to this query that may occur to a block manager is to ensure his crop cuts are consistent with agency objectives in future, thus completely undermining the purpose of this type of monitoring. An ongoing system of performance monitoring during the season is needed to enable early detection of problems, in addition to monitoring overall system performance.

There are other decisions and deadlines agreed to at the kanna meeting. However, these fall within the realm of internal monitoring of management, and in the absence of established procedures such monitoring remains ad hoc. To complete the cycle of system performance successfully, monitoring the workplan must be integrated into an organizational nexus where the governing norms, the relevant systems and procedures for allocating responsibilities, and monitoring performance are spelled out for individuals. This must go beyond the job description, the duty list, and the O&M manual presently used.

WATER MANAGEMENT: ANTICIPATED AND UNANTICIPATED CONSTRAINTS

Wickremaratne (1986) lists three constraints on System H performance. These are: 1) limited capacity of reservoirs within System H compared to the large extent of irrigable land, resulting in System H depending mainly on Mahaweli diversions; 2) about 60 percent of the irrigable land in System H contains well-drained (reddish-brown earth — RBE) oils which need more water for the cultivation of lowland rice; and 3) the limited capacity of diversions to System H through the Bowatenna Tunnel.

In computing water requirements, the assumptions made in the design of the irrigation system at the planning stage are taken into account. These include the type of soils to be irrigated. The approximate percentages of soil distribution are as follows: well-drained RBE soils, 40 percent; poorly drained (low-humic gley — LHG) soils, 40 percent; and imperfectly drained RBE soils, 20 percent. The crops proposed in the design were lowland rice for imperfectly drained and poorly drained soils, and upland crops for well-drained soils during *both* seasons.

Water requirements are computed in the following manner: land preparation for lowland rice — 17.8 centimeters (cm) (7 inches); land preparation for upland crops— 3.8-5.0 cm; percolation and dike leakages for lowland rice —15.2 cm; deep percolation and run-off losses for upland crops — 50 percent of irrigation requirements for the season. Probable rainfall in the project area is considered to be 80 percent; effective rainfall is computed as 50 percent of the actual amount received (evapotranspiration is not mentioned in this computation) (Wickremaratne 1986).

The irrigation channel system is designed for a 1 cusec (28.3 liters per second) discharge at the turnout. A field channel irrigates 6-23 one-hectare allotments. The number of days that water is issued to the channel depends on the number of allotments under its command. Distributary channels feeding the field channels have the capacity to deliver one cusec to all field channels at the same time. The main and branch channels which feed the distributary channels have also been designed accordingly. Thus, operationally, water rotations are expected along field channels, while larger channels are on continuous flow. There are regulators along main and branch canals, and distributary channels to regulate water and deliver the full requirements to the distributary and field channels. Measuring devices are placed at the head of all the channels and also at intermediate points in some channels. There are small balancing reservoirs in the main and branch canals and minor reservoirs in the irrigable area which receive surface return flows from the upper reaches (Wickremaratne 1986).

In practice, at the level of the administrative block the irrigation engineer and block manager say that the percentage of LHG soils suitable for rice is actually more than 40 percent. Second, maha has become a season of 100 percent rice, without upland crops. Third, the catchment area of Kalawewa receives an annual rainfall of approximately 25.4 cm of which 70 percent usually comes in maha; fifty percent is effective rainfall (12.7 cm). Of this amount, to quote the deputy resident project manager for water management (DRPM [WM]):

> The amount that comes between say October and February (when the water requirement for the cultivation season is at its peak) is important, and this is only about 12 inches (30.5 cm) which is not much. The function of rainfall, if it comes, is to fill the tank in readiness for the start of the season and provide adequate moisture for land preparation.

MAHA 1986/1987 IN SYSTEM H

Given this background, other constraints emerged at the beginning of maha 1986/1987. One was a mechanical problem reducing the amount of water that could be diverted through Bowatenna to Kalawewa Reservoir. Thus, the DRPM (WM) for Galnewa, in his address to the farmers at the cultivation meeting held at Kalankuttiya

in September 1986, declared that due to this mechanical problem, Kalawewa would not receive water at the beginning of maha and this cultivation season would have to be based on the premise that the amount of water that could be expected from diversion at Bowatenna would be only about 34 m^3/sec (1,200 cusecs) per day. Because other tanks also receive water from this source, the amount expected to reach Kalawewa would be even less. In fact the actual amount of water received during the season averaged around 22.6 m^3/sec (800 cusecs), and the cultivation season was begun with just the water in the reservoir.

The DRPM further stated that as of August 1986, Kalawewa Reservoir had not received its monthly allocation of water because of the lack of rainfall in the catchment of the Polgolla Barrage. As a result, at the end of the yala season the water level in the reservoir had dropped to 6.2 MCM. The season began with 45.7 MCM in Kalawewa in October, of which 12.3 MCM is dead storage. The normal expectation is 74-80 MCM; occasionally the reservoir even spills at the start of maha.

Adjustment of the Plan

In response to this crisis, several adjustments were made at the project level at Galnewa and at the block level at Kalankuttiya. A rotation system was established on the Kalawewa LB/MC. MC issues were begun with Kalankuttiya Block, followed by Meegalewa and Galnewa. Distributary channels were rotated, with issues to the right of the Kalankuttiya branch canal followed by the left (head and tail end respectively). Water issues were to begin on 10 October, but the season was postponed to 20 October. Water was then issued simultaneously to both sections of Kalankuttiya.

In addition to the rotation of blocks at the LB/MC level (at any one time, 2 out of 3 blocks would receive water from the LB/MC), and the distributaries within Kalankuttiya, the standard application of 6.35 cm (2.5 inches) depth for rice every 7 days was lengthened to 8-10 days.

At the Kalankuttiya Block, the AO in announcing the cultivation plan at the kanna meeting, stated that past rainfall for September-October had been as follows: 7.62 cm in 1981, 1.78 cm in 1982, 2.54 cm in 1983, 10.16 cm in 1984, and 5.08 cm in 1985. Taking these figures into account, rice cultivation in maha would allow for 25 days of water issued for land preparation, with a total of 150 days for the long-term (4.0-4.5 month) varieties and a total of 120 days for the shorter (3.0-3.5 month) varieties. Harvesting before the anticipated rains at the end of March 1987, as well as the need to use this rain to fill the reservoir for the next season, sets the limits regarding the last possible dates for beginning and ending cultivation. As a result, in spite of the low tank levels, cultivation must begin by mid-October.

THE SYSTEM H WATER MANAGEMENT COORDINATING PANEL

Rationale

Despite considerable rainfall in the last 10 days of October 1986, the period from November 1986 to February 1987 experienced 90 percent dry conditions. In System H during the month of November, more water was used than the amount allocated in the SOP. The water level of the Kalawewa Reservoir dropped rapidly in mid-December. Though mechanical problems continued to interfere with diversions, the DRPM (WM) maintained that by the end of December 1986 the reservoir had received 113.5 MCM of the expected quota of 115 MCM from diversion.

The FMU at Galnewa and the top management at MEA were informed that while the tank level was dropping rapidly, all the water users at the system level were drawing water with no awareness of the needs of, or the quantities taken by, others. While the system-level allocation under the SOP could be compared with the amount of water released from the reservoir, there was no mechanism in place to allocate that water by project or monitor such allocations. Furthermore, some of the variables taken as given in the SOP, such as rainfall predictions, were no longer valid. A mechanism was required for the ongoing review of the SOP at the system level and for adjusting water deliveries according to the exigencies of the situation.

Operations

In response to the sharp drop in tank level, MEA/Colombo requested the Irrigation Engineer, Flow-Monitoring Unit, to coordinate and supervise the allocation of water from the Kalawewa Reservoir. According to him, this was not a task that could be handled by one person alone, so he recommended the formation of a committee. On 20 December 1986, the System H WMCP was formed. It met once a week, on Friday. The venue for the meeting was rotated among the three project locations and was decided upon at the end of the previous meeting, taking into account the ability of the participants to meet previous commitments and get to the venue on time.

The membership was as follows: 1) DRPM (WM), Galnewa Project, chairman (LB/MC is under his authority); 2) Irrigation Engineer, Flow-Monitoring Unit, Galnewa, secretary; 3) Project Engineer, Tambuttegama; 4) IE, RB/MC unit (water allocations to Tambuttegama and Nochchiyagama are under his authority); 5) IE, Yoda Ela, (who is responsible for diversions to Anuradhapura — H3); and 6) IE, Galkiriyagama (who controls the Dambulu Oya Reservoir).

The functions of the WMCP were: 1) to discuss and decide weekly sluice issues, taking into account the availability of water; 2) to insure, with assistance from others, that only the allocated quantity is taken from the reservoir and is distributed properly within the irrigable areas; 3) to increase efficiency by varying diversions within the system; 4) to submit data regarding reservoir levels, sluice issues, rainfall, and inflows

into the system on a daily basis through the secretary of the WMCP to the CIE, MEA, who upon presenting the situation to the WMS, would then obtain the required diversions into the system; and 5) through the secretary of the WMCP, to maintain close contact with the Bowatenna complex and bring to the notice of the CIE any problems regarding diversions.

The Irrigation Engineer, Flow-Monitoring Unit, who is the secretary to the committee, explained the role of the WMCP thus:

> The subject of discussion at these meetings was operations (for water management) for the upcoming week in the H area. The official in charge of the management of a particular section of the main system is responsible for presenting the relevant details regarding rainfall and stage of crop growth, and indicate how much water is required for his area. The Irrigation Engineer, Flow-Monitoring Unit is responsible for submitting information on rainfall in the Kalawewa catchment, water through diversion, and the balance in the tank at the end of the previous week. Based on this information a decision is made on how much to issue at the field level, with an eye towards stretching the water until the last issue for the season as decided upon at the kanna meeting. A decision is also made regarding the amount to be issued to each sluice for the next week. The distribution of this amount within the project is the function of the operating staff. So long as they do not exceed the weekly average, they can decide whether to distribute the given amount of water in two or five days, or to reduce issues if there is adequate rainfall. In addition, these meetings are also a forum for reviewing the previous week's operations from the perspective of how decisions were implemented with reference to the decisions made. Underlying these operations is the assumption that canal control of water issues alone is not enough, that the efficient distribution of water within the block is important, and that this can be achieved only with the cooperation of block-level officials such as the block IE and his engineering assistants (EAs) as well as the farmers.

CRISIS MANAGEMENT: SAVING THE SEASON

A cultivation season was carried through to a successful conclusion despite a failed monsoon which provided approximately 10.2 cm less rainfall than usual. This drought was worse than that of 1982/1983 when, it is said, the harvest was lost. From the uncertainty of water issues as a result of rapidly dropping tank levels and sluice issues in excess of the SOP early in the season, the end of the season saw the system shift to performing more efficiently than normal. The credit for this goes legitimately to the System H WMCP.

In maha 1986/1987, given the water-scarce conditions, the absence of a management structure to regulate the allocation of water from the tank to the sluice at the system level became apparent. With the SOP as its charter, and the backing of the top

management of the MEA as its source of authority, the newly formed WMCP had legitimacy and authority. This was further enhanced by the scarcity of water and the potential consequences of this for the farmer and the economy, which added a moral component to its authority. From being a Kalawewa-focused operation, it immediately became a systemic activity incorporating the Kandalama and Dambulu Oya tanks as well.

With conserving water as the objective, the long-term goal was to save the season, and in doing this, the objective of water management itself changed. The emphasis shifted from on-farm moisture levels to conserving water in the reservoir at the main system. Conserving water at this point implied two actions. First, to reduce the quantity of water issued, the committee decided to reduce water issues from 6.35-5.72 cm (2.5-2.25 inches); subsequently there was a progressive reduction in issues, initially by 20 percent and then by 40 percent. Second, water issues from Kalawewa Reservoir were systematically monitored.

In order to perform these functions and achieve its objective, the committee had to maintain communication between the system level and the levels above, the MEA head office and the general manager and through him the WMS. This was primarily through daily telephone calls and radio messages.[6]

Further, given the distance and the unpredictability of diversions, it was necessary to maintain daily communication with the chief engineer at the Bowatenna complex (e.g., through such communication, the Bowatenna Tunnel was cleared of debris impeding the passage of water). It also meant ensuring that there was adequate water in the Mahaweli River to be diverted at Polgolla to Bowatenna by seeking diversions from the Kotmale Reservoir upstream. Further, it even entailed, in a moment of "touch and go," initiating a dialogue with the Irrigation Department (ID) through ministerial channels to tap the dead storage in the Nalanda Reservoir (i.e., water below the level which cultivators using water from Nalanda Reservoir can tap) for 8.64 MCM on the understanding that 2.47 MCM would be diverted to the Huruluwewa Project under the ID (this even entailed convincing the IE in charge of the reservoir that the water was for agriculture and not hydropower). The water from Nalanda while not in itself sufficient for a rotational issue, raised the tank level at Kalawewa. This enabled the issue of water during the last rotation for the season.

DISCUSSION

In order to understand the management of the main system, it is important to distinguish between "allocation" and "distribution" of the scarce water resource. At the system level, the WMCP is a mechanism for allocation of water. Further, as allocations

[6]In the absence of a telephone or at least an extension at the FMU, the secretary achieved this objective through much shuttling between his office and the office of the RPM, across the street.

are done within the framework of the SOP, the function of the WMCP is to implement and monitor allocation, not assign rights to users who will then have access to water. Allocation of water is first to a system, and next to a project, both of which are supply-focused rather than demand-driven, in other words businesses without consumers, where an abstract amount of water per hectare is issued to an impersonal system. Given its particular location in the main system, and the task it must perform, the mode of operation best suited for this purpose and within which it has clearly performed well is the bureaucratic or administrative mode (i.e., rule-driven) rather than the managerial or entrepreneurial mode.

The distinction between these two modes, as made by Stevenson and Gumpert (1985), is a distinction between strategies. The bureaucratic or administrative mode is distinguished from the managerial or entrepreneurial mode by the following characteristics:

* the former is characterized by fixed resources to meet fixed contracts while the latter explores opportunities in a rapidly changing socioeconomic and political environment;

* regarding commitments to seize opportunities, the administrative mode acknowledges multiple constituencies and takes fewer risks while the managerial mode takes the opposite stance;

* regarding control over resources, the administrative mode results in stable authority structures with the potential for inertia and resistance to change, while the entrepreneurial mode is characterized by the episodic use of resources channeled to identified opportunities;

* regarding management structure, the bureaucratic mode is hierarchical, while the entrepreneurial mode has a flat management structure with multiple informal networks.

Allocation of water to systems, and within systems to projects and blocks, was carried out in an administrative mode (i.e., setting fixed targets by applying simple rules to achieve a single objective), to stretch a very limited water supply to the end of the cultivation season. The Irrigation Engineer, Flow-Monitoring Unit, as the secretary was the moving force behind this effort. Clearly he brought to it the ethos of the FMU, as a body standing apart and in a sense above the system-level administration. First, the key task of the WMCP was to monitor water consumption at the block level against planned consumption, without becoming involved in operational work. Second, this body was a specialized group, without exception irrigation engineers. Third, whether they represented a project or a main sluice, they represented a common interest, the management of an irrigation system to stretch the water supply to the end of the season.

Punctuality and regular attendance of its members were emphasized by the WMCP, and members were often reprimanded for nonattendance and lateness. Weekly figures on system diversion and sluice issues were rigorously maintained, with a comparison done between the anticipated (SOP target) and actual releases. Further, in terms of sluice issues to the three projects, the actual figures and what was estimated at the previous meeting were compared based on available information from the field by the irrigation engineer representing the project. The latter was held accountable for his decisions and explanations were asked, given, and discussed frankly and in a friendly manner. These discussions were a veritable gold mine of information about an area referred to as "operational difficulties in the field." The proceedings of the meeting were systematically and thoroughly documented, and copies of the minutes were sent to all participants as well as to the General Manager of the MEA.

Examining this management exercise from the perspective of business management (Mackenzie 1969), it can be said that in this case the planning, organizing, staffing, and control aspects were in place. The planning function was essentially derived from the SOP and the WMCP. Staffing was done by the General Manager of the MEA, but appointed from among those who were directly performing, and therefore responsible for the particular functions. Organizing for plan implementation was clearly the sole task of the WMCP, while control was exercised in the course of implementation. Ultimate control rested with the top management at the MEA. Technical expertise, specialization, documentation, regularity, and predictability are hallmarks of a bureaucratic mode of administration and organizing for implementation is classically the task of bureaucracy. At this level of the main system, what was required was strong management, and it was.

CHAPTER III

GALNEWA PROJECT AND KALANKUTTIYA ADMINISTRATIVE BLOCK

This chapter shifts the focus of the discussion from the system level to the project and block levels, with particular reference to Kalankuttiya Block in Galnewa Project.

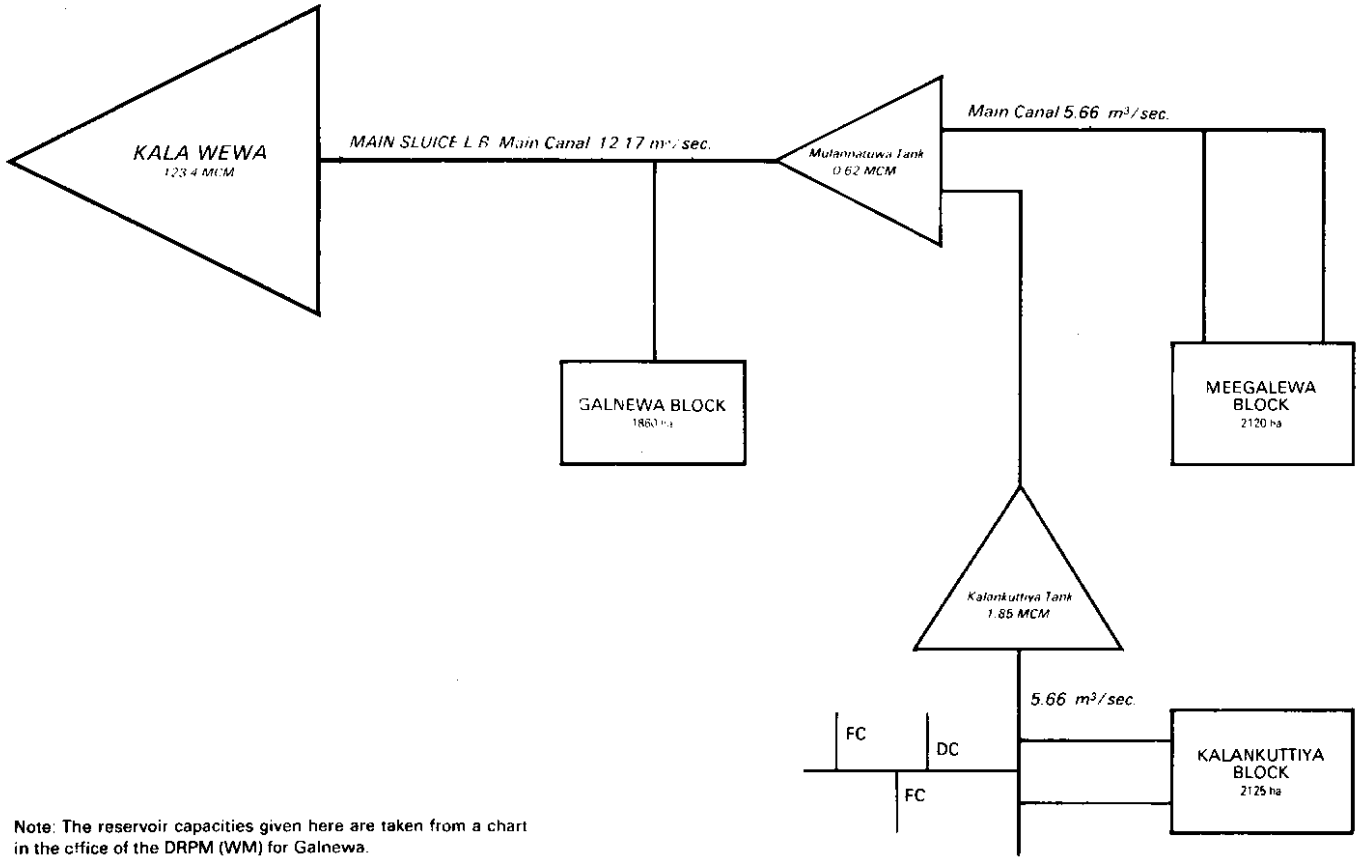
Kalankuttiya administrative block encompasses the physical branch canal system at Kalankuttiya. The area under the branch canal is divided into five numbered irrigation zones (305, 306, 307, 308, and 309) (see Figure 6). Distributary channels off the branch canal are labeled, for example 305-D1, which means the first distributary in irrigation zone 305. The number of field channels on distributaries ranges from 2-23. Field channels in turn may irrigate from 6-23 farm allotments, though the average is 10 field allotments per field channel.

Superimposed on this physical system are the administrative units, numbered from one to eight in this case, each under a unit manager. Given five irrigation zones and eight administrative units, the latter in some cases crosscut the former. The administrative and physical systems in turn encompass social or hamlet units. There are 22 hamlets in the Kalankuttiya administrative block with 3-5 hamlets in each irrigation zone. While hamlets normally do not crosscut irrigation zones, with the exception of units one and eight, they do crosscut administrative units. This has implications for water management at the interface of main system and its distributary networks.

KALAWEWA LEFT BANK MAIN CANAL, GALNEWA PROJECT: MAIN SYSTEM OPERATIONS

The Kalawewa LB/MC is the principal conveyance system delivering water to three administrative blocks in the Galnewa Project (Figure 7). These are Galnewa, Meegalewa, and Kalankuttiya. Its length up to Kalankuttiya is approximately 17.7 km, its capacity is 12.17 m^3/sec (430 cusecs), and it takes about 18 hours to deliver water to the tail end of the system. By virtue of its location in Galnewa Block, the main sluice as well as approximately 9.65 of the 17.7 km fall within the territory of this block.

Figure 7. Water Delivery System (Kalawewa L.B. Main Canal, Kalankuttiya Branch Canal).



Note: The reservoir capacities given here are taken from a chart in the office of the DRPM (WM) for Galnewa.

Galnewa receives its water supply through 23 direct offtakes from the MC. Meegalewa as well as Kalankuttiya receive water from the LB through intermediate storage at Mulannatuva Tank which has a capacity of 0.62 MCM. This tank is located in the Meegalewa Block and is storage for Meegalewa as well as the source of supply for the link canal delivering water approximately 3.2 km away to the Kalankuttiya Tank, with a capacity of 1.85 MCM. This is the supply system for the branch canal at Kalankuttiya, nucleus of the physical system delivering water to the Kalankuttiya administrative block.

Water Computations at the Main System

Initial water issues are based upon the extent of land prepared during the land preparation period as allocated in the cultivation calendar. Subsequently, for each rotational issue there is a standard allocation of water for the total extent under cultivation. A further computation is made for seepage and percolation (5 percent) and for conveyance losses (10 percent) in the command area and the MC. Losses at the level of the distributary channel are discounted as they are assumed as on-farm seepage. During maha 1986/1987 on the average 5.66 m^3/sec (200 cusecs) were issued to the Kalawewa LB/MC, of which an average of 2.12 m^3/sec (75 cusecs) was the amount expected at Kalankuttiya.

The DRPM (WM), Galnewa Project, is in overall command of the LB under the coordination of the RPM, Galnewa. At this point, the main system shifts from a system of allocation to one of distribution. Here there is a constituency of farmers. However, this constituency is identified within the boundaries of the block rather than the project, and the task of distributing the water allocated per block is the primary responsibility of the IEs of the three administrative blocks. The RPM and the DRPM are officially the main actors in the official management structure established to monitor the system. However, in reality, water allocated to the LB and distributed among the three blocks becomes embedded in a different operational/management scenario.

The IE for Galnewa Block, although in theory a subordinate of the DRPM (WM), is to a large degree the principal actor in control of the main system. Various reasons for this management anomaly have been given by different officials. According to the DRPM (WM), the main sluice and a good part of the canal is within his territory, and the main system should be under one engineer; therefore it "makes sense." According to the Block Manager, Kalankuttiya, because of his proximity to the water source as well as the direct offtakes from the MC, he has the responsibility to see that the others receive their due share and therefore it "seems right." However, our data show that both the engineering and the moral assumptions proved inadequate at a time of crisis, from the perspective of its implications for water distribution at Kalankuttiya.

KALANKUTTIYA ADMINISTRATIVE BLOCK: MANAGEMENT STRUCTURE AND FUNCTIONS

The official decision-making apparatus in control of the physical system is shown in Figure 8. There are some interesting differences in perception of the role and responsibilities of the IE and EAs. The IE, who was recently transferred to this block, says that he is responsible for water management in the whole block from the tank to the field channels. His other duties include contract supervision, building maintenance, labor management, and preparing budgets for construction and maintenance.

According to the IE, the irrigation zones under Kalankuttiya are divided between two EAs as follows (see Figure 8):

EA1 is in charge of zones 306-308 (the tail end of the system);
EA2 is in charge of zones 307-309 (the head end); and
Zone 305 is under a technical officer (TO) substituting for EA3.

The IE describes the EAs' duties as follows: EA1 and EA2 are mainly responsible for construction and maintenance of the irrigation structures, including roads and culverts. Their other duties include employing casual laborers and estimating irrigation works.

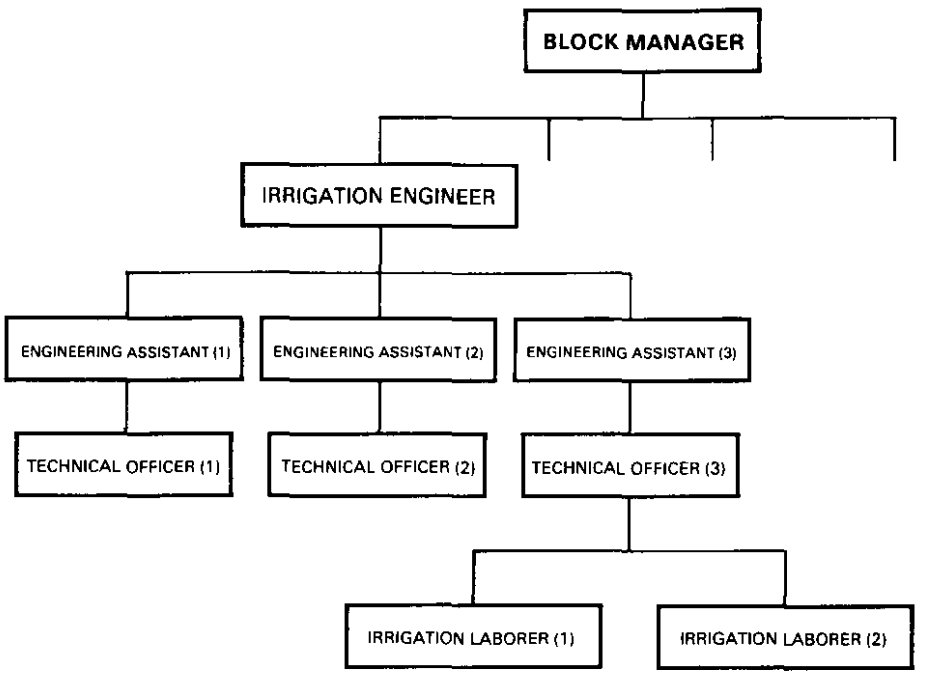
But according to all three EAs and other TOs, EA1 and EA2 are not connected with water management. Only if there is an irrigation difficulty will they attend to it. During the last rotation, due to serious water problems, all EAs and TOs were instructed to visit the fields and attend to water problems. Otherwise they are not directly connected with water management.

The IE, however, maintained that EA1 and EA2 are in charge of water management in their zones. The two EAs denied that they have such duties and suggested the IE, as a newcomer to the block, was basing his information on his previous experience. This difference in perception suggests a certain degree of flexibility, and perhaps that confusion exists at this level of management.

EA3, a woman, is in charge of water management. Her work is limited to calculation and documentation in the office. She is assisted by a TO at the field level. According to the reports of cultivation patterns submitted by the unit managers, she prepares water issue programs for the main sluices and the distributaries under the supervision and approval of the IE. Other water management records and schedules are also prepared by her.

The TOs' duties include supervision of labor and construction and camp maintenance. TO2 is in a middle-level category between the EAs and other TOs because he has followed a technical training course. Irrigation zone 305 is under him and his duties there are similar to those of EAs.

Figure 8. Organization for Irrigation Control in Kalankuttiya Block.



TO3 is stationed at Kalankuttiya and TO1 at Hurigaswewa. They are responsible for camp maintenance. Other supervisory work is divided between them with each responsible for four units. TO3 assists EA3 in field-level water management. He carries out her instructions through the two irrigation laborers (ILs). His water management duties from the main sluices to the distributaries include controlling the gates, collecting data, and visiting the channels.

Two ILs work under TO3 to open and close distributary and main sluice gates, and collect water issue information for EA3. IL1 controls the gates of the main sluice and 305-D1 to 308-D3 distributaries under the TO's instructions. IL2 controls the distributary gates from 306-2 to 307-D3, on TO's instructions. At the distributary, water management is the responsibility of the unit manager.

ROTATIONS DURING MAHA 1986/1987 AT KALANKUTTIYA

Continuous irrigation began on 21 October 1986. Rotational issues began on 26 November. The cultivation season included a total of 11 rotational issues, the dates of which are given in Table 1.

Table 1. Date of actual water deliveries for maha 1986/1987.

Rotation	Duration		Upper section (305 D1-306 D2)		Lower section (309 D1-307 D3)	
	From	To	From	To	From	To
1	26/11/86	3/12/86	28/11/86	3/12/86	26/11/86	29/11/86
2	5/12/86	13/12/86	8/12/86	13/12/86	5/12/86	8/12/86
3	13/12/86	21/12/86	17/12/86	21/12/86	13/12/86	17/12/86
4	21/12/86	29/12/86	26/12/86	29/12/86	21/12/86	24/12/86
5	31/12/86	8/1/87	4/1/87	8/1/87	31/12/86	4/1/87
6	16/1/87	25/1/87	18/1/87	25/1/87	16/1/87 (22/1/87)	20/1/87 (23/1/87)
7	27/1/87	5/2/87	31/1/87 (27/1/87)	5/2/87 (29/1/87)	27/1/87	31/1/87
8	7/2/87	18/2/87	13/2/87	18/2/87	7/2/87	12/2/87
9	18/2/87	2/3/87	26/2/87	2/3/87	18/2/87	24/2/87
10	4/3/87	6/3/87	—	—	4/3/87	6/3/87
11	11/3/87	20/3/87	11/3/87	20/3/87	14/3/87	18/3/87

Note: Continuous irrigation for land preparation: 21/10/1986-25/11/1986. Rotational issues began on 26/11/1986. The actual dates of water deliveries in some cases are different from the planned dates mentioned in the text.

Source: MEA Files (1987).

In this section we examine two rotations in depth. We first document the proceedings of Kalankuttiya block meetings before, during, and after rotation number 6 (R6), and management strategy at the project level. We then provide similar documentation of rotation number 8 (R8). We also describe meetings between the project- and field-level staff and farmers.

The block meeting is a weekly (Saturday) event presided over by the block manager, and includes his key staff as well as the unit managers within his administrative boundaries. Occasionally, an FA participates. In principle each rotation had a duration of seven days, with approximately three and a half-day issue for the head and tail ends respectively. However, as the following detailed account shows, the IE was forced to modify the duration of the rotations, leading to many problems.

Rotation Number Six (R6) at Kalankuttiya Administrative Blocks

R6 extended from 16-25 January 1987 (Table 1). Our account begins with a planning meeting before R6 began.

10 January 1987. The IE explains to the unit managers the need for a nine-day rotation in order to save water. The unit managers state that in some areas such a rotation is already in place, even up to 10 days in certain cases. If the rains continue, water issues could be stopped completely. The IE says that there must be at least 2.5 inches (6.35 cm) of rainfall for this to happen. The unit 8 manager replies that because his unit (at the tail end) received less rain, it would experience a shortage if there were such a stoppage. The IE states that he would take into account the measurements from the rain gauge near unit 8.

24 January 1987. The block manager asks the IE to explain the preceding and upcoming rotations. The IE says during the last rotation there were many problems as both sections of the block had to be given water after the branch canal was closed during the rain. It became a problem to get water to the tank as the LB/MC was closed. The present water level of the Kalankuttiya Tank is 2 feet (ft) 11 inches (0.89 meters). The issue of water to Galnewa would be completed by 12:00 noon today and the Kalankuttiya Tank can start getting water from today. The next rotation (R7) will begin on 26 January; therefore, Kalankuttiya could stock water only up to then. The first water issues would be given to units 6, 7, and 8 from 26-30 January. The block manager states that the water management activities during the last rotation were very unsatisfactory and farmers had made complaints.

31 January 1987. The block manager inquires from the unit managers whether they had submitted the reports that he had requested on the fields that did not receive water during 16-25 January 1987 (R6). The IE says that he had received the reports and reads out a list of fields that did not receive water, such as four allotments in 306-D4, five plots in 309-D1, etc. Listening to this, the block manager says that some allotments in almost all distributaries had not received water and questions the group on ways to solve the problem. The IE advises the unit managers to take necessary steps to prevent this from being repeated in the next rotation as otherwise it is difficult to conserve the water in the tank. He adds that it was decided at the WMCP meeting to reduce water issues further to seven days. All the unit managers complain that it is difficult to carry out a seven-day rotation (3.5 days for each of the two sections of the block). The IE says that the daily inflow into Kalankuttiya Tank is now 70 cusecs (1.98 m^3/sec). The policy is to maintain inflow equal to outflow. If water is issued on an eight-day rotation, it should be carried out properly, not exceeding the time limit. The IE agrees to issue water on this basis but advises the unit managers to carry out a rigorous rotation.

Explaining R7 he says that water would be issued to the lower section from 27-30 January; to the upper section from 31 January to 4 February. The main channel would be closed from 4-5 February. The next rotation (R8) would be started on 6 February. Water would be issued from 6-8 February to the lower section and from 9-12 February to the upper section. Again the main channel would be closed for two days. Thus, the fields would receive water once in 10 days. The IE advises the unit managers to distribute water efficiently to all allotments or else it would be difficult to conserve water.

R6: Management Strategy at the Project Level

Between decision making for the allocation of water at the system level and the reality at the block level, there is a management strategy at the project level, primarily reflected in the RPM's block meeting and the program and progress evaluation meeting. The DRPM (WM), addressing the RPM's block meeting (12 December 1986), said that Kalawewa receives 18.4 m^3/sec (650 cusecs) (daily diversion), but issues are more than this. Therefore, water issues from the LB must be reduced gradually from 7.08-5.66 m^3/sec (250-200 cusecs). To do this, Galnewa, Meegalewa, and Kalankuttiya blocks should each use on the average 1.84-1.98 m^3/sec (65-70 cusecs) and give 9-day rotations if necessary.

Again at a similar meeting on 22 January 1987, the DRPM (WM) says:

> The amount of water received at Kalawewa is 650 cusecs (18.4 m^3/sec).
> The daily average issues from Kalawewa are:
>
> | | |
> |---|---|
> | Right bank | 750 cusecs (21.23 m^3/sec) |
> | Main sluice | 200 cusecs (5.66 m^3/sec) |
> | Left bank | 225 cusecs (6.37 m^3/sec) |
>
> Total issued 1,175 cusecs (33.26 m^3/sec)
>
> Thus Kalawewa issues 525 cusecs (14.86 m^3/sec) more than it receives (it must be noted that the RB, main sluice, and LB issues are not simultaneous but staggered, and therefore this total is not issued at any one time, but rather is an aggregation). The water level of Kalawewa is dropping by three inches (7.62 cm) daily. Therefore, the rotation should be extended to at least eight days. The 225 cusecs (6.37 m^3/sec) issued from the LB channel must be shared among Galnewa, Meegalewa, and Kalankuttiya blocks. If water could be conserved until February at least, the farmers who have cultivated according to schedule could save their crops. To get the benefit of the rains from 8-10 January, the LB channel was closed for 4 days. At this time, the water level of Kalankuttiya rose from 4.5-6.3 ft (1.37-1.92 meters). After the rain stopped, all three blocks had to be issued water simultaneously. This resulted in a drop in the water level at Kalankuttiya Tank.
>
> The better practice is not to issue water simultaneously to all three blocks. Therefore, Galnewa would not receive any issues for four days. Meegalewa would begin tomorrow [i.e., 23 January]. After the three-day water issue at Kalankuttiya, it would not receive issues until 26 January. Then, the eight-day rotation would begin without overlapping. It is better if the water rotation could be extended to nine days.
>
> At this stage, the manager of unit 1 mentions that in his unit, distributary 305-D1 had not received water for 13 days. The RPM and DRPM (WM) discuss possible solutions to this, including the possibility of increasing the amount of water issued from the LB/MC as water is necessary in the flowering stage of the rice crop. The Kalankuttiya IE says Galnewa had taken more water than it had been allocated.

Asked by the RPM whether it would be possible to give adequate water to this distributary if water issues are increased to 300 cusecs (8.49 m^3/sec) at the LB, the IE replies that water could be issued on the following day [there is no evidence that such a decision was implemented].

The RPM advises the unit managers and the FAs to go to the fields and check whether water is being wasted from the fields that are receiving it and not simply wait until farmers complain. Now the unit managers become aware only when the farmers make complaints. During this period the practice of visiting fields should be followed at least one hour before the main channel is closed. The DRPM (WM) says that water issues for the next two weeks from the LB/MC would be decided after the next meeting of the WMCP. The question that meeting will address is, not increasing the amount of water issues from the LB sluice, but how to save the water in Kalawewa. Under the present conditions the storage in Kalawewa would be depleted by 25 February. If the water problem becomes more acute in the fields, the main channel has to be opened. If the main channel is opened (due to their position at the head of the canal) Galnewa farmers would "steal" (by illegal tapping) water and that is why he is reluctant to open the main channel. The RPM says that the project officers should be kept informed every day by the IE of the water level of the tank, the amount of water received, the amount issued, and the subsequent water level. The DRPM (Agriculture) says that if the tank does not receive the expected amount of water, the water level on Galnewa (fields) would be measured.

Rotation Number Eight (R8) at Kalankuttiya Administrative Block

2 February 1987. The block manager asks the IE and the unit managers to discuss problems encountered during the previous rotation (i.e., R7). Unit 1: due to illegal tapping, additional water had to be issued. Unit 2: due to difficulty in sending water to 305-D2, water had to be issued for an additional half day. Fields were dried out because of the length of rotations, so longer water issues had to be made. Unit 3: due to the length of the previous rotation, water had to be issued to 305-D3 for an additional day. Unit 4 was able to distribute the fixed quantity of water during the set period, because the unit manager curbed illicit night tapping with the help of the farmer representatives. Unit 5: due to the damaged condition of the channel, mainly four allotments in 309-D3 did not receive water during the last rotation. Unit 6: absent. Unit 7: due to lengthy rotations, water had to be issued for 12 additional hours as fields were dried out. Unit 8: no problems regarding water issues.

The IE Kalankuttiya said that before every rotation the IEs of Galnewa, Meegalewa, and Kalankuttiya meet and discuss water issues. Kalankuttiya Tank is closed on the day before water issues. The tank is also closed if the water level is below five feet (1.52 meters). The tank received 60 cusecs (1.7 m^3/sec) on 5 and 6 February. It is expected that during the next rotation from 7-14 February the tank

will receive 70 cusecs (1.98 m^3/sec).[7] Therefore the unit managers should not extend water issues during the next rotation.

7 February 1987. The IE Kalankuttiya addressed the Distributary Farmer Organization of 305-D3. This meeting was called to explain the low water level in the Kalawewa Tank and to discuss plans for water distribution in order to conserve water. If water could be conserved until 15 March, about 60 percent of the rice crop could be saved. It might be difficult to issue water beyond this time for late cultivators. The water requirement for the flowering stage of rice was 2.5 inches (6.35 cm) every seven days. But the 7-day rotation was extended to 10 days in order to save water. If the units do not stick firmly to the four-day water issue, tank levels for the following water issue would be affected. The tail-end units are now receiving water after 11 days while the head-end units received one additional day's issue. This could be avoided if there is effective farmer organization.

10 February 1987. The IE Kalankuttiya met the farmer leaders of unit 1. At present Kalawewa receives only 550 cusecs (15.57 m^3/sec) a day so farmers must not take additional water through illegal tapping or by exceeding the quota for the four-day issue. Kalankuttiya Tank can only issue the quantity of water it receives daily from Mulannatuva—70 cusecs (1.98 m^3/sec). If we exceed this, the tank level will drop and this in turn will affect the length of the next rotation as well as deprive the tail end of a timely rotation of water. Some farmers take more water than necessary (2.5 inches is adequate for rice). Any additional water taken is wasted and would only damage the crop at the tail end. When water issues were begun, the level of the tank was 5 ft 4 inches (1.62 meters). It had dropped to 3 ft 9 inches (1.14 meters) in over three days. This was because the tank was not receiving the agreed amount of water from Mulannatuva—60 instead of 75 cusecs[8] (1.69 m^3/sec instead of 2.12 m^3/sec). Given this, water issues can continue only until the next day. Under the circumstances would it be possible to close those field channels not in need of water, to help out others who need it? Some farmer leaders agree with him.

14 February 1987. Fifty furious farmers from unit 1 demanded that they be given more water, as what they had received was not adequate. They complained that they did not receive the required amount of water during the time allocated to them; the water flow in the channels was less than the quantity expected. Moreover, due to the long rotations, the fields were dried out and naturally, the

[7]As one might note here and elsewhere, we have found that numbers quoted by officials at meetings whether it be rainfall, water in cusecs, or acre-feet, are only approximations subject to some variation and may vary from documented figures.

[8]The IE used different figures at different times, sometimes 70, sometimes 75 cusecs.

water received was not adequate to moisten the fields. In effect, their rice plants were not dying but were being killed by the negligence of the officers. With considerable difficulty they had saved their crop until this stage, and now it was dying for want of water when in fact there was water still in the tank. When the IE was calculating the amount of water issued to them, the farmers shouted him down by saying that they wanted water and not figures. The farmers asked the IE to visit their fields, and the latter promised to do so within the following half hour.

According to the unit managers present at this meeting it is true that the crop is dying at this late stage of the season because of the lengthy rotations and insufficient issues of water. A decision could have been taken to issue several short water rotations during this cropping stage to save the crop without preserving water until 15 March, because by this time most of the fields would be ready for harvesting; those who had complied with the advice of the officers and deadlines set at the kanna meeting, would finish cultivation by the end of February. It is these farmers who should be given priority at this time and not the late starters. Under the circumstances, a unit manager could not ask farmers to follow the cultivation calendar in future. Also, by the end of February, a large number of farmers will have completed cultivation and will no longer need water. At this point, if others needed additional water issues, it could be given. A unit manager (they feel) can suggest this but no one will take heed.

14 February 1987. At the block meeting, the IE requests the unit managers to visit the fields, ensure that adequate water is received, and also submit a report on water distribution during every rotation. He asks the unit managers if farmer organizations were helpful in water management. The unit managers say that this was the case; then the IE says that these organizations should be used in order to enforce the four-day rotations. The unit managers reply that the farmers at this point need water over a longer period than the time set as their fields are drying up due to long rotations, and that decisions regarding the timing of water issues should be taken after visiting the fields and not at meetings. In particular, those who followed the cultivation calendar should be given short rotations now. Under the circumstances, what was the rationale for issuing water until 15 March? The IE says that water would be issued until 15 March. The unit managers say that special attention should be paid to those farmers who abided by the cultivation calendar; if those who followed the cultivation calendar were given short rotations, it would induce them to follow the agency's instructions the next season as well.

The IE replies that there should be a stock of water in the tank in order to issue short rotations and that he would put forward this suggestion at the next meeting of the IEs of the project [there is no indication that such a decision was ever implemented]. The unit managers state that this should have been done before. The AO adds that water issues are decided based upon the water level in Kalawewa Tank. The unit managers state that the water should be issued and not stocked.

The IE states that the agency is not stocking water, but there is simply not enough in the tank to be issued. The manager of unit 1 states that in making decisions on water issues the need to save water as well as the farmer's needs should be taken into account, and not merely the former aspect. The EA (WM) adds that steps should be taken to give shorter rotations the next time.

28 February 1987. The IE says that as the water level at Kalankuttiya was precarious water issues had to be reduced. This is because the tank is not receiving its anticipated 70 cusecs (1.98 m^3/sec) and instead is receiving only 48 cusecs (1.36 m^3/sec). In addition, DRPM (WM) has instructed him to reduce water issues by 20 percent. The unit managers should report to him the extent of fields that no longer need water so that he could make this reduction. The day before, upon inquiring as to why Kalankuttiya was not receiving its allocated amount of water, he discovered that tank levels at Mulannatuva had dropped to six feet (1.83 meters). As a result, Kalankuttiya could no longer receive water. During the previous rotation units 1, 2, and 3 had used more water than requested, because there was no organized mechanism for water distribution at the farm level. The unit managers respond that fields were dried out from long rotations, and the time allocated for issues was not sufficient to moisten the fields. The IE informs his audience of the low water level at Kalawewa, the problems associated with diversions from Bowatenna, and the possibility of receiving water from Nalanda; and advises the unit managers to impress upon the farmers the need to conserve water.

The block meeting is the key forum for monitoring the progress of the cultivation season at this level, the problems encountered at the unit level in water management as well as other issues, and for handing down information from the project management. However, unless there is a problem to report, there is no routine flow of information upwards or feedback given on it, for example the unit managers' suggestions for overcoming difficulties arising from water shortage and its impact on the credibility of the agency in implementing the cultivation calendar. Also, as discussed below, there is no systematic flow of information downward to the lower levels, the unit, and turnout. As a result, except for target monitoring, the information exchanged at the block meeting fails to become part of a management control system. As a general forum of information exchange, the block meeting served as an arena for ventilation of grievances by the unit manager and the farmers, and more significantly, for clearing misconceptions about policy decisions, such as that the inflow equals outflow policy is not an attempt by the agency to hoard water.

R8: Management Strategy at the Project Level

The RPM meets the farmer leaders of Kalankuttiya on 3 February 1987. Speaking on the current water crisis the RPM says:

Today water distribution has become a fight against nature. There is nothing one can do if nature does not give water. We (officers) have a duty to preserve and

distribute the water that is available, but some get angry with us when we try to conserve water. There is a grave water problem today. Only a very small amount of water is in the Kalawewa Tank. That amount has to last until the harvest. Three hundred thousand acres (121,410 ha) of paddy in the Northwestern Province are damaged completely. There is no water in the Anuradhapura District except in the Mahaweli Project area. Under the circumstances, with great difficulty we give water to about 23,500 allotments. There was no opportunity to fill the tank at the beginning of maha, and the water level at Kalawewa kept decreasing. Sometimes water rotations had to be extended for 10-12 days. The quantity of water now in Kalawewa is about 38,000 acre-feet (ac-ft) (46.9 MCM). Of this, only 26,000 ac-ft (32.1 MCM) can be issued.

Then the RPM asks the farmer leaders how many more water rotations are needed; they request six rotations. The RPM says that the cultivated land extent is 66,000 acres (26,710 ha); 87,000 ac-ft (107.4 MCM) of water is necessary for 6 rotations, to distribute at 2.5 inches (6.35 cm). But there is only 27,000 ac-ft (33.3 MCM) of water in the tank now. Officers must distribute water in such circumstances. Sometimes farmers who do not know this blame the officers.

Next, the block manager invites the IE Kalankuttiya to explain the status of the Kalankuttiya Tank and the present water distribution system. The IE says that the RPM has explained the present condition of Kalawewa. Under these circumstances, Kalankuttiya Tank issues only the amount of water it receives. To extend the distributary rotations beyond their set time is a waste of water and also a denial of water to other farmers. Water had to be issued two or three times to 307-D3 during the last rotation due to water tapping by the top section farmers. It was the farmers of 305-D1 and D2 who stole water. The IE asks the turnout leaders who represent these two channels to stand up and then advises them to stop this behavior.

Water is issued at the rate of 2.5 inches per acre [15.69 centimeters (cm)/ha] and if a few illegally tap water, others suffer. Therefore, the IE requests the farmer leaders to take steps to stop it and if they are unable to do so, to inform the officers. Watchers are appointed by the agency to stop water tapping but still water theft cannot be stopped. The IE requests the farmer leaders to stop it through farmer organizations.

Next, the IE draws a chart explaining how the rotations are being carried out. The first water issues are to units 4, 5, 6, 7, and 8; the second, to units 1, 2, 3, and 4. 306-D2 channel of unit 4 is being divided into two sections in the rotations.

```
            ]]]]]
                ]  Unit 1 2 3 4 ¦  4 5 6 7 8
Kalankuttiya    ]  ————————Main channel————————————————
    Tank        ]  ————————————————————————————————————
            ]]]]]                  ¦
                                   ¦
                                306-D2
```

Earlier 2.5 inches was issued for seven days. Now it has been extended to 10 days according to the water level in the tank [it is 2.25 and not 2.5 inches]. If the head enders take additional water, the tail enders would suffer.

The block manager next asks the DRPM (WM) to speak on water management and farmer organizations. The latter says that the RPM and IE have enlightened the gathering on the present water crisis and the steps that had to be taken. Now everybody has an understanding of the consequences of excess use of water and the importance of forming farmer organizations. Organizations should be at all levels (i.e., the system, project, block, distributary, and turnout levels).

At the system level, a WMCP has been appointed in collaboration with all three RPMs to make decisions on water issues from Kalawewa Tank to the projects of System H. Water was issued before based on field-level requirements. But the WMCP operates on the premise of conserving water in the tank. At weekly meetings, the WMCP decides on water issues based on the water level in Kalawewa and reviews the previous week's decisions. The WMCP was appointed in mid-December and it paved the way for conserving water. It will decide on the water issues from the main channel. It is very important to have block-level organizations for fair and equal distribution of water. Putting excess water on the fields is only a waste. As stated by the RPM, the amount of water in Kalawewa is less than 10,000 ac-ft (12.34 MCM). Kalawewa receives its water from Mahaweli but it is doubtful for how long it can receive the present daily 750 cusecs (21.23 m^3/sec) from Bowatenna. It is necessary to have organizations at all levels for the distribution of water. Not simply due to the current water crisis but under any circumstances, it is very important to have such organizations.

20 February 1987: The RPM Meets the Kalankuttiya Block Staff

The RPM asks the IE, Kalankuttiya, about the current problems (in R8) related to water issues from Kalankuttiya Tank. The water level in the tank has dropped to 2 ft 4 inches (0.7 meters), and as a result, water was not issued to unit 8 (tail end) which was due to receive water first under the current rotation. The tone of the inquiry is somewhat harsh and accusing. The IE is asked why he did not do anything about it, and why he waited until the tank level dropped that low. The IE in reply says that Kalankuttiya Tank did not receive the expected amount of water from Mulannatuva Tank. The RPM says that the requested amount of water was being issued to Kalankuttiya from LB/MC and that something was wrong somewhere for some areas not to receive adequate water. He asks the IE why he was not informed of this. The IE says that water issues during the current rotation started on 18 February and proceeds to read the daily inflow from Mulannatuva to Kalankuttiya Tank. As he gets to the readings for 20 February, he hesitates; the RPM picks up on this and asks the IE whether he is not visiting the field to check the gauge readings. The IE says that he was unable to visit the field today because of his presence at this meeting (the meeting began at 1430 h; usually officers attend to office routine in the morning and visit the field in the afternoon). The RPM continues, "in Meegalewa and Galnewa there is no such problem, why only in Kalankuttiya?"

The AO stands up and adds that on the day in which the current rotation began, the tank level was 3 ft 11 inches (1.19 meters); on 19 February it was down to 2 ft 5 inches (0.74 meters), and today it has dropped to 2 ft 4 inches (0.71 meters). As a result, unit 8 is without water for 13 days. The IE says that Mulannatuva has not received the expected amount of water from Galnewa (LB/MC). The RPM says that this situation should not have happened. Of the five administrative blocks under the Galnewa Project, Kalankuttiya is the only block with constant problems. It is up to the IE to see that adequate water levels are maintained at Kalankuttiya Tank. The AO says that on 14 February about 100 farmers came to the block office and demanded water. They had to be issued water beyond the rotation period. The IE hands over his "field note" on inflow into Kalankuttiya Tank, maintaining that it has received less than the anticipated 75 cusecs (2.12 m^3/sec). The RPM again inquires why he was not informed about this. The AO says that he and the IE informed the DRPM (WM), who is not present, but no action was taken.

The RPM says that the DRPM is a busy man, has other things to do, and that the water level of the main tanks was such that only two further water rotations were possible. Kotmale, Bowatenna, and Kalawewa had 7,000, 8,000, and 22,000 ac-ft (8.64, 9.87, and 27.15 MCM) respectively. In Kalankuttiya Block, the rate of water issue was 400 cusecs (11.32 m^3/sec) during the last rotation. The IE says that the excess was 221 cusecs (6.25 m^3/sec) and not 400 cusecs (11.3 m^3/sec), because the total allocated to Kalankuttiya was 1,077 ac-ft (1.33 MCM) and what was consumed was 1,298 ac-ft (1.6 MCM). The RPM says that when the water rotation is not given at the scheduled time in adequate quantities the farmers lose confidence in the officers, and overirrigate their fields as insurance. Then, he inquires from the unit managers the extent of the crop damage due to water shortage and the water requirements at the unit level for the upcoming rotation. This adds up to approximately 87 ha out of the total cultivated extent of 2,026 ha—approximately 4 percent of the total can then be assumed to be damaged as a result.

The AO claims that Galnewa Block does not pay heed to the water requirements and problems of Kalankuttiya. The RPM says that he cannot believe it. He adds that the IE should have informed him, "we have six blocks and sometimes there are delays." The IE says that it was because the DRPM (WM) had promised to issue 113 cusecs (3.2 m^3/sec) on 18 February that he did not inform the RPM of this problem. The RPM instructs the IE to report to him daily at 5:00 pm on the water level of the Kalankuttiya Tank. Questioned by the RPM, the AO says that according to the growth stage of the crop, about 40 percent of the fields do not need water at present, but the farmers will not listen. The general consensus is that about 25 percent of the total cultivated extent will not need water after the conclusion of the current rotation. Accordingly, water issues in the next rotation could be reduced by 20 percent. The RPM says to the unit managers, "now you said 40 percent and I have accepted 20 percent so don't come back to me and report that some fields did not receive adequate water." He further states that in

> order to be able to issue water until 20 March, it is expected that there will be a reduction of water issues by 50 percent after the next rotation, but if fields are damaged there is no purpose in reducing water issues. In previous years, maha was begun with the tank at spill level but this season was started without even the minimum level of water. The situation was made worse as there was no rain during the season. The farmers know this as well as the officers and as a result it was possible to economize water usage.

According to the IE Kalankuttiya, it is a well-known secret that Galnewa Block taps water flowing through the LB into Mulannatuva storage. Even though he would not admit it, the RPM knows this. Galnewa can tap this water very easily through the gates in the channel and the IE Kalankuttiya explained it as follows:

> There are four regulators along the MC to the Mulannatuva Tank. There is a distributary channel at Galnewa (one of the 23 which are direct offtakes for Galnewa from the MC) just above the regulators. The farmers around this area can get water by lowering a regulator and thereby increase the water level in the MC at this point, but in fact reducing the quantity of water flowing downward to Mulannatuva Tank. Of the 250 cusecs (7.1 m^3/sec) issued from Kalawewa to the LB/MC, 150 cusecs (4.2 m^3/sec) should come to Mulannatuva, but each time it receives only 130 cusecs (3.7 m^3/sec), hence 20 cusecs (0.6 m^3/sec) short. During every water issue to Mulannatuva there is a shortfall of 20 cusecs (0.6 m^3/sec) and the RPM knows this. From 9:00 pm (2100 h) on 17 February to 8:00 am (0800 h) on 18 February, a larger quantity of water over and above this amount has been taken by lowering the regulator.

CONCLUSION

Bearing in mind what the SOP is intended to do, in Kalankuttiya water consumption for the cultivation season ended about nine percent below the SOP targeted values (Table 2). The block average duty computed at the end of the cultivation season was 0.12 MCM per ha (4 ac-ft per acre), giving a weekly average depth of 6.35 cm (2.5 inches).

Table 2. Anticipated and actual water use, maha 1986/1987.

Block	Anticipated ac-ft[a]		Actual ac-ft	% below average
	Average	Dry		
Galnewa	20639	22300	20600	1
Meegalewa	23500	25400	19900	15
Kalankuttiya	23500	25400	21300	9
LB/MC Total	74500	80400	66100	11

[a]One acre-foot (ac-ft) = 1,234 cubic meters (m^3).
Source: MEA (1986/1987).

In R6, the objective was to make strategic use of rainfall. But as rain fell sporadically on the LB, the entire system was turned off. At Kalankuttiya while there was no recorded rainfall during the rotation, the last recorded rainfall was 0.76 cm (0.30 inches) at Kalankuttiya and 0.87 cm (0.34 inches) at Hurigaswewa making a total of 1.63 cm (0.64 inches) on 11 January — 4 days prior to the commencement of R6. However, according to the IE, during R6, rainfall at Kalankuttiya varied between head and tail, amounting overall to less than 2.54 cm (1 inch) per day at the highest and an average of slightly over 5.08 cm (2 inches) total for the three-day period. Of this amount, the tail end received a total of 3.81 cm (1.5 inches) for three days. This is considerably below the standard of at least 6.35 cm (2.5 inches) required before the system can be shut down.

When the sluice was reopened, the management faced an unenviable position: simultaneously, it had to issue water to all three blocks on the LB. At Kalankuttiya, also it had to give simultaneous issues to the entire block. The physical system is designed to do this, but given water shortages and resultant low tank levels at Kalawewa, the management, in the interest of equity at system level, was unable to do it. Thus, taking into account conveyance losses and using a conservative estimate of the ratio of water to land (1 cusec to 20 acres), almost the total command area under the Kalankuttiya branch canal (2,120 ha) could be irrigated with the branch canal operated at full capacity. But this requires a tightly managed operational plan on agency and farmer side of the participative management equation. Managerial constraints at the operational level, as discussed below, preclude such a scenario, even during a season of plentiful supply of water.

At Kalankuttiya, on 11 January 1987, the tank level was 1.8 meters (Table 3). The requested issue from the LB management was 2.12 m^3/sec (75 cusecs). Based on the agency's computation of 6.35 cm (2.5 inches), this amounts to 1.35 MCM (1,093 ac-ft) which is less than half the quantity of water required to irrigate the entire command area of 2,026 ha in maha. This is without taking into account canal losses (normally 15 percent), but as canal loss tends to increase when dry conditions prevail and rotations are lengthened, the volume of water required is 1.55 MCM (1,257 ac-ft).

Table 3. R6 at Kalankuttiya, 16-25 January 1987, including daily rainfall and tank levels.

Date	Rainfall in inches		Tank level	Issues in cusecs[a]
	Kalankuttiya	Hurigaswewa		
11	7.6	8.7	5' 11"[b]	-
12	-	-	6' 7"	-
13	-	-	6' 10"	-
14	-	-	6' 10"	-
15	-	-	6' 11"	-
16	-	-	6' 10"	50.0
17	-	-	6' 6"	76.0
18	-	-	6' 0"	145.0
19	-	-	4' 3"	126.0
20	-	-	2' 6"	74.0
21	-	-	1' 9"	27.0
22	-	-	2' 6"	71.9
23	-	-	2' 6"	66.5
24	-	-	2' 11"	67.5
25	-	-	3' 7"	25.0

[a]One cusec = 0.0283 m^3/sec; [b]one foot (') = 0.3048 meters, one inch (") = 2.54 cm.
Source: MEA Files (1987).

This leaves no leeway for what is written-off as operational or management losses – unlawful tapping by farmers, excess use by head enders (interestingly, illegal tapping by distributary channel per day was noted in the water issue chart of the agency in 6 out of 11 rotations), benign neglect by the agency, and structural defects in the system. The question we are raising here is, why does the block request less water than actually required? We understand that this is the standard procedure without variation between the two cultivation seasons; but in maha the entire command area is irrigated while in yala only 50 percent is cultivated.

It is possible that even in maha the plan is to irrigate the head and tail ends of the command area as separate entities. Yet in most rotations some channels in one section were issued additional water while simultaneously the other section was being irrigated. In R6, water was issued for two extra days to all distributaries and three extra days to three distributaries. In R8, one extra day of issue was given to all and two days to two distributaries. Further, in 8 out of 11 rotations, simultaneous issues were given from 1-3 days. Under a no-drought scenario we assume that the balance during maha is expected in rainfall and inflows from the catchment area.

But, if the tank level is already 1.8 meters and if the agency must issue water to the entire command area with the expected 2.12 m^3/sec (75 cusecs), not all of which comes, by the agency's own admission, the inherent problems are clear: demand and supply do not match. This is further compounded by the growth (flowering) stage of the crop and the reality of the seven-day rotation becoming 10-12 days. Moreover, as the MC and tank levels dropped at Kalankuttiya, the tail end of the system did not receive adequate water at the expected times. To compensate for this, the agency was forced to issue additional water through extended rotations. As a result, if one looks at the actual water duty for the block, or per distributary channel, or the issue charts giving total actual issues (Table 4), they are close to the computed requirements.

Table 4. Water duty computed at the unit level at the end of maha 1986/1987.

Unit	Ac-ft[a] per acre[b]
1	4.21
2	3.94
3	3.45
4	4.04
5	3.96
6	4.26
7	4.02
8	4.21
Block average	4.01 ac-ft per acre
Weekly average	2.5 inches[c]

[a]One acre-foot (ac-ft) = 1,234 cubic meters (m^3); [b]one acre = 0.4047 ha; [c]one inch = 2.5 cm.
Source: MEA Files (1987).

Table 5. R6 water issues, maha 1986/1987: MEA and IIMI calibrations.

	JANUARY 1987																						
	Unit 1	Unit 2			Unit 3			Unit 4			Unit 5				Unit 6		Unit 7			Unit 8	Total	Total	
Date Jan.	305 D1	308 D1	305 D2	308 D2	305 D3	305 D4	308 D3	306 D1	306 D2	309 D1	309 D2	306 D3	306 D4	309 D3	306 D5	309 D4	309 D5	307 D1	307 D2	307 D3	dis.[a] IIMI	dis. MEA	Difference
16	—	—	—		—	—	—	—	—	4.25	2.05	2.70	3.50	6.00	13.00	6.80	5.95	3.95	3.68	11.50	—	76.40	13.02
	—	—	—	—	—	—	—	—	—	—	2.21	1.94	3.94	5.09	12.48	—	5.81	4.04	5.69	12.62	63.38	—	—
17	—	—	—	—	—	—	—	—	—	4.25	2.05	2.70	3.50	6.00	14.00	6.80	5.95	3.95	4.00	12.50	—	76.50	10.80
	—	—	—	—	—	—	—	—	—	—	2.21	1.94	3.94	5.09	12.48	—	5.81	4.04	5.69	12.62	65.70	—	—
18	21.50	7.03	5.08	3.90	7.15	5.00	7.73	6.50	8.00	4.25	2.05	2.70	3.50	6.00	14.00	6.80	5.95	3.95	4.00	13.00	—	145.00	6.54
	21.67	6.93	5.22	3.81	6.36	4.04	7.76	6.37	5.33	—	2.21	1.94	3.94	5.09	12.48	—	5.81	4.04	5.69	15.01	138.46	—	—
19	19.80	5.20	5.00	3.85	6.80	4.60	6.81	6.50	8.10	2.00	2.05	2.70	3.50	6.00	14.00	6.80	5.95	3.00	0.50	2.40	—	126.00	5.60
	21.67	6.45	5.09	3.81	6.36	4.04	7.76	6.37	5.33	—	2.21	1.94	3.94	5.09	12.48	—	5.81	3.34	2.37	5.01	120.40	—	—
20	19.00	5.00	4.75	3.72	6.35	3.75	—	6.50	8.10	—	—	1.00	0.50	2.85	4.45	3.00	—	—	—	—	—	74.00	1.50
	19.41	6.69	4.83	3.31	6.06	3.70	6.83	6.37	7.06	—	—	0.73	1.46	2.21	3.91	—	—	—	—	—	75.50	—	—
21	8.25	1.50	2.30	1.82	3.05	1.65	1.55	4.00	2.00	—	—	—	—	—	—	—	—	—	—	—	—	27.50	34.00
	7.60	2.50	4.58	3.07	5.76	15.48	3.14	6.75	12.71	—	—	—	—	—	—	—	—	—	—	—	61.50	—	—
22	21.50	5.90	5.95	3.65	7.60	5.50	7.73	6.95	9.50	—	—	—	—	—	—	—	—	—	—	—	—	71.90	1.20
	21.67	6.45	5.88	3.07	7.32	4.38	7.76	7.15	7.06	—	—	—	—	—	—	—	—	—	—	—	70.70	—	—
23	17.50	5.90	1.70	1.00	1.90	2.85	2.00	1.75	8.50	—	—	—	—	—	—	—	—	1.70	2.00	60.00	—	66.45	13.60
	16.44	6.45	1.70	0.77	0.41	1.85	1.94	1.13	7.06	—	—	—	—	—	—	—	—	1.85	2.38	5.02	52.80	—	—
24	14.70	5.90	—	—	1.85	—	—	—	3.00	—	—	—	2.10	—	—	—	—	3.52	5.08	16.75	—	46.75	6.10
	16.03	6.45	—	—	1.40	—	—	—	3.87	—	—	—	2.70	—	—	—	—	3.71	6.54	16.35	52.90	—	—
25	—	—	—	—	—	—	—	2.00	3.25	—	—	—	—	—	—	—	—	—	3.84	20.00	—	25.00	4.00
	—	—	—	—	—	—	—	2.12	3.87	—	—	—	—	—	—	—	—	—	4.75	18.34	29.09	—	—

Note: Figures are in cusecs. For each day, upper row is MEA calibration, lower row is IIMI's. All measurements were done by MEA personnel. One Cusec = 0.0283 m^3/sec or 28.3 litres/sec.

[a] Discharge.

Source: MEA Files (1987).

This still begs the question as to why the agency's targeted issues and actual issues as reflected in the issue chart are sometimes the same, at times under, and at other times well above the target. According to our computations, in R6 the agency issued 1.62 MCM (1,316.2 ac-ft) which amounts to 7.67 cm (3.02 inches) depth (Table 5). This is significantly above the agency target of 5.72 cm (2.25 inches). But this was done at the expense of extending the rotational period targeted by the operational plan — from a rotation of 7 days to one of 10 days. This was also the case in R8 with water issues continuing beyond 11 days (Tables 6 and 7).

How can one explain the problems documented in these rotations? The answer lies in the timing of the issues. When timing is unreliable, the agency loses its credibility with the farmers and thus loses the management controls, which at this level are based on morality (sharing with fellow farmers and equity considerations), and on trust and faith in the reliability of the main system at the upper reaches — the interface between participatory and agency management from the farmers' perspective. Further, this unreliability weakens the binding effects and resultant expectations between farmer and agency centered around the implementation of the cultivation calendar.

In R8, we see a variation on the theme from R6. Deleting the rainfall from the scenario, the issue here is one of a rotation interrupted due to failure to receive the anticipated quantity of water from the LB management (Table 6). In terms of the volume and timing of water issued and its impact on the bipartisan management of the main system, the consequences are the same, aside from the implications for the growth stage of the crop. The targeted and actual deliveries for this period for the LB were 3.89 MCM and 3.89 MCM (3,150 and 3,152 ac-ft) respectively for the week of 11-18 February; and 3.89 MCM (3,150 ac-ft) and 3.79 MCM (3,074 ac-ft) for the week of 19-26 February (Table 8). For the whole rotation, the agency's total delivered amounts to the field, taking into consideration 15 percent canal loss, is 1.76 MCM, (1,427 ac-ft) or by our computation 1.56 MCM (1,264 ac-ft) (Table 7). This implies 8.00 cm (3.2 inches) in the field by official figures and 7.37 cm (2.9 inches) by ours, again above the target of 6.35 cm (2.5 inches).

Table 6. R8 at Kalankuttiya, 13-24 February 1987, including daily rainfall and tank levels.

Date	Rainfall in inches		Tank level	Issued (cusecs)[a]	Cusecs received, Kalankuttiya
	Kalankuttiya	Hurigaswewa			
13	-	-	3'11"[b]	73	NR[c]
14	-	-	3'10"	73	NR
15	-	-	3'11"	75	NR
16	-	-	3'11"	74	NR
17	-	-	3' 9"	65	NR
18	-	-	2' 5"	77	58
19	-	-	2' 5"	62	58
20	-	-	2' 4"	64	160
21	-	-	2' 6"	69	NR
22	-	-	2' 9"	50	NR
23	-	-	2'10"	35	NR
24	-	-	3' 5"	7.85	NR

[a]One cusec = 0.0283 m^3/sec; [b]one foot (') = 0.3048 meters, one inch (") = 2.54 cm; [c]not recorded.
Source: MEA Files (1987).

Table 7. R8 water issues, maha 1986/1987: MEA and IIMI calibrations.

	FEBRUARY 1987																							
	Unit 1	Unit 2			Unit 3			Unit 4			Unit 5				Unit 6		Unit 7			Unit 8	Total	Total	
Date	305	308	305	308	305	305	308	306	306	309	309	306	306	309	306	309	309	307	307	307	dis.[a]	dis.	Diffe-
Feb.	D1	D1	D2	D2	D3	D4	D3	D1	D2	D1	D2	D3	D4	D3	D5	D4	D5	D1	D2	D3	IIMI	MEA	rence
13	21.50	5.90	5.08	3.90	7.15	5.00	7.73	5.50	10.00	—	—	—	—	—	—	—	—	—	—	—	—	73.40	5.50
	21.67	6.45	5.09	3.81	6.36	4.04	7.76	5.38	18.39	—	—	—	—	—	—	—	—	—	—	—	78.95	—	—
14	21.50	5.90	5.08	3.90	7.15	5.00	7.73	6.50	10.00	—	—	—	—	—	—	—	—	—	—	—	—	73.40	4.40
	21.67	6.45	5.09	3.81	6.36	4.04	7.76	6.37	16.33	—	—	—	—	—	—	—	—	—	—	—	77.80	—	—
15	21.50	5.90	6.60	4.50	7.15	6.50	7.73	6.75	8.50	—	—	—	—	—	—	—	—	—	—	—	—	75.40	2.10
	21.67	6.45	6.57	3.81	6.36	4.04	7.76	6.62	14.28	—	—	—	—	—	—	—	—	—	—	—	77.50	—	—
16	21.00	5.70	6.60	3.90	7.15	5.00	7.73	6.75	8.70	—	—	—	—	—	—	—	—	—	—	—	—	74.00	3.50
	21.67	6.45	6.57	3.81	6.36	4.04	7.76	6.62	14.28	—	—	—	—	—	—	—	—	—	—	—	77.50	—	—
17	21.50	5.90	6.60	1.60	7.15	3.10	5.50	6.75	7.70	—	—	—	—	—	—	—	—	—	—	—	—	66.20	4.50
	21.67	6.45	6.57	1.53	6.36	+0.50	+0.50	6.62	13.91	—	—	—	—	—	—	—	—	—	—	—	70.78	—	—
	—	—	—	—	—	2.89	4.78	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	3.70	4.50	2.05	1.58	1.00	—	—	—	—	6.00	2.05	2.70	3.50	6.00	14.00	7.50	5.95	3.76	2.70	9.50	—	77.20	0.70
	3.27	5.84	0.96	0.63	0.85	—	—	—	—	—	2.21	1.94	3.94	5.09	12.48	—	5.81	3.93	4.18	10.03	76.49	—	—
19	—	—	—	—	—	—	—	1.05	—	6.00	2.05	2.70	3.50	6.00	13.00	7.50	5.37	3.70	2.12	2.60	—	62.00	6.40
	—	—	—	—	—	—	—	0.77	—	—	2.21	1.94	3.94	5.09	12.14	—	5.81	3.87	3.08	3.34	55.60	—	—
20	—	—	—	—	—	—	—	—	—	6.00	2.05	2.70	3.50	6.00	14.00	7.50	5.95	3.80	2.40	3.60	—	64.00	7.90
	—	—	—	—	—	—	—	—	—	—	2.21	1.94	3.94	5.09	12.48	—	5.81	3.93	3.62	3.58	56.10	—	—
21	—	—	—	—	—	—	—	—	—	6.00	2.05	2.70	3.50	6.00	14.00	7.50	5.95	3.75	2.07	7.10	—	69.00	11.30
	—	—	—	—	—	—	—	—	—	—	2.21	1.94	3.94	5.09	12.48	—	5.81	3.82	3.08	5.90	57.70	—	—
22	—	—	1.02	—	—	—	—	—	—	1.50	0.12	1.90	1.97	2.90	5.41	4.24	2.50	4.00	4.55	20.00	—	42.80	5.50
	—	—	—	—	—	—	—	—	—	—	0.18	0.62	1.16	2.10	5.06	—	4.19	4.04	5.94	18.34	48.30	—	—
23	—	—	—	—	—	—	—	—	—	—	0.22	—	—	—	2.25	—	—	—	7.00	25.00	—	35.24	8.40
	—	—		—	—	—	—	—	—	—	0.05	0.16	0.58	0.67	3.91	—	0.98	2.02	8.43	26.98	43.70	—	—
24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.00	5.80	—	7.85	2.10
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.08	6.90	9.98	—	—
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.08	6.90	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Note: Figures are in cusecs. For each day, upper row is MEA calibration, lower row is IIMI's. All measurements were done by MEA personnel. One Cusec = 0.0283 m^3/sec or 28.3 litres/sec.

[a] Discharge.

Source: MEA Files (1987).

Table 8. Kalawewa Tank issues, maha 1986/1987.

Tank issues 2-10 February 1987 in ac-ft[a]

Tank	Canal	Planned	Actual	Difference (ac-ft)
Kalawewa	Right bank	7700	7558	-142
	Yoda Ela	2430	2466	+36
	Left bank	3150	3074	-76

Tank issues 11-19 February 1987 in ac-ft

Tank	Canal	Anticipated	Actual	Difference (ac-ft)
Kalawewa	Right bank	7700	9018	+1318
	Yoda Ela	1460	1980	+ 520
	Left bank	3150	3152	+02

[a]One acre-foot (ac-ft) = 1,234 cubic meters (m^3).
Source: System H WMCP Files (1986/1987).

But this rotation forcibly brought home an issue that had been latent in R6, that is, the role and accountability of the agency at the levels of the LB, project, block, unit, and below, in allocating and distributing water released from the Kalawewa Reservoir. Thus, on 1 day of the rotation, the block management discovered that only 0.23 m^3/sec (8 cusecs) was received from the LB and not 2.12 m^3/sec (75 cusecs). The implications of this as well as the management strategies, or lack thereof, are discussed below.

Here we wish to point to the absence of a formalized mechanism to ensure that the expected quantity of water reaches its destination and if it does not, the procedures to be observed to redress this imbalance. While the FMU uses the readings from the automatic recorder at the main sluice from Mulannatuva Tank to the link canal at Kalankuttiya in order to compute the water duty for the block, the block management itself maintains no regular records of inflow into Kalankuttiya Tank. What they have are tank water levels and daily issues. If there is a rapid drop in tank level, it is taken as an index that something is amiss and then inflow is checked. Monitoring as a rule is replaced by monitoring by exception.

Further, using the staff gauge readings given by the block IL with our own (i.e., IIMI's) rating curves for the distributary channels raises a number of questions. For example, why are readings sometimes taken once a day and at other times twice a day? More readings would presumably improve the reliability of measures (if not supply) in the distributaries. In 309-D4, readings at two points rather than one are required, but not taken. In the absence of these, we were unable to calibrate 309-D4 (we also do not have calibration curves for 309-D1).

We understand that the block ILs should take two staff gauge readings per day and that the TO (WM) should monitor their work. However, we were told that because these laborers are "very reliable and have many years' work experience, it is not necessary to keep close check." In other words, at this level operations hinge upon trust, which we have advocated above as part of management by results at the lower levels of the system. But some problems can be addressed only in an adequately monitored management system, if not at the interface between the block and unit, then at the interface between the block and project. These relate to the frequent complaints by unit managers and farmers that the water levels in the distributaries fluctuate and are not adjusted systematically (Table 8). We believe that a large part of this is due to the tank level dropping at Kalankuttiya, and the lower than expected levels in the MC, especially at the tail end.

Duckbill weirs may assist a flexible and equitable supply in the distributary by maintaining constant head at the offtake point, but the varying MC flow can be adjusted only if the gates of the distributaries are adjusted (e.g., as supply in the MC drops, or if the head enders take more than their due share). Moreover, gauge readings are taken by the agency at the head of the distributary, and unless gate adjustments are made systematically, what is reflected at the head end may not accurately reflect the picture at the tail end.

When the agency's calibrations are compared to those of IIMI, one of three patterns is possible: first, there could be a perfect fit between the two. Second, one set could be consistently higher or lower, possibly due to the method of calibrating, and would therefore have a neutral effect on the discrepancy between the two sets of data. Third, there may be random fluctuation. This is what we find. This pattern relates to the reliability of the staff gauge readings.[9] It is our understanding that the IL may take two readings but he may average it and document it as one. Further, the lower echelons of the agency, including the ILs themselves, have pointed out another possible cause; obstructions at the orifices of distributary channels due to constant dumping of garbage into the main channel by the farmers. According to one IL, the water level in the distributary channel can drop even due to leaves swept into it. In the absence of systematic monitoring, such issues must necessarily remain in the realm of speculation.

[9] IIMI does not have its own set of readings for maha 1986/1987.

CHAPTER IV

MATRIX MANAGEMENT: PROBLEMS AND POTENTIALS

EVOLUTION OF THE MANAGEMENT OF SYSTEM H

An examination of the evolution of the management organization of System H from the era of the United States Operations Mission (USOM) and the United Nations Development Programme/Food and Agriculture Organization (UNDP/FAO) Mission or Master Plan in 1968 to the present provides a useful perspective on the changing objectives of Mahaweli management philosophy. It is commonly believed that the architects of the system were influenced by the thinking behind the Malaysian Federal Land Development Authority (FELDA). However, a former Director General of the MASL said that "if any one told you that the Mahaweli organizational structure was borrowed from elsewhere, they are not telling you the truth."

The Master Plan, in the volume on Organizational and Management Requirements (UNDP/FAO 1968:63,78), states that the project could be a testing ground for the application of an integrated approach to agricultural development and for testing new ideas such as cooperative marketing and rural home economics. It suggests administrative work be concentrated at the head office, relieving the field staff to allow them to do the work for which they are trained and recruited. There should be as much authority as possible delegated to the "man on the spot."

Other key recommendations of this report were to have a small number of well-trained field staff with specialist backstopping, and on the agency side, to have an organizational structure comprising an area development team under an area controller, a project unit of approximately 3,000 ha under a project manager with a background in agriculture and settlement, and a village development officer with a background in agriculture. On the farmer side, the report recommended a cultivation committee with one development worker trained in practical agriculture assisting it, one irrigation agent for water management at its own expense, one person for the collection of field taxes and other duties, and a multipurpose cooperative society for

the supply of inputs, credit, and for marketing. Credit would be channeled by the banks through the cooperatives and would be tied to the marketing of the farmers' produce. The bank would lend to the society at a low rate of interest and it in turn would lend to the farmer, leaving a margin of profit. The society would help store the crop and sell it when prices are good.

Subsequent to the Master Plan is the Feasibility Study (Vols. 1-8) commissioned by the Government of Sri Lanka and carried out by *Société Grenobloise d'Etudes et d'Applications Hydrauliques* (SOGREAH) of France in 1972 (SOGREAH 1972); Diagnostic Analyses of 1982 and 1983 (Alwis et al. .1982, 1983); World Bank Evaluation Team Report (World Bank 1985); and Scudder (1981) and Scudder and Wimaladharma reports (1985a-c).

The SOGREAH Feasibility Study, volumes 1 and 7 in particular, indicates the role expectations and objectives upon which the smooth operation of the management was expected to depend (SOGREAH 1972). As a physical system designed for flexibility, System H has a canal system radically different from the older schemes. For optimum water management a maximum of 20 ha served by a turnout (field channel) was planned with 20 farm outlets. Control was envisaged to occur at this point, with up to 20 farmers working as an integrated group. Ten turnouts would be clustered as a village which would be connected to the major town by a trunk road. The main and distributary canals were designed for constant flow at full capacity to enable full discharge to be issued to farms on a rotation basis.

Taking the farmer as the nucleus, and the turnout organization of farmers as the primary mechanism for water management, the turnouts would each have a farmer representative elected by the farmers. These were to be joined into cluster committees which would elect representatives to a "farmers' union" for the project. The committee and unions would be autonomous, and officials would participate in them only when invited and only in an advisory capacity. No predetermined pattern of farmer organization was to be forced upon the project area; once uniform procedures and structures had been established by the farmers, these procedures would be codified to achieve stable organizational structures. To see that existing legislation did not interfere with the implementation of farmers' committees, it was recommended that the project area be recognized as a special area where new development techniques and organizational patterns would be tried.

To administer the project, a minimum number of officials to whom the settler is known and who are known to him was envisaged. The field organization of the project included the divisions of water management, agricultural production, community development and training, and marketing and credit coordination. Specialists in charge of these areas were to be under the single administrative authority of the project manager.

At this stage, data gathered from interviews with key designers of Mahaweli management philosophy, when brought into the discussion harmonize with it, and illustrate their contrasting perspectives. Thus, to paraphrase one former senior official from MASL:

> Mediation between functional and territorial authority was the key to the management system which emerged in the Mahaweli. It was a response to the problems inherent in the extremely specialized departmentalism prevalent at the time. As a new project focused in its early phase on land development and settlement, there was a need for a strong centralized organization with the accent on territorial authority. The unit manager was the territorial representative of the MEA. At the block level there were functional specialists representing the key disciplines under the administrative control of the block manager, again a territorial man. At the project level, the same principle operated with the RPM and his DRPM. Centralization became an issue in creating a distinct role for the farmer once the early phase of settlement was completed. The unit manager and the farmer organization (the farmer) were competitors for role and functions. The prototype of the officer-settler organization was the estate model where a territorial functionary — the superintendent or his assistant — was the field officer with the laborers under him.

A former official of the Mahaweli Development Board (MDB) presents another view.

> [He] was opposed to the unitary system (also called the "military system") of management because it was a matrix of a lot of material brought from different areas. The original concept in management was the command area — the branch canal was carved out as an irrigation block. Water management was to be the central theme and the block was to be under an irrigation engineer (IE). The block and the unit today are administrative areas and not command areas, and the former conflict with the latter. The unit manager was authoritarian in his approach and related to the farmer on a patron-client basis. The territorial organization was imposed on the irrigation system, and a unit manager was imposed on 250 farmers with 10-15 farmers in each turnout group. The shift of thinking from the command area to the administrative unit is reflected in the focus of attention from the turnout group to the distributary channel organization. Under the unitary system, the RPM took over the functions of the government agent (GA), so other departments did not begin to function. All activities operate in a single line, the unit and block managers and the RPM. It is autocratic.

N.G.P. Panditharatna, former Director General of MASL, expresses yet another perspective:

> Timing is crucial, especially the first five weeks into the cultivation season. The performance of the whole season hinges upon the ability to get started on time,

with adequate agricultural input and credit. For this, the role of the unit manager in the management of the individual farmer's account together with the bank is crucial. The unit manager would vouch for the creditworthiness of the farmer, help him with the paper work and get the loan on time. He would help the farmer get his seeds, fertilizer, etc., and debit it to his account. Upon harvesting, he would also see that the crop is taken from the farm gate and transported to the stores of the Paddy Marketing Board. Once the crop is sold he would also see that the bank gets its repayment and the rest goes into the account of the farmer. With bulk buying by the Mahaweli Authority, the concessionary finance scheme of the central bank, and the unit manager managing the debit and credit of the bank balance of the farmer, there was to be no need for the farmer to handle money or deal with agencies. It was a simple system where institutions dealt with each other through the unit manager who dealt with the farmer. It was expected that within 4-5 years the farmer would have saved 20 percent of his income in savings which would enable the farmer to "live off his own fat" and make him "a proud chap and not the poor innocent farmer as he is often condescendingly called."

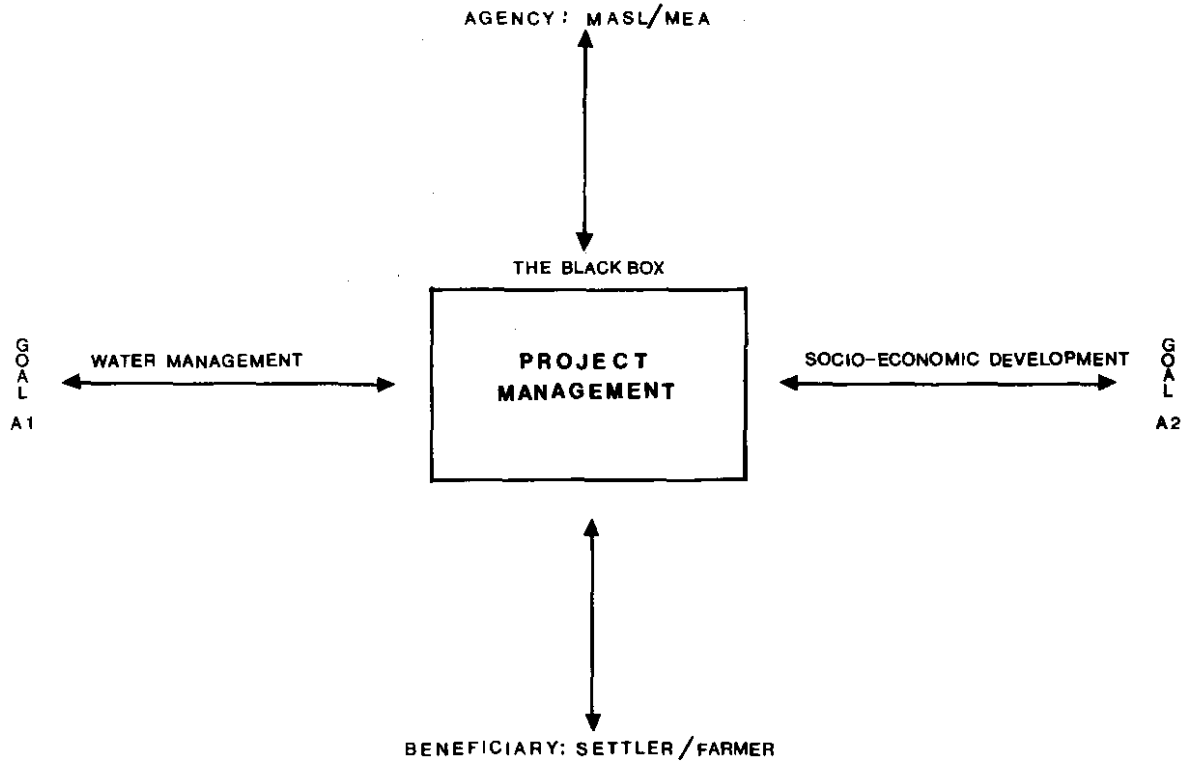
The unit manager should be a generalist, rather than an agricultural specialist. He was to be an arts graduate with nine months' training, who understood the problems of the farmer and acted on behalf of the farmer. He was to be responsible to the Mahaweli Authority for the farmer. His prospects depended on this performance. The engineer attached to the block and the TO would look after O&M and water management and the other specialist officers the other key aspects, but the unit manager was the coordinator and the manager. Everything needs management, meaning direction and guidance; it is a full time job and a professional job. His job is to gain access to things and this is time-consuming.

The UNDP/FAO and SOGREAH reports were meant to describe the preferred organizational arrangements (i.e., the structures and the functions of key individuals within these structures). From the outset, a tension emerges between two sets of functions and participants — the management of the water versus a constellation of activities labeled as settler welfare; and agency personnel versus the settlers/farmers in the system (Figure 9). A weighted balance among these four components is essential to optimize the management capacity of the organization.

However, the dynamics of personnel management or management control is not addressed in the reports, and as a result this tension has not been successfully balanced. Thus, the "master plan" as well as the SOGREAH report discuss the role and functions of farmers and describe the role of the agency in this context. The emphasis in the Scudder (1981) and Scudder and Wimaladharma (1985a, b, and c) reports is on settler welfare and settlement and the role of the farmer in water user associations as opposed to community development societies. The agency is perceived as characterized by over-bureaucratization and "burned-out syndrome."

Taking the unit manager as the representative of the agency at the field level, his role is perceived by Scudder and Wimaladharma as a "dense, unified, extension service." In

Figure 9. The Four Components of MEA Management.



their writings and interviews, Jayewardene (1984) and Karunatilleke (1982) have also emphasized this extension aspect of unit management and the role of the unit manager as the coordinator of services for agricultural development and settler welfare. However, the first Water Management Synthesis Project Report states that "the advantages that the Management Agency expected from the newly unified management structure have not been fully realized at the farm level due to the excessive work load and undue emphasis on paper work" (Alwis et al. 1982:29). The second Water Management Synthesis Project Report states that the unit managers interviewed said that they perceived their role as extension agents whose main responsibility is to provide the necessary services to the farmers (Alwis et al. 1983:174).

In Panditharatna (1984), we see an elaboration of the credit management dimension of the unitary style of management. It is expected that the unit manager will work closely with the local bank in estimating credit requirements for cultivation, and help in channeling repayments to the bank at the end of the season. The input credit which is given in kind makes the task easier. If the produce is marketed through the Paddy Marketing Board, credit granted can be automatically offset. If marketing is done through private dealers, then the unit manager must exhort the farmers to repay.

The Mahaweli Ganga Development Project as a large-scale, multipurpose project has macro- and microlevel policy implications. At the macrolevel the choice is primarily between hydropower and agriculture while at the micro- or system-level water management and settlers are the primary considerations. The smooth operation of the total project hinges upon a successful dialogue between *policy makers* and *management* at the macrolevel and *management* and the *farmer* at the microlevel.

It is important to note the essentially *project* nature of the present management system as reflected in its temporary outlook, centralized characteristics, and progress monitoring through key production indicators. These are generally characteristics of the early phase of the project cycle. Centralization has been further enhanced by the colonization and estate models of organization that were incorporated into the philosophy of management, and also, with the introduction of the MEA territorially integrated management. This trend was institutionalized with the introduction of the unit manager and the block manager. Thus, Karunatilleke (1982:171) notes that unit and block management is best suited for the initial stages of a project with emphasis on settlement and infrastructure development. He contends that this stage must be followed by the middle stage of the project when a "matrix style" of management must emerge for economic growth, to be followed by the penultimate stage when the project is transferred into the hands of the routine administration.

Unit and block management within the context of the Mahaweli Act is already a structure for matrix management. However, the functional expectations placed particularly on the unit manager are still those of the first rather than the second stage. Over the extended life span of the project, it is evident that other expectations have been built into the block and unit manager roles, especially the role of the unit manager

— that of extension agent, agricultural extension worker, and business and finance manager. Instead of relieving them of administrative work as recommended by the UNDP/FAO Master Plan, it is clear that they have been overburdened with bureaucratic chores.

The role of the block manager is also anomalous. He has simply become a conveyor of messages from the RPM, and a supervisor, physically distanced from the unit manager. There are specialists for irrigation, agriculture, marketing, and credit at the block. The FA is in charge of agricultural extension and the IL is responsible for water management. There is, thus, no need for another extension worker. The role of the unit manager as coordinator and integrator between the farmer and the specialist, not simply as a passive link, but as an active manager whose performance is monitored and evaluated by others through standardized systems and procedures, is lost.

This situation is further compounded by the gap in the other side of what the SOGREAH Report (1972:1:25) envisaged as "partnership management"— the settler turned farmer and the farmer organization. The feasibility studies as well as subsequent reports have viewed the block as the key to allocating water (Sullivan 1984) and monitoring performance (the monthly modular monitoring by the PMU), including the annual budget, as well as the construction and cultivation program. But the feasibility studies also anticipated that a farmer organization, either a water user group or cooperative, would fill this role at the block level rather than the agency, a goal yet to be realized. In the absence of this, the role of the agency has become increasingly visible.

The lag on the farmer side of the equation is the result of several shifts in focus — different consultancies have advocated at different times a cooperative society on the pre-existing model of such societies, a water user association, and a community development society. This lack of consistency in policy, objectives and strategy has set back the development of farmers' organizations, so that too many functions continue to fall to the agency by default.[10]

The timely commencement of the cultivation season is important in efficient water management. But water management must be linked with opportune supply of credit for inputs and access to markets if the farmer is to break away from what seems to be a vicious circle of rural indebtedness. Thus, a random survey conducted as part of this study in Kalankuttiya Block revealed a high degree of sales, leasing, and mortgaging of land by allottees even though these are officially prohibited (Table 9). These figures are very close to those in Bulankulame (1986:5, Table 2), though his "nonowner operators" included share tenants.

[10]We suggest that a farmer organization integrating water, credit, and marketing, rather than an organization based only on rights to the allocation of water, makes better sense in the long term and that community development should become the function of a separate body. Despite the occasional politicization of such organizations, cooperatives have a long and familiar tradition in Sri Lanka, and hence, could be a reasonable basis, especially for organizing groups of settlers turned farmers.

Table 9. Incidence of sales, leasing, and mortgaging of allotments in selected Kalankuttiya units in yala 1987.

Unit	D-Channel	Turnouts	Allotments no.	Original owner		Sold, leased, mortgaged	
				No.	%	No.	%
1	305-D1	21	28	16	57	12	43
5	309-D4	5	11	4	36	7	64
8	307-D3	15	19	6	32	13	68
Total		41	58	26	45	32	55

Source: IIMI Survey (1987).

The statistics available in the office of the manager (lands) for permits issued to allottees show the following:

Block	Total allottees July 1987	Permits completed	Permits handed over
Kalankuttiya	2027	1636	1352

Thus, 284 of the completed permits have not been given to the allottees. Because these permits must be handed over personally to the original allottees, it can be assumed that the reason for the gap is that the allotments have changed hands and the new owner is unable to collect the permit in the meantime. Illegal alienation is commonly given as the principal explanation by the agency.

Over time, the form of farmer organizations in System H has not only alternated between the concept of water user group and community development society, but the boundaries of associations have also alternated among the turnout, the hamlet, and the distributary channel. As emphasized in the feasibility reports, the need to encourage experimentation and therefore the need not to be hampered by legislation constraining line agencies, was a prime consideration in the case of farmer organizations and project organization. Paradoxically, this has had the unfortunate result of leaving too much of the operation and implementation of some 20 ordinances in the hands of the RPM — a managerial exercise which should have ended during the early phase of the project.

The RPM continues to be the repository of executive authority while the block and unit managers operate on delegated authority, case by case. Divested of what are legitimately their managerial capacities, these two levels of management have a

superfluous role. In the absence of a viable farmer organization, they become a stop gap and even an impediment to the development of such organizations. From the farmers' perspective, the distributary channel organization seems to be the emerging compromise (the hydrological boundaries accommodating the administrative unit). This again underscores the presence of the agency in a sphere defined originally as belonging on the farmer side of the equation.

PROJECT MANAGEMENT WITH A MATRIX FRAMEWORK

Policy decisions are handed down from the MEA/Colombo, but cultivation programs are evolved from the bottom up at the unit and block levels. According to MEA management philosophy, programs and officials are monitored against self-set targets. Given that, the project, as a result of its intermediary role between the system level and the lower levels, is a management enterprise without a constituency. The role of the RPM and his staff becomes that of a monitoring agent. However, unlike the System H Water Management Coordinating Panel, management is not a specialized, single-interest, linear, and bureaucratic coordinating effort but a matrix style of what is referred to as integrated management. Thus, the RPM is the overall monitor and immediately under him are four DRPMs, each representing key areas of policy. These are agriculture, water management, community services, and lands (see Figure 3). From the perspective of MEA managerial philosophy, these key areas must be integrated in order to measure success; one is not supposed to progress at the expense of the others.

Daily monitoring occurs through messenger, informal conversations, informal discussions, formal meetings, and requests for progress reports. Meetings are often on a one-to-one basis (e.g., DRPM [WM] calls in the block IE or the RPM calls the block manager). For monitoring purposes, there are two formal meetings, the progress evaluation and upcoming program review meeting held approximately every six months by the RPM with his staff, convening all the administrative blocks under his jurisdiction, and the meeting convened by the RPM and his staff at the level of the individual block, known as the RPM block meeting, approximately once a month. The purpose of these meetings is to discuss problems and issues emerging at this level, inform the block staff of policy decisions handed down from MEA, and monitor the progress of the cultivation program.

Decision making within a matrix framework as it is commonly used in project management is appropriate under the following conditions: 1) where simultaneous dual decisions must be made, 2) when a high level of uncertainty is generated by the environment, 3) where financial and human resource constraints are factors, or 4) when faced with a large quantity of products or services. A matrix also provides a transitional bridge between old and new management situations.

Ideally, matrix management includes team work and team strategy. A team is a working group with a common purpose, through which members develop mutual

relationships for the achievement of goals. Teamwork implies cooperative and coordinated efforts, a sharing of talent and leadership, and the playing of multiple roles. The ideal number of persons engaged in such joint action is usually no more than eight, although it may be expanded to include a natural grouping. Team performance evolves through group processes, partly through experience and training in technical, organizational, and interpersonal skills. Members gain strength from one another and build on the capabilities of their fellows — the combination is energized through "synergy," the capacity to facilitate cooperation in bringing together diverse elements so as to produce more than the sum of their parts (Harris 1985:14). Structural mechanisms are in place for dealing with procedure, organization, roles, control, and leadership, and the combination becomes orderly, directed, flexible, and responsive. A strong sense of group identity and morale results in a work culture that is open and supportive, permitting risks to be taken and confidences to be shared.

Project teams are established where members report to project and functional managers. In the absence of proper team development, the pitfalls of this type of matrix organization are a tendency toward power struggle and anarchy, excessive overhead, and decision strangulation (Harris 1985:233). To overcome this situation, leadership is shared by a team, and multiple functions are performed by different members at various times. A team has two sets of activities; one set sustains its internal workings, and the other, its task activities (Harris 1985:chap. 8).

In the first category, sustaining internal workings of the team can be stimulated for example, by a person who can develop a computer simulation may provide task leadership, one who can ease tension by joking at a moment of crisis may offer maintenance leadership, while a person who helps a group deal effectively with minority opinion, contributes norm leadership. These types of leadership are in turn associated with three types of behavioral orientations.

1. Task behavioral orientation is behavior of team members that affects carrying out of the work, and includes the mode of decision making — whether it is by consensus or leader *fiat*; problem-solving mechanisms — whether there is a method and whether the mechanisms are systematic; and communication — who for example, initiates and proposes tasks, defines problems, seeks and gives information, and clears up confusion.

2. Maintenance behavioral orientation is behavior of members that maintains group morale and cohesiveness. Conflict resolution is central to this, including the mechanisms for giving and receiving feedback, and the sensitivity with which it is handled.

3. Norms and value orientation include priorities and protocols that influence how the group works. Task activities are those achievement activities that enable the group to realize goals or targets within a specific time frame. These include analyzing the work to be performed; planning the use of project resources; setting

priorities and performance standards; developing a budget and getting it funded; recruiting, orienting, and supervising personnel; installing project controls; and establishing project communication, reporting, and evaluation systems. The more team participation there is in performing these tasks, the greater is the chance for success of the project. A team charter and team leader are necessary to bring together the technical and human resources required, and to develop team and organizational relationships.

THE RESIDENT PROJECT MANAGER AND MATRIX MANAGEMENT

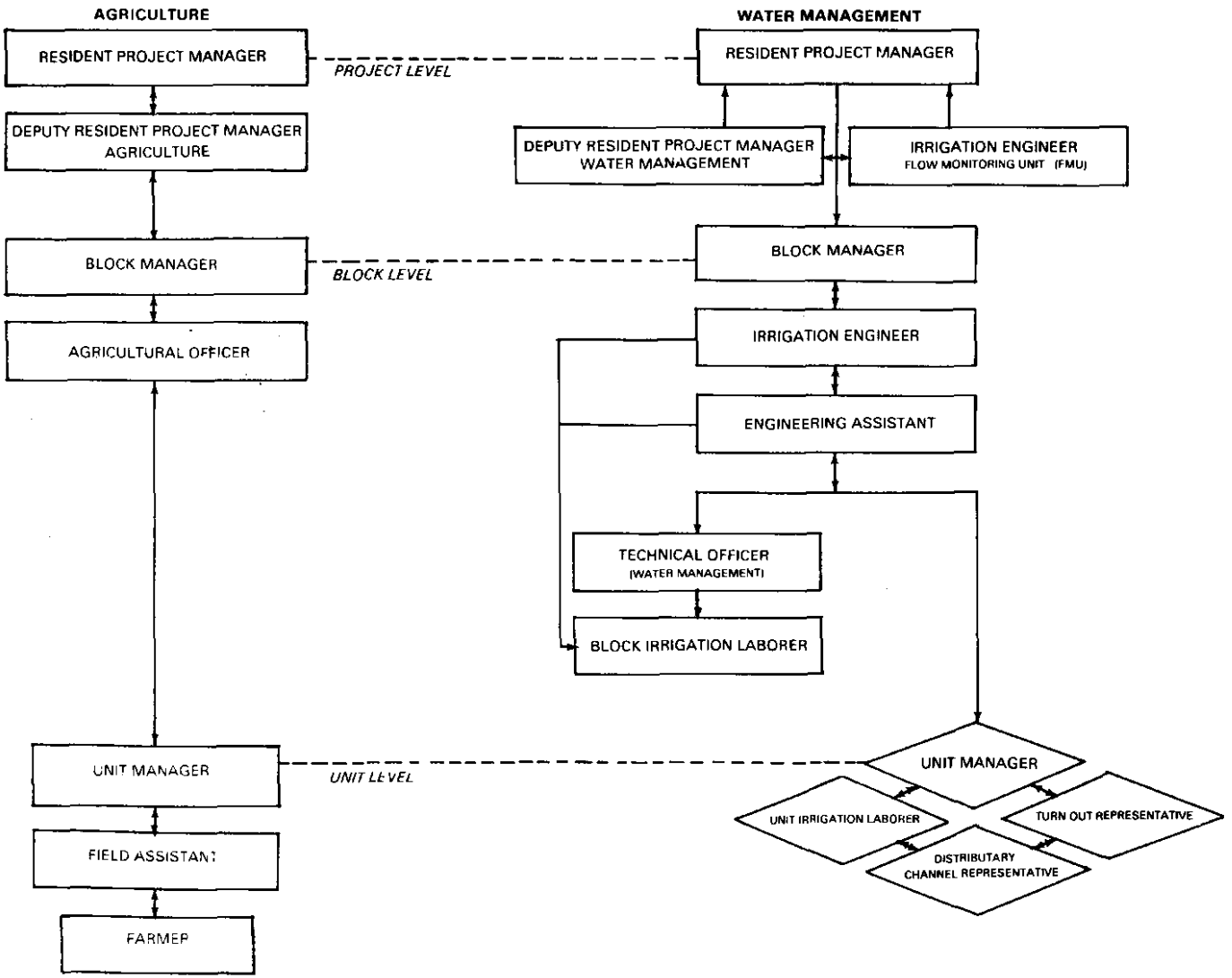
MEA perceives its management at the field level as integrated matrix management. In management science, matrix organization refers to a mode of organizing, especially of large-scale projects, that results in persons having task and function assignments, and as a result, being attached to two units of the organization or having two bosses simultaneously. The matrix has functional units across the top, and task units down the side, with entries indicating persons from various functions assigned to a given task (Drucker 1977:565). Task units combine with other similar units within demarcated functional boundaries to realize objectives and programs under the manager of this functional unit.

The stated objective of MEA's matrix organization is to improve the coordination function of the agency (MEA 1985:3-4) among its task divisions, and the interface of the agency with the evolving process of institutionalizing farmer participation in management.[11] While the organization chart of MEA reflects operational reality in the performance of some tasks (e.g., agriculture), it does not reveal the complexity of field-level conditions in other cases, notably water management. Statutory authority for irrigation management is vested in the functional unit of the project and specifically in the position of the RPM. The block and unit simply have delegated authority — authorization must come from the project level. In the absence of telephone links among units, blocks, and project, such communication takes time. Information is passed down functional lines while those who must make decisions based upon this information are task-bound. Figure 10 is a schematic presentation of the contrasting matrix organizations for the management of agriculture and irrigation in Kalankuttiya Block.

The exercise of authority and responsibility and the transmission of information are key components of management emerging out of this matrix. The RPM has real authority, but for irrigation at the project level, authority and information are shared within a team. The Irrigation Engineer, Flow-Monitoring Unit, acts as the liaison

[11] "Institutionalizing" here involves establishing individual roles of farmer representatives at the distributary and turnout levels, and not necessarily building formally constituted farmer organizations.

Figure 10. Contrasting Matrix Organizations for Managing Agriculture and Irrigation in Kalankuttiya Block.



between the project and the Chief Irrigation Engineer at MEA/Colombo, as well as the Water Management Secretariat, in a network of officers at the field level. Agriculture is simple in form and lean in staff — "few administrative layers and few people at the upper level" (Peters and Waterman 1982:306) — and thus conforms to one of eight characteristics of managerial excellence as discussed by Peters and Waterman in their now famous book, *In Search of Excellence.*

The more arduous and challenging task, which some say is impossible to achieve (Seckler and Wade 1986:78), is the integration of irrigation management and agriculture. This is where the matrix organization falls short at the project level. At the project level the participants in this management strategy are the RPM and his DRPMs — agriculture, community development, lands, and water management. However, our research shows that the primary function of the office of the RPM is as coordinator and monitor of the administrative blocks. The task of water allocation is de facto in the hands of other offices. The RPM's office, viewed from the perspective of water management alone, has the role of monitoring the use of water but not controlling its distribution (this is normally a task for the block office), and when the need arises, as in maha 1986/1987, coordinating allocations among the blocks.

Viewed from this vantage point, the project office embraces a matrix of activities as well as a matrix of personnel representing such activities. But this in itself does not make the whole exercise matrix management. Based on our observations, several conclusions emerge regarding matrix management at the RPM's office.

* The size of the group to be managed (the personnel within the RPM's office, i.e., the effective group with decision-making power, excluding the clerical staff) can be reduced to a manageable group of 8-10, for example, the RPM, four DRPMs, the program and progress control officer, the marketing officer, the project personnel officer, and the project accountant (Figure 3). However, this office by its very nature becomes operative through the block office. While daily informal contact is clearly the norm, the two formal meetings for coordinating and monitoring are too large and unwieldy to be productive. Thus, the "team" of participants is too big for effective matrix management.

* The number of subjects covered by the management "team" is in excess of what can be discussed and examined thoroughly. As a result, what is discussed is a random selection from the range of possible issues selected by the RPM. Some discussions become perfunctory and some people do not get an adequate hearing.

* The meetings we observed were in every case summoned without adequate notice, and as a result, adequate preparation on the part of the block staff was not possible. There is no set schedule or formal procedure. This contrasts with the meetings of the System H WMCP.

* Budgets, objectives, and priorities are set by MEA/Colombo, which also recruits and trains personnel. Program planning and implementation is the result of a dialogue between field-level and Colombo officials.

Project control through program monitoring and evaluation against self-set targets is part of MEA management philosophy. However, systematic monitoring of the total development program and its progress, called program and progress control, is really the task of the PMU. The PMU has a set of eight reporting modules or forms numbered from A to H. At the block level, modules A, B, C, E, F, and G are completed on a monthly basis while D and H are done once in three months. Four copies of each module are prepared. The block office retains one and submits the remaining three to the program and progress control officer at the project office. The latter retains one for the project office file and submits the original to the PMU with a copy to the Managing Director, MEA.

Module A reports settlement figures; B reports on figures on allotments and housing construction; C includes construction of buildings, wells, and roads; D has population statistics, deaths, births, disease control, food programs, education, and community development activities; E reports agricultural inputs, extension, credit, marketing, and crop insurance; F reports on water supply — rainfall figures, sluice issues from reservoirs, and the area cultivated; G reports on agriculture—crops, land preparation with rainfall or irrigation, available manpower, tractor power and buffalos, and market price for the produce; and H reports on personnel — the administrative cadre, the number and nature of training programs for officers and farmers, and cultural activities.

As described by the program and progress control officer, the modules are for the "inspection of the PMU and the information of the MEA." The modules are basically a statistical comparison of total targets, monthly targets, and what was realized during the course of the month, together with a few lines of comments (if any) by the block manager and a comment by the RPM. Based on the feedback from the PMU to MEA, the managing director will inquire further if necessary from the RPM. An issue emerging from this monitoring may become the focus of a management brief, which is essentially a discussion, sometimes with illustrations, done on a two-to-three month basis by the top staff including the RPM of the MEA.

Financial monitoring of the budget is the joint task of MEA and MASL. Draft budgets are developed at the block level. The sum total of the block budgets, together with the project office budget, are discussed at MEA by the managing director and project coordinators and submitted to MASL for approval. Monthly monitoring by MEA is through the project expenditure statement. At the end of six months, the budget is revised in consultation with project officials by evaluating areas of under- and overexpenditure. At this stage, if there is a cutback in the budget of the Mahaweli Ministry and through this the MASL, it is passed on to the project budget. Within the

block, the transfer of funds to and from items is at the discretion of the RPM, in consultation with the managing director.

The project coordinator, based at MEA/Colombo, who is the overall coordinator/liaison officer for System H, is best described as a liaison between MEA and the system, and the system and other government agencies. The project coordinator describes himself as the link between the general manager and the project, as well as various consultants and the project and other agencies and the project. During the construction phase of a project, he has greater responsibilities — planning for settlement and infrastructure development and liaison with donors. Subsequently he becomes a coordinator of line functions of outside agencies for program implementation in the project, such as telephone service or electricity supply.

He is normally kept informed of everything that goes on in the project, including routine administrative appointments and transfers. Once or twice a month he visits the project to discuss the progress and assist in solving problems. He is on the phone to the field three to four times a week. The specialists at MEA may deal more frequently with matters relating to their own area, such as water management, but the project coordinator generally "knows about everything." He receives the monthly progress monitoring modules from the PMU via the managing director. He also receives the reports submitted by the FMU, quarterly reports on all project activities, seasonal reports submitted for the project, and the occasional reporting by the System H WMCP. He describes his role as a generalist, a manager, and one who keeps himself informed. If critical issues are pointed out by the PMU through the MASL, he will initiate an inquiry at the project level. Administration within the project is at the discretion of the RPM; administrative reorganization through amalgamation of units and the transfer of unit managers is an example.

However, what is lacking in this management exercise is attention to the maintenance activities of the team, which are simply left to the discretion of the project officials. The professional management monitoring or the exercise of management control as an in-house activity of the MEA at the project, and more logically at the block levels, has been subsumed under standard project management monitoring techniques. What emerges is not a team but a hierarchical structure: communication, especially at the lower levels, is largely a one-way process; instead of shared leadership, the system pivots on the RPM.

In the absence of clear-cut standards for evaluating performance, and given rapidly shifting job priorities, the yardstick for program monitoring is individual performance within the current program, rather than the program itself as a collective exercise of the team. The individuals targeted are usually placed at the stress points of the management system, with the least access to decision making. Because there are no clear-cut standards for evaluating performance of a team with reference to its program, except in terms of numerical targets, the style of such monitoring becomes personal and is construed by the recipient as well as the group as an affront rather than an impartial evaluation of performance. This lowers morale among the group.

Team morale is further reduced by the apparent identification of Galnewa Project with Galnewa administrative block. Both offices are located in Galnewa, across the street from each other. At times the office of the RPM is referred to as the Kalawewa RPM's office, but because the Kalawewa Reservoir irrigates other project areas as well, such identification does not seem apt. The project office is generally known as the "Galnewa RPM's Office."[12]

To further complicate the scenario, as discussed above in Chapter III, sluice issues from the LB/MC, though formally under the charge of the DRPM (WM) Galnewa Project, in reality are under the supervision of the IE Galnewa. This has led to a perception of conflict of interest on the part of this IE. The general sentiment among officials at Kalankuttiya was one of lack of empathy and support by the project management as well as the IE Galnewa. To solve this problem, in February 1987, a channel of communication was established in the form of regular informal meetings of the IEs for Galnewa, Meegalewa, and Kalankuttiya. Unfortunately, much of the value of this exercise was lost because of its ad hoc nature — they were informal discussions with no record of decisions or precedents set (this is in contrast to the WMCP meetings at the system level). In the absence of a formalized structure, it is not an experience that can be repeated.

However, an unexpected source of help came in the form of the Irrigation Engineer, Flow-Monitoring Unit, who was aware of the night irrigators and illegal tapping upstream at Galnewa, and who also knew that the hump gauges used as measuring devices along the MC at Galnewa do not adequately reflect this loss. According to the Irrigation Engineer, Flow-Monitoring Unit, the recorder is fixed over the hump and the water level over the hump is minute, so changes recorded in the chart are small. A change in discharge of 140-280 liter/sec (5-10 cusecs) is too small to cause a perceptible change in water level. This IE is working on setting up an automatic recorder with pulleys so that the markings on the graph will reflect even relatively small changes. To do this, he must import special graph paper to do the calibrations, and this may take time.

As a temporary alternative, this IE initiated a system of patrol laborers who monitored the canal at night. This practice was also adopted by the blocks. The Irrigation Engineer, Flow-Monitoring Unit, and the block manager admitted to the limitations of such an exercise: "as the two patrol laborers walk the distance of the canal from one end, the farmers steal from the other end." According to the Irrigation Engineer, Flow-Monitoring Unit, during the period when the patrol laborers were hired, it was discovered that conveyance loss in the MC up to Mulannatuva Tank, which had been as high as 20 percent, fell to 5-8 percent. Upon learning this, the Irrigation Engineer, Flow-Monitoring Unit, in computing water duty per administrative block deduced that the difference was the result of illegal tapping at Galnewa, and added the difference of 12 percent to the water consumption of this block, so that its previously computed low water duty was considerably enhanced. As

[12] Since the completion of this study, there has been a major reorganization and the boundaries of these units have changed.

the IE himself stated, the FMU does not normally involve itself in the internal operations of the administrative block; but clearly this is an instance where its monitoring process was instrumental in filling a void on the LB/MC.

A counterpart to the System H WMCP is required for coordinating water allocation and distribution on the LB/MC. It should go beyond the loosely structured arrangement described above. The role of coordinator should be entrusted to an official at the project level rather than a peer and fellow participant at the block level.[13]

This could then be linked with a streamlined version of the presently existing block-level organization. However, it is a link that can be exploited to its full potential only by effective matrix management at the project level. But as our data show, because of the nature of the management pyramid, the role of the project management is essentially that of a monitor. It is perceived by those subject to its monitoring (in this case the Kalankuttiya Block) as partial towards another administrative block; the oral style of monitoring is regarded as a personal evaluation and moreover a personal attack; and perhaps due to the large size of the gathering, as well as the multitude of issues covered, such monitoring becomes a perfunctory exercise without adequate chance for those at the receiving end of criticism to defend themselves. Though it is implicit that program performance depends on the collective effort of a managing body, in reality targets within the program, as well as individuals rather than the group (team), are picked at random for evaluation. Typically, they are at the lower end of the administrative hierarchy.

THE ADMINISTRATIVE BLOCK AND THE UNIT: THE CRUX OF MATRIX MANAGEMENT

At the unit and block levels, there is truly a need not for a bureaucracy, but for a matrix management strategy. In terms of function and size (area plus population), the administrative block is the optimum location of management responsibility exercised in a matrix framework. However, the block manager, and certainly the unit manager, have no independent jurisdiction; they implement policy with the stamp of approval from the RPM, who delegates authority on a case by case basis. In the absence of independent authority, *ésprit de corps* among agency officials at all three levels is crucial. This is also the essence of matrix management and as discussed earlier, is lacking in the monitoring system of the project office.

In addition to the modular monitoring done by the PMU, the project office requests monthly progress reports from units and blocks, which are for the monthly MEA staff

[13]Since this study was completed, we understand MEA has appointed an IE in overall charge of the LB/MC. LB MC

meeting, where the RPM represents his project. These reports essentially cover the same type of information as in the modules — monitoring of statistical targets. Absence of supervision coupled with the plea, "there is no one to teach us and correct us, instead they will reprimand us and belittle us," is often heard at this level. At the unit level of management, there were no complaints of poor salary, but there were two complaints against the higher levels of management — lack of appreciation for the work done, and absence of friendly advice and supervision. Task overload of the management system and the quicksand of rapidly shifting priorities, especially at the unit level, further compound this situation.

Management of the interface, or the ability to capitalize on the social, economic, technical, political, and other environmental factors, is particularly important at this level. But paradoxically it is accompanied by decreasing ability on the part of the management to exercise managerial control effectively . Also, conflict management, a key function of a management system, is very important as the frequency and intensity of agency-farmer contact increases, but again paradoxically, the capacity of the management system to perform this function is weak. What remains is a lower-level bureaucracy eliciting criticism from the higher management and the farmers with little incentive to give the best performance, rather than the type of matrix management required.

At the block level, the absence of either direct or delegated authority weakens the hand of the block manager. Though devoid of real authority, the block manager continues to be the primary transmitter of information from above.. The agriculture component of the management team at this level is lean, including simply the block manager and the AO. However, water management requires a more complex approach. In the ideal scenario, the block manager must transmit information (for example an unanticipated change in the volume of water available through diversion) to the IE, and through him, to at least the EA (WM) and the TO who assists this EA, and then to the block IL. It is here that the farmers come in to the scenario as beneficiaries, but in the absence of a viable organization, they are simply ad hoc pressure groups. Nevertheless, from the agency side alone, in comparison to the project level, the network of relationships for team management at the block level is very complex and ineffective.

MATRIX MANAGEMENT: COUNTER STRATEGIES AT THE UNIT AND DISTRIBUTARY LEVELS

At the unit level, a comparison of the agriculture and irrigation components of team management shows a sharp contrast. The unit manager and the FA deal directly with farmers for agricultural training and extension. But for water management, there is a dichotomy between the unit manager as the source of information and (minimal) authority, while responsibility for water management may be distributed randomly among the unit manager, the unit IL, and on the farmer side of management, the

distributary channel representative and the turnout leader (Figure 10). We found no pattern for the eight units in Kalankuttiya Block. A clear understanding of who should have the information, and timely flow of information seemed difficult to achieve in Kalankuttiya Block.

Lack of adequate and timely information flows among various levels of the agency, and between the agency and farmers, compounded by coordination problems, inadequate performance monitoring, and unrealistic amounts of water requested for some rotations, leads to perceptions of unreliable and inequitable water supplies at the unit and farm levels. These problems lead to responses at the unit and distributary levels that we have called "counter strategies."

Counter strategies are primarily requests made at the unit level by unit managers and the unit-level IL, popularly known among farmers as the *Jala Palaka Sevaka* (FA/WM), for additional water on a day-to-day basis. During the period of land preparation, water issues to units and distributaries are computed based on what the unit manager conveys to the block office through the "field note." A notebook is sent from the block office through a messenger on a push-bike to each unit office, and the unit manager documents the extent under land preparation as well as the extent anticipated. Water issues are computed accordingly. Once land preparation is over and rotational issues begin, water issues are said to be standard releases computed according to the area cultivated. Also, when harvesting commences, the unit managers inform the block office of the area harvested by distributary so that water issues can be reduced accordingly. What actually happens during a given rotation, however, is somewhat different from the stated pattern.

Requests for a certain amount of water per unit and distributary do not simply end at the completion of land preparation, with further issues then standardized. The field note is a daily routine. Even during rotations, a unit manager may request water for a time period beyond the set rotation through this mechanism. The original purpose of this note was to redress the imbalance in cases where the level of water in the distributary is below the anticipated level, so that adjustments can be made the following day. There are two notebooks, one for units 1, 2, and 3, and another for 4, 5, 6, 7, and 8. Typically, there are four columns for each entry — the date; the distributary; comments by the unit manager such as "if there is no rainfall, an additional three hours of water is requested on 6 August 1986" with his signature; and the verification of the EA (WM).

But the field note is at least a 24-hour process, so the necessary adjustment in a distributary is usually done the next day. The carrier of the note, the block office IL, must complete his round of all the unit offices and upon his return to the block office, notify the IE, or his EA. It is stated that typically this mechanism is used more frequently by the unit managers at the tail end of the block, those who have to commute some distance to get to the block office.

At Kalankuttiya, the use of the field note was discontinued by January 1987. According to the IL who maintained the notebook, this was a chore he had to do each morning in addition to taking the gauge readings. He reported his "difficulties" to the EA (WM) and then discontinued the practice. According to the EA (WM) herself, the field note was not a success because any requests for additional issues of water could be granted only the following day. This opinion was substantiated by at least half of the unit managers. However, at least one unit manager was of the opinion that the field note was discontinued on purpose because it was evidence against the block management. It was proof that the unit managers did not at times receive the quantity of water they had been promised. The alternative mechanism, largely followed by the unit managers in close proximity to the block office, is to communicate personally.

The two rotations examined in depth were extended for a number of reasons. These included absence of anticipated rainfall, the precariously low water level of Kalawewa Reservoir, the management of interblock distribution of sluice issues from Kalawewa LB/MC, and rapid drop of tank levels at Kalankuttiya, with a resulting insufficient water in longer-than-average distributaries and at the tail end. Based on observations, or the complaints he receives from farmers as to whether any fields in his unit are suffering from lack of adequate moisture, a unit manager requests either the IE or the EA (WM) to lengthen a rotation for a particular distributary beyond the allocated time limit.

Such requests comprise a "hidden dimension" first noticed in casual conversation at block meetings. After probing persistently for more information, the following became apparent in interviews with the IE and EA (WM): usually rotations are lengthened as a result of verbal requests by the unit manager when he visits the block office (daily visits are typical). Again, a unit manager may make a request personally to the EA (WM) informally, (approximately 25 percent of the time). Only in cases where the request is sent through an intermediary, maybe a farmer or the laborer employed under the unit manager, is there a demand for a written request. For maha 1986/1987, no file was maintained for these chits, though it is apparent from our observations and the agency's records that rotations were lengthened upon demand.

When we inquired about this file from the EA (WM), she said that a file is maintained for such requests in the current season. For maha, she searched her desk and came up with five written requests. In the absence of systematic record keeping, it is possible that more were simply lost. All five request an extension of the rotation. The wording of these chits is worthy of note in that they vary in their degree of explicitness. One is in the nature of a standard government document with a "my reference number," specifying the dates of the rotation and giving distributary gauge readings. It notes that because the amount of water received has declined progressively, it is not possible to complete the rotation in four days. Therefore, a further day's extension is requested. Another request says that in 306-D4, 3 allotments did not receive adequate water during the last rotation and as a result, an 18-hour extension of the rotation is sought. A third request is from unit three, stating that

305-D3, 305-D4, and 308-D3 had received very little water as of 19 January 1987. Therefore a two-day extension of the rotation is sought. The next chit requests an extension for 305-D3 and 305-D4 until 6:00 pm (1800 h) on 4 February 1987 (the request itself is dated the previous day). The fifth request is again from unit 2, asking for a 24-hour extension of the rotation for 308-D1 and 305-D1.

In the absence of an adequate record of these requests, one must either assume that the disparity between issues computed and issues released is the result of other such requests, or do a survey to elicit through document or memory whether other requests were made. Our evidence indicates that no records are maintained at the unit office. Data of this nature (dates, times, and amounts of water) based on recall are at best tenuous. At least four unit managers have stated that they go to the home of the EA (WM) in the morning before she goes to work and make their requests personally. This method is considered quick as the EA (WM) can make the necessary arrangements to give additional water the same morning.

The main reason (the sole reason according to some unit managers) for requesting this additional water is undersupply in the distributary. Water issues begin with the expected quantity and gradually decrease. Unit managers often claim that the IL checks the distributary gauges on the first day of water issue for accuracy and then does not make subsequent adjustments; but on successive days, as water is issued over an increasingly larger area, the gauge height drops. The EA (WM) denies this and says that the gauge height drops because of illicit tapping by the farmers. When this happens, the expected area cannot be irrigated within the time frame of the rotation. In addition, water shortages result in longer rotations which lead to some allotments being so dry as to necessitate additional water. Even though records were not maintained, units 7 and 8 at the tail end of the system have made such requests almost every rotation during the latter half of maha.

A unit manager commonly requests additional hours of water, thereby extending a rotation. Sometimes he supports such a request by mentioning farmer demand, or independently asks for extra water by referring to the low gauge height. A unit manager may make his request in cusecs if the distributary water level is low, or he may make his request in hours, to lengthen a rotation. At the block office, unit managers' requests are usually converted into cusecs. A unit manager at the tail end stated that he preferred to make his request in cusecs, because the more cusecs he gets the sooner he can finish irrigating his fields. Another unit manager, also at the tail end, stated that he prefers to make his requests in hours; calculating in cusecs is the duty of the water management section in the block office.

According to the IE Kalankuttiya, the agency does not take into account soil variations in computing water issues at the field level; only the cultivated extent is accounted for. However, in practice, the unit manager, his IL, and the farmer leader at the turnout consider these factors. Also, the agency does not take into account faulty structures in making its computations, but the unit manager in making a request for an

extended issue does take this into consideration. Thus, to draw on an example from this yala in 309-D3 of unit 5:

> This is a distributary that is two kilometers long and the distance up to the last turnout is three kilometers. The calculated water supply to this channel should reach a gauge height of 3 ft (0.91 meters) but on this particular day it had a reading of 2.5 ft (0.76 meters). Consequently, the flow into the last 2 turnouts was only one-third of the capacity, and the farmers in these turnouts could not irrigate their fields within their time limit of 6 hours (even after 12 hours they were still trying to complete the task). Moreover, there was a leak in a field channel in turnout [number] 8 aggravating the situation. In addition, a big leak in the distributary itself, near turnout 4, had enabled some farmers to cultivate approximately eight acres (3.24 ha) of rice (the water budget and the cultivation program for the LB had explicitly ruled out rice). When calculating the water supply to the distributary, these leaks are not taken into account, but the unit manager must consider them when making extended issues. The calculated gauge height of 3.0 ft (0.91 meters) was reached on the first day of issue (5 May 1987), while the next day the reading was 2.8 ft (0.85 meters). Taking into account the overall situation, the unit manager made a request to the IE [verbally through the EA (WM)] for an increase in the gauge height up to 3.5 ft (1.07 meters) in order to complete the rotation during the set time (approximately three and a half days in a seven-day rotation for the block). His request was turned down as the main sluice must be adjusted in order to accommodate this request. According to the unit manager, this would compel him to ask for an extended rotation.

More frequent than requests made by the unit manager are similar requests made by the unit-level IL. Originally, the IL was part of the organizational structure under the Mahaweli Development Board. In 1983, a change was made in the nature of their appointments. The age limit for applicants was lowered from 25 to 20 years. The salary of an IL was increased from Rs 615.00 to Rs 800.00[14] for the casually employed and Rs 1,100.00 for a permanent IL. Educational qualifications were greatly reduced from GCE (Ordinary Level) Examination with five subjects and a pass in the one-year practical farm school course of the Department of Agriculture previously, to a pass in grade eight and two years' experience in opening and closing turnout gates and branch gates, now. Above all, supervisory authority over the IL was removed from the hands of the DRPM (Water Management) and now, vested with the unit manager. However, there was no basic change in the tasks to be performed by the IL. To quote a circular issued in October 1983:

> (the IL) will be responsible for water management within the unit manager's area . . . duties will include the opening and closing of branch channel gates and turnout gates, issuing of irrigation water for cultivation purposes and urgent minor repairs in irrigation channels . . . care, maintenance and security of turnout gates, channels, irrigation roads, and reservations coming under his supervision; prevention of damage and thefts, encroachments or polluting the channels. . . .

[14] US$1= Rs 31.00 in 1988.

The IL is indeed the kingpin of water management from the agency side of the partnership.[15] The position has evolved from the ditchrider as envisaged in the SOGREAH Feasibility Study of 1972 (a person hired by the farmers), to the FA (WM), to the present day IL for water management. This person is at the agency-farmer interface. In theory, he must carry out the instructions of the unit manager. But in practice, especially due to the latter's absence from the field in most cases, the unit manager relies on the IL for water management tasks which go beyond simply operating the turnout gates. Often, the unit manager will prepare the water issue timetable after discussion with the IL, and the turnout leaders will distribute water under the IL's supervision. In unit 7, for instance, the IL has complete responsibility for water distribution up to the field level. Often farmers faced with a water shortage will come directly to the IL and the latter will on his own meet the EA (WM). The farmers view this as time saving because even if they inform the unit manager, the latter will send the IL to the EA. Further, the IL from the unit often has direct contact with his counterpart at the block. Any changes in the volume of water required is often made verbally, directly to him.

The IL is the coordinator between the farmers and the unit manager. Typically, an IL has several years' experience in water distribution and a good knowledge of the field. He carries messages from the unit manager to the farmers and vice versa. He obtains field data for the unit manager on the progress of land preparation and the subsequent stages of the cultivation season, and water issues are based on this information. He assists the unit manager in selecting *bethma* lands (a system of sharing lands during water-short seasons) and in organizing *shramadana* (voluntary communal labor) and other social events. In the interim, he acts as a carrier of urgent letters and reports from the unit to the block office.

Despite considerable water management responsibilities, as a laborer and often a casual one at that, he is at the lowest level of the agency. He has no authority from the agency and information flow from the block is often haphazard. In the eyes of the farmer he is a *meccan* — a peer — and not a *mahattaya* (gentleman), as other officials are referred to, and thus, he commands no respect; yet he is not a fellow farmer or a part of the farmer organization. Faced with this inability to enforce decisions, he overlooks or ignores what he cannot resolve, such as the head-end farmer overirrigating his field or excess use by agency officials who are themselves cultivators.

The ditchrider was originally envisaged by the planners as an "educated laborer" and so was the FA (WM). However, the educational standards required of the IL are lower, and he receives no training in water management. He also needs some training and some systematic monitoring from the irrigation section of the block office, thereby formalizing what is presently taking place, that is, expanding the link between him and

[15]Bottrall (1981) and Wade (1980) arrived at a similar conclusion, that water management hinges upon the lowest echelon of the management system.

the EA (WM). Further, his relationship with the unit manager must be resolved, specifying the managerial functions of the latter, or integrated management will become what the agency sought to avoid in the beginning — functionally isolated in line agency style.

As a response to managerial problems upstream resulting in a lack of timely and adequate supply of water downstream, management at the unit level has already evolved a linelike, rather than matrix teamlike response — the unit manager appealing to the EA (WM) at the block and not through the block manager, and the IL at the unit level communicating with his counterpart at the block office or the EA (WM).

A reliable set of data from this presently "hidden dimension" would be an index of agency responsiveness to water requirements in the field at the farmer-officer interface. It would also be a clue as to how agency management strategies at the unit level take into account and redress the imbalances in the allocation and distribution of water at the block and project levels of the main system. In addition it could also be used as a measure of management efficiency regarding responsiveness to farm water requirements. This could then be combined with other management efficiency variables related to optimal use of available water. Then, a critical path analysis could be performed to arrive at an index of managemt efficiency. This topic is discussed further in the next chapter.

MATRIX MANAGEMENT BELOW THE UNIT MANAGER

Paradoxically, there is no clear strategy in this managerial grid for the transmission of information from the unit manager to his assistants and the farmer representatives. This is a scenario from yala (the week of 15 August 1987):

> *The IE at the block meeting, Kalankuttiya.* The Kalankuttiya Tank level this morning was 2 ft 3 inches (0.69 meters). It was receiving 80 cusecs (2.26 m^3/sec) from Mulannatuva as of yesterday but this was dependent upon diversion from Bowatenna into Kalawewa. We have decided to limit the rotation to three days, not to issue water to paddy cultivators "under any circumstances" and to issue water from the bottom to the top.
>
> *A rotation in 307-D3 in unit 8 on 19-20 August 1987.* The main sluice was opened at 6:00 am on 19 August; water was issued from bottom to top, and water reached T1 (turnout number one) at 5:15 pm. However, neither the turnout leader nor a single farmer was present in the field. During the previous rotation, the lower section had been issued water last and the farmers were unaware that a change had been made at the block meeting in order to optimize water issues when the tank level was at 5 ft (1.52 meters), thereby enabling issues to the tail end of the system.

The general awareness of low tank levels and the tail ender traditionally being thwarted in his expectations of a reliable water issue were further factors.

When water reaches T1 and T2 (turnout number two), the IL sends a message to the turnout leaders. The IL has the keys to the turnout gates and when he estimates, based on his own experience, that there is adequate water (there are no gauges at the turnout), he opens the gates. The leader of T2 arrives and asks the IL to increase the flow further, which the latter does. Three farmers come to the field at this point and because they are the first to arrive, they are given water even though one is a rice cultivator — the IL was not aware that rice cultivators were not to be given water though in this case clearly he could do very little about it. At this point, the IL calls it a day and goes home. Water is issued to the tail-end farmers the next day.

The longest distributary in the block (approximately 3.5 km) is 307-D3. Head-end farmers had cultivated several hectares of rice with water from a leak in the channel. At one point, the distributary is wider than at other points and it takes several hours for the water to pass this spot after which it overflows. Aside from these problems in the physical system, what was evident from the managerial side is that in most cases at Kalankuttiya, it is the IL and not the unit manager from the agency, or the distributary channel representative or turnout leader from among the farmers, who is responsible for water management. The unit manager participates in the block meetings, but the decisions made at meetings such as the one described above do not reach the IL, the turnout leader, or the farmers.

CHAPTER V

TOWARDS AN INDEX FOR PERFORMANCE MONITORING AND EVALUATION

WATER MANAGEMENT: THE ANALYSIS OF A MANAGEMENT SYSTEM

Water management decisions and strategies, as well as the monitoring of the performance of management with reference to such decisions and strategies, have been described and analyzed at the main system level of System H. The focus of analysis is storage in the Kalawewa Reservoir, the allocation of water to the LB/MC, and its distribution among three administrative blocks. Management by the agency on the branch canal of one such block — Kalankuttiya — during two rotations in maha 1986/1987 has been given special emphasis.

Management by the agency, as in the operation of the conveyance and distribution system within the parameters of the project, the administrative block and the unit, has been documented under a water-scarce and crisis scenario which called for greater management efficiency and intensity than is normally the case. By the same token, it was also an opportunity for revealing the crucial connecting links and their strengths and weaknesses in main system management at System H.

As a management system under stress with managers forced into decision making under uncertain conditions, we have shown how the agency during the course of the season came up with several alternative strategies and counterstrategies. The water management objective was adjusted from 6.35 cm (2.5 inches) at the farm gate, down to 5.72 cm (2.25 inches). Simultaneously, a closer monitoring of management performance through establishing standards of accountability was implemented at the system level.

Conceptually, such decisions shifted the agency's concern from moisture levels on farms, to storage levels in the reservoir. This was based on the overriding goal of stretching what was in the tank to the end of the cultivation season to save the crop.

Consequently, at the system level and then at the project and block levels, the objective was to issue only the quantity of water received, whether it was from further upstream to Kalawewa, from Kalawewa to the LB/MC, from the LB/MC to Mulannatuwa and then to Kalankuttiya Tank, or ultimately issues within the Kalankuttiya administrative block. In examining sluice issues to the LB/MC it is clear that water issues were often below the targets for the week (storage levels in Kalawewa showed progressive improvement). Moreover, as pointed out by the management, there was a successful maha harvest. Why, then, did problems emerge in R6 and R8?

In our view this was primarily due to the inability of LB/MC and block management to maintain constant tank levels at Kalankuttiya in order to ensure uninterrupted and consistent discharge at the distributary level. This situation was further compounded by excess use of water by farmers at the head end, and the failure of the IL to monitor deliveries adequately at the distributary level.

Information on inflow into Kalankuttiya became of paramount importance, but such records were not routinely maintained. Although 2.12-2.26 m^3/sec (75-80 cusecs) were expected from Mulannatuwa, only 1.27-1.42 m^3/sec (45-50 cusecs) routinely arrived. The agency personnel blamed this shortfall on illegal tapping by farmers. In addition, 15 percent of the delivered amount is assumed to be conveyance loss along the LB/MC, leaving 1.1-1.2 m^3/sec (38-42 cusecs), that is, nearly 50 percent of the amount officially assumed by higher-level management. It is not that management is unaware of this shortfall; rather, higher-level agency officials believe that if they give the full requirement initially, much of it will be wasted; they thus deliberately give too little, and issue more on demand during the rotation.

The number of days water is issued to a field channel is supposed to depend on the number of allotments under its command. With the exception of small ones, distributaries are meant to have constant flow at full capacity (Wickremaratne 1986, A. Maheswaran[16] in interview on 14 October 1987). But the reality of maha 1986/1987 at Kalankuttiya was quite different because, as claimed by the IE Kalankuttiya, the physical system under constant flow can irrigate only up to 50 percent of the command area simultaneously. This in turn depends on the flow into Kalankuttiya Tank from storage at Mulannatuwa (which must also take into account the water requirements of the Meegalewa administrative block). Further, distributary releases are uniformly computed on an area basis even though it is clear that there must be flexibility at the unit level through extended rotations to compensate for differences in requirements. At the lower level of the agency, there is clearly a suspicion and distrust of the gauge readings done by the IL and a demand that his performance be monitored.

The consequences of the Kalankuttiya Tank level dropping below the critical point of 0.91 meters, and often well below the optimum level of 1.52 meters could be seen

[16]Mr. A. Maheswaran was formerly Secretary to the Ministry of Mahaweli Development, and earlier, Director of irrigation.

during the two rotations under discussion. During R6, despite the operational arrangement made at the level of the LB and the project to stagger water issues to the three administrative blocks so that at any given time water would be issued to two blocks only, closure of the system to make use of rainfall resulted in the following rotation beginning simultaneously in all three blocks as well as, in the case of Kalankuttiya, all 20 distributaries. R8 illustrated a similar problem, though in this case, given the growth stage of the rice crop in Kalankuttiya, it had further serious implications.

The official agency perception is that any increase at the LB/MC level would not effectively reach the farms and would instead have to be written-off as a loss one way or another. Besides, as the DRPM (WM) stated, allocations to the LB are based on requests made by the block IEs, and once a request is made they must learn to manage with it. This begs, however, the question as to whether and to what degree there could be more built-in flexibility to accommodate the exigencies at the different points of the main system.

The reality of the theoretical 6.35 cm (2.5 inches) 7-day rotation at the farm level was 5.72 cm over 10 days, and at the tail end of the main system and in some distributaries, 5.72 cm for 12-14 days. In R8, this was further compounded because the crop was in the flowering stage in certain areas and failed to receive adequate water. The situation was aggravated by the decision taken at the project level to cut back water issues by 20 percent from the original quota.

The upshot of this was complaints by farmers, and by unit managers on their behalf, that the IE was hoarding water in the tank and letting the crop die, and that those farmers who put faith in the deadlines set at the kanna meeting had their crop in the flowering stage and needed shorter rotations of water but were not receiving any. Late sowers, whose crops were at an earlier stage of growth, would benefit by the decision to lengthen rotations to give the two final issues at a time when the farmers who were on schedule would be harvesting. Also, the farmers who saw some water in Kalankuttiya Tank (when it was below 0.91 meters, thus below the minimum level at which issues can be made) could not understand why the IE would not release it to them in their time of need, until the problem was finally explained at meetings. On the other hand, the IE himself was put in the classic "no-win" situation, as at the project level the "matrix hierarchy" (this phrase seems an apt description in the absence of team processes and shared leadership at this level) placed the blame for dropping tank-levels at his door.

Up to this point questions have been raised about flexibility in decision making. This lack of flexibility in project- and block-level management is counterbalanced by flexibility at the unit level. Unfortunately, the form and nature of these strategies remain ad hoc and largely undocumented as well as not legitimate, as if this flexibility reflects lower-level mismanagement of water. As a result, their cumulative value is not readily visible. This flexibility is in contrast to the frequently heard complaint of the lack of agency responsiveness to the needs of farmers.

There is also the reality of the high degree of farmer intervention at the main system level in what is fundamentally an agency-managed system, with farmer participation in the implementation of decisions at the tertiary level. Our research shows that such intervention had an impact in at least three areas of the main system: 1) at the direct offtakes of the LB/MC at Galnewa, which is from the perspective of Kalankuttiya the conveyance system, but is also the distribution system within Galnewa administrative block; 2) along the link canal between Mulannatuwa Tank and Kalankuttiya, which is still the conveyance system for Kalankuttiya, but is now under the distribution system of Meegalewa administrative block, as well as passing through an area cultivated under a tank which was in existence prior to the Mahaweli irrigation system; and 3) at the head end of the distributary channels of Kalankuttiya.

Finally there is an area not addressed by the present study, the distribution system at the turnout and below. Farmer intervention at these levels, whether in the form of night irrigators who go undocumented and are not part of computations of water duty, or the head enders who overirrigate, unmindful of their counterparts at the tail end, is a phenomenon of which the agency is aware and yet unable to control. Hence, it looks for solutions in the direction of farmer organization and farmer participation.

MAIN SYSTEM MANAGEMENT: THE SEARCH FOR AN INDEX OF MANAGEMENT EFFICIENCY

The literature on the management of irrigation systems contains two sets of concepts which are tools for performance evaluation — conveyance loss and efficiency, and distribution loss and efficiency. Essentially the first is loss along the main system (seepage, percolation) that is, losses in the physical system. The second, by implication, is dependent upon the irrigation practices of the farmer in addition to the condition of the physical system. However, if irrigation efficiency is to be taken as an indicator of "how efficiently the available water supply is being used, based on different methods of evaluation" (Michael 1978:546), we contend that neither of these computations takes into account what we would call "management losses." These are the result of the agency's failure to use systems and procedures which are part of the normative rules and structures of the management system, and which must be accounted for at the main system level.

As described by the DRPM (WM), in maha 1986/1987 Kalawewa tank-duty at the LB/MC was computed based on assumptions about canal conveyance efficiency — MC losses at 10 percent, distributary channel losses at 10 percent, and field channel losses at 5 percent (total of 25 percent). He estimated application efficiency on the farm, with losses assumed to be around 38-45 percent. But what is excluded from this consideration is main system management efficiency.

Our data indicate areas and categories of information and concepts to be explored in ultimately developing a diagnostic tool for evaluating the performance of management vis-à-vis irrigation efficiency. These areas include:

* the identifiable management levels in the main system, for example, system, project, block, irrigation zone, and distributary;

* the objectives of management at each level;

* whether the main system is identified as a conveyance or distribution system or both; and

* the correlation between level of the system and operational style — whether bureaucratic or entrepreneurial management — based upon the ability and flexibility of each level to respond swiftly through in-place operational procedures for decision making for planning, monitoring, implementation, and operation.

CONCLUSIONS AND RECOMMENDATIONS

This paper has focused on the *management control system* of the MEA at Galnewa Project in System H in its integrated components of planning, standards of performance, monitoring of actual performance, comparison of actual performance to planned targets, and corrective action. Focusing on the management system during drought conditions which produced a shortage of water, it has assessed the capacity of the management to respond to the crisis by examining the role of management at crucial points in the main system, with emphasis on the strength and capacity of the management controls in place, or the effects of their absence. This section provides a summary of our conclusions and major recommendations.

1. The MEA of the MASL is an open and flexible organization with a willingness to incorporate change — witness its responsiveness to the recommendations of consultants as well as to our ongoing dialogue with the agency during this research.

2. Despite an impressive list of consultancies, and frequent references to the *people dimension* of management, this dimension has not been incorporated effectively. This could be explained as not essential because of the temporary "project nature" of management. But the agency has simultaneously gone ahead with implementing "integrated management." Because the agency is presently going through a reorganization phase with amalgamation of projects, blocks, and units, and a transfer of personnel, the time is opportune to appraise what it has achieved and assess what needs to be done. As it stands, the *management* of the project, as distinct from the physical operation of the system, is in a perennial transition phase and this has an impact on whether or not the project has gone on to a further stage of economic and social development, as claimed by some (Bandaragoda 1987:189), and how fast it can approach handing over and incorporation.

3. At the system level, this transitory nature of management has concentrated simply on construction, development, and settlement as yardsticks of monitoring. This monitoring is left to the individual discretion of the project staff. The question asked in this type of monitoring is what is the return on investment, and not whether it is the optimum return, or is sustainable.

In our examination of microsystem management controls, we find in the Galnewa project a strongly developed set of control tools for financial and production control, and an absence of a similar set for performance appraisal of the management itself. From the managerial perspective, we find a more than adequate presence of control through rules, orders, and procedures, control by reports, and the sporadic presence of control by exception.

However, appraisal of performance of managers against predetermined standards, the identification of areas of strengths and weaknesses, and the use of strengths to tap employee potential are conspicuous by their absence. Officer and farmer training at agricultural institutions is an area in which the agency has focused some attention. However, we believe that training, irrespective of its adequacy or appropriateness, is not a solution to the absence of effective performance appraisal, and will not motivate personnel to give their best performance.

Adequate and timely feedback of information and swift corrective action are also absent; had they been present MEA/Colombo's query about Kalankuttiya's low crop yields would have been unnecessary. By the same token we find preventive controls and warning controls also absent (e.g., warning controls would have alerted the management that the pre-existing arrangement for allocation of water from the Kalawewa Reservoir was unsatisfactory before MEA/Colombo exercised control by exception). In the absence of key controls, those controls that are present do not perform at optimum levels. An analogy is a car with some but not all controlling gears in the hands of a driver who haphazardly uses whatever shifting mechanism is available; the engine has power but the driver is hampered from optimizing its use because of this limitation.

4. As a multipurpose project with both *macro-* and *microsystem* goals, and a microsystem dependent on diversion of water from higher levels, in a typical year management at the interface between the macrosystem boundary of the MEA and the microlevel at System H is essential. The SOP might be "cast in concrete" but the weekly decision making of the WMS is not, and this results in the ad hoc character of microsystem planning. Systematic communication of this information to the system operators — FMU and the System H WMCP — is required, so that they can take this into account in their decision making *before*, not after, the fact. A telephone and computer link with the WMS computer seems an easy and obvious suggestion.

The successful operations of the WMCP in maha 1986/1987 and in yala 1987 is a credit to the untiring efforts of the WMCP members, and the IE of the FMU in

particular. The impact of decision making at this level is really felt at the next level below, the project-level water allocation, where the agency has not yet established its farmer constituency for water distribution.

5. Within the microsystem (i.e., within the boundaries of the three projects), effective communication of decisions will, by assuring a predictable supply of water, strengthen the hand of the agency in coming to terms with the political environment and will enhance the credibility of the agency in the eyes of the farmers. Together with performance-monitoring controls, this will also strengthen the role of the RPM as project monitor, not simply of water, but the integrated monitoring of all key areas.

6. At system and project levels, the most appropriate mode of operation is the administrative mode, that is, a *bureaucratic style of management*. During a crisis or uncertain conditions, management in a bureaucratic mode is successful when the irrigation system is perceived as an allocation rather than a distribution system. In System H, while control defaulted upward under conditions of stress (Levine 1987), it did so efficiently in an administrative mode and within a large proportion of the system — a greater proportion of the system was successfully administered as a conveyance rather than a distribution system. The modern entrepreneurial style of management is better suited to smaller systems or to lower-level sections of larger systems for water distribution to the users (customers).

The commonly accepted distinction between the administrative or bureaucratic and the entrepreneurial or management modes of operation, as characterized by a distinction between implementation of rules and their vigorous manipulation, is overly simple. Bailey (1970) has suggested a distinction between "normative rules," those derived from basic values or based on formal rules, and "pragmatic rules," those which are accepted as required to provide flexibility to achieve the goals within the framework (limits) of the normative rules. Normative rules and pragmatic rules are integral to both modes of operation; the difference is in their order of importance. In the bureaucratic mode, normative rules predominate over pragmatic rules; in the entrepreneurial mode, pragmatic rules dominate.

7. The picture shifts radically at the subproject level (e.g., the hydrological boundaries of the Kalawewa LB). As in the case of the System H WMCP, water is the single focus but now the main system becomes a system for allocation and for distribution. What is evident is that as a management exercise, the agency views the system as the former and not as the latter. The need for a coordinating mechanism similar to the System H WMCP, with the project engineer rather than the IE for Galnewa Block at the helm, and the need for performance-monitoring controls, were apparent and are recommended.

8. Absence of performance control at the LB/MC filters down to the administrative block. In Kalankuttiya, the absence of control was evident at the tank and the branch canal. Given that the financial budget, the water budget (weekly releases), the targets of

the cultivation program, and the progress monitoring by the PMU are all focused on the block, this is the core of the main system. It is here that the Mahaweli block manager has a challenging opportunity to mediate between administrative bureaucracy and a modern entrepreneurial style of management by systematically manipulating management controls and translating them within the context of the Mahaweli goal-oriented work culture for his unit managers. Instead, we find an unfortunate absence of performance control, dominance of administrative routine, and lack of independent authority of the block manager.

Furthermore, because it is a distribution system, conflict resolution is a key managerial task. It was originally envisaged that partnership management with the farmers would logically begin here. The block manager, while managing the unit managers, must, through them, manage the interface between the latter and the farmers through participative management. He should try out innovations and take the occasional risk, aiming for devolution at the turnout and the distributary levels, because conflict resolution among water users at these levels is an area which the agency has been unable to deal with. This could be done through an MBO approach.

Participative management training, and not simply training in agriculture extension or water management, is indicated here. Further, in this age of microcomputers, MEA could install a computer in the office of the block manager and train him in its use. Then he could construct trade-off curves among selected performance measures after examining the complete set of possible optimal solutions for any objective function. With this information he may select the most preferred schedule, making the best trade-off between cost and optimum solution.

9. The unit manager must translate the goals set at the block level into action. A unit manager is ideally a microcosm of the block manager. In practice we find that the problems which ail the block also affect the unit, only more so. The reason is, this is the lowest level of management and yet the high point of impact of management on operations in the field. As in the block, though the physical system is primarily a conveyance and distribution system for water, water management cannot stand alone. To make sense it must be functionally integrated at least with input, credit, and marketing. It is the task of the unit manager to be a *manager* at this interface, not to be a bureaucrat or extension agent (the block office could handle most of his paper work and the FA is there for extension work). In the MASL/MEA management structure, this is the point which seems to lend itself best to a form of MBR.

At this level the agency should let the "logic of the organization" (Kuhn and Beam 1982) take over. Based on an incentives approach (Heaver 1982), and recognizing what the unit-level officials are able to do, given the incentives and the pressure from above and below, it should evaluate performance by results. The unit manager's credibility hinges upon the success of managers at other points in the main system but because he must himself face the farmer it impinges on him directly. The absence of performance controls is most acutely felt here (for example, the unit managers' perception that top

management lacks concern for them or the common complaint by the farmers and unit managers that the block-level IL does not monitor distributary issues systematically). Also felt is the lack of managerial skills and training and this in turn has implications at the turnout and below in the role of the turnout leader, the IL, and the farmer.

In the absence of performance controls, water is used less efficiently, and the excess loss is written-off as operational or managerial losses. In other words, the IL and the unit managers compensate for complaints by issuing water whenever available as demanded, and by extending rotations. This may not result in equity or higher yields without participatory irrigation management, which in the Mahaweli lexicon is "partnership administration."

At the end of maha 1986/1987, the crop-cut survey done by the Department of Census and Statistics showed that Kalankuttiya Block had the lowest yield in comparison with other areas within the Mahaweli and outside. MEA/Colombo, using control by exception, asked for an explanation from the block manager. With adequate performance controls, this could have been detected early and perhaps prevented. Further, the explanation given by officials at the block level for the low-average yield, is that the lowest yield — 1,091.8 kilograms per hectare (kg/ha), or 21.18 bushels per acre (bu/ac) — was recorded in unit 1 at the head end of the system, while the next lowest — 2,077.4 kg/ha, or 40.3 bu/ac — was in unit 5 at the middle of the system. These two units, according to figures released by the block office at the end of the cultivation season, had water duties of 1.28 and 1.21 meters respectively. Thus, the problem is not water shortage, but poorly timed and managed supply, and the inability of the head and tail enders to share it. The next lowest yield was recorded at the tail end of the Kalankuttiya Branch Canal, where our research documented water shortages due to the lower-than-anticipated tank levels and the resulting inability of the agency to supply the water. Solutions to these problems lie less in the realm of engineering design and more in the realm of communication, feedback of information, and above all, performance control.

Thus, water *per se* is not the key independent variable determining crop production levels in an irrigation system, but *management*, broadly defined. The total amount of water delivered even during this drought year was more than adequate for the crop; problems arose as a result of unreliable, unpredictable, and ill-timed supplies.

Given the magnitude and cost of the Mahaweli Development Program, to have the greatest possible impact on the intended beneficiaries, and to enhance the sustainability of operations, an investigation into the hitherto overlooked aspects of performance control can lead to further improvement of a project already judged by many observers to be economically viable. From the perspective of water management, controls placed where they are necessary but lacking will provide a yardstick for estimating the improvements possible in what is presently an ambiguous area written-off as "management loss." From the perspective of functionally integrated matrix management, an effective management control system can result in better management capable of

interacting within its boundaries, and with its environment, by monitoring and analyzing information already available in the agency and within the capacity of the agency to handle without extra cost. This will enable the creation of a more flexible, creative organization based on teamwork.

GLOSSARY

ADMINISTRATIVE STYLE OF MANAGEMENT. This is characteristic of an organization which is hierarchical and large scale, and in which formal procedures and exercise of managers' authority is constrained by rules; often referred to in the text as "bureaucratic."

BETHMA. Cultivation during a water-short season where part of the command area (usually a proportion of the upper part) is shared by the farmers. This results in the shifting of some farmers from their original allotments and the temporary sharing of allotments belonging to others.

CONTROL. Management function that aims to keep activities directed in such a way that all desired results are achieved.

CONTROLS. Means by which a manager performs his control function. Typically, this includes measurement of the progress of an enterprise towards objectives in accordance with the established plan.

DUCKBILL WEIR. A regulating structure deriving its name from the fact that it takes the shape of a duck's bill.

ENTREPRENEURIAL STYLE OF MANAGEMENT.This is characteristic of a horizontal, rather than a hierarchical organization of a smaller scale where, unhampered by regulations, the manager is driven by the perception of opportunity.

GANGA. This means river in Sinhala.

INCENTIVES APPROACH. Emphasizes the role of incentives and motivation in management and asks the question, what is management likely to do given the pressures and incentives brought to bear upon its members?

LOGIC OF ORGANIZATION. Derived from Kuhn and Beam (1982), this implies a certain managerial logic pervading large-scale organizations by virtue of size, internal variation of functions, changing situations to which they must adapt, and evolving levels of technical competence, quite independent of its management ideology.

MAHA. The main cultivation season lasting typically from October-March. Primarily using rainfall with supplementary irrigation, the total command area is normally cultivated with a single crop (rice).

MANAGEMENT CONTROL SYSTEM. The monitoring of the progress of the operational plan of management in the interlinked dimensions of workplan and resources, standards of performance, system of monitoring actual performance, comparison of actual performance with planned targets, and corrective action.

MANAGEMENT OF THE INTERFACE. A farseeing manager with a practical agenda for meeting tomorrow's challenges provides leadership and flexible management solutions by maximizing the information and resources available to him, blending technological, managerial, scientific, political, socioeconomic, and cultural factors (Harris 1985).

MANAGEMENT BY OBJECTIVE (MBO). The organization has clear objectives, and sound long-term plans, and the manager is clear about the results he must achieve to realize these objectives. Objectives are quantified and broken down into the results expected from the main operating areas. Managers in those areas clarify their objectives by identifying the most important results to be achieved and the means with which they can achieve this.

MANAGEMENT BY RESULTS (MBR). This is a take-off on the above and is expressed in the following manner by Seckler (1986): result (R) is the relationship between predicted outputs (PO) of an organization as specified in objectives and the actual outputs (AO) from the operations of the organization. R= AO/PO results in the acceptable range of error. If the cost of error is high, it points to the need for corrective mechanisms in the control system.

PARTICIPATIVE MANAGEMENT. Drucker (1977:566) defines this as "an approach to improving management practice that emphasizes participation of *all* [emphasis added] impacted parties in decisions."

SHRAMADANA. Voluntary participation of the community in tasks intended to improve their quality of life.

SYNERGY. Management as an agent of change approaches the managerial organization as an energy system. Synergy is defined as cooperative and combined actions of individuals in an organization to achieve a common goal, particularly in attempting to transform the work culture of an organization (Harris 1985:61).

YALA. Dry-season cultivation lasting from May to August. Dependent primarily on irrigation, this is the season for the cultivation of other field crops, in addition to or instead of rice.

REFERENCES

Abeygunewardena, Walter. n.d. Agricultural development in the Mahaweli Project -- an analysis.

Alwis, J. et al. 1982. System H of the Mahaweli Development Project, Sri Lanka, 1982: Diagnostic analysis. Water Management Synthesis Project Report 16. Fort Collins, CO, USA: Colorado State University.

Alwis, J. et al. 1983. System H of the Mahaweli Development Project, Sri Lanka, 1983: Diagnostic analysis. Water Management Synthesis Project Report 20. Fort Collins, CO, USA: Colorado State University.

Bailey, F.G. 1970. Stratagems and spoils. Oxford: Blackwell.

Bandaragoda, D.J. 1984. Management control and its relevance in the Mahaweli Economic Agency. Mahaweli Manager 2(1):2-4.

Bandaragoda, D.J. 1987. Social development in the Kalawewa settlement project of the Accelerated Mahaweli Development Programme. Regional Development Dialogue 8(2):159-201.

Bottrall, Anthony F. 1981. Comparative study of the management and organization of irrigation projects. World Bank Staff Working Paper 458.

Bulankulame, S. 1986. Social aspects of water management during the maha season 1985/1986 in Dewahuwa and Mahaweli H2 block 305 -- precept and practice. International Irrigation Management Institute Working Paper 1. Digana Village, Sri Lanka: IIMI.

Drucker, Peter F. 1977. Management. London: Pan Books.

Harris, Philip R. 1985. Management in transition. San Francisco, CA, USA: Jossey-Bass.

Heaver, Richard. 1982. Bureaucratic politics and incentives in the management of rural development. World Bank Staff Working Paper 537.

Jayewardene, Jayantha. 1984. The management of System H of the Accelerated Mahaweli Programme. Mahaweli Manager 2(1):14-17. EDI-IIMI Workshop. Mimeo.

Jayewardene, Jayantha. 1987. A briefing on System H of the Accelerated Mahaweli Development Programme. Mimeo.

Karunatilleke, T.H. 1982. Settlement management patterns in the Mahaweli H area. Pp 165-182 in Kapila P. Wimaladharma (ed.), Land Settlement Experience in Sri Lanka. Colombo, Sri Lanka: Ministry of Lands and Lands Development.

Koontz, Harold and Cyril O'Donnell. 1968. Principles of management. New York, NY, USA: McGraw Hill.

Kuhn, Alfred and Robert D. Beam. 1982. The logic of organization. San Francisco, CA, USA: Jossey-Bass.

Levine, Gilbert. 1987. The Taiwan irrigation associations: Observations from the outside. Policy Workshop On People's Participation in Irrigation Management. Unpublished paper. Hyderabad, India: Administrative Staff College.

Mackenzie, R. Alec. 1969. The management process in 3-D. Harvard Business Review (Nov-Dec):80-87.

Mahaweli Authority of Sri Lanka. 1979. Parliamentary Act no. 23. Government Press of Sri Lanka.

Mahaweli Economic Agency. 1985. Statistical bulletin System H.

Mahaweli Economic Agency. 1986/1987. Seasonal operating plan for maha. Mimeo.

Michael, A.M. 1978. Irrigation theory and practice. New Delhi, India: Vikas.

Panditharatna, N.G.P. 1984. Mahaweli settlers and the problems of rural credit. Central Bank of Ceylon Occasional Paper 9.

Peters, Thomas J. and Robert H. Waterman. 1982. In search of excellence. New York, NY, USA: Warner Books.

Putti, Joseph M. 1987. Management: A functional approach. Singapore: McGraw-Hill.

Raby, Namika. 1985. Kachcheri bureaucracy in Sri Lanka: The Culture and politics of accessibility. Syracuse, NY, USA: Maxwell School of Citizenship and Public Affairs, Syracuse University.

Scudder, Thayer. 1981. The Accelerated Mahaweli Programme (AMP) and dry zone development: Some aspects of settlement. Report 3. Unpublished manuscript.

Scudder, Thayer and Kapila Wimaladharma. 1985a. The Accelerated Mahaweli Programme (AMP) and dry zone development: Some aspects of settlement. Report 4. Worcester, MA, and Binghamton, NY, USA: IDA/Clark University.

Scudder, Thayer and Kapila Wimaladharma. 1985b. The Accelerated Mahaweli Programme (AMP) and dry zone development: Some aspects of settlement. Report 5. Worcester, MA, and Binghamton, NY, USA: IDA/Clark University.

Scudder, Thayer and Kapila Wimaladharma. 1985c. The Accelerated Mahaweli Programme (AMP) and dry zone development: Some aspects of settlement. Report 6. Worcester, MA, and Binghamton, NY, USA: IDA/Clark University.

Seckler, David. 1986. On the management of public organizations. ISARD Working Paper 1. Fort Collins, CO, USA: Colorado State University.

Seckler, David and Robert Wade. 1986. Issues in the management of irrigation systems. In David Seckler (ed.), The Contribution of Management Science to the Management of Irrigation Systems. Manuscript of forthcoming book.

SOGREAH. 1972. Mahaweli ganga development project feasibility study for stage II. Vols. I and VII. Colombo, Sri Lanka: MASL.

Stevenson, H.H. and D.E. Gumpert. 1985. The heart of entrepreneurship. Harvard Business Review (Mar-Apr):85-94.

Sullivan, Edwin F. 1984. Proposals for improving water management in System H of the Mahaweli Project. MEA Files.

UNDP/FAO Mission of Investigation. 1968. Mahaweli ganga irrigation and power project: Organizational and management requirements. Unpublished report.

Wade, Robert. 1980. On substituting management for water in canal irrigation: A South Indian case. Economic and Political Weekly 15(52):147-160.

Wickremaratne, H.A. 1986. Water management in System H of the Mahaweli Project. Diyawara 3(Aug):1-6. Colombo, Sri Lanka: Agrarian Research and Training Institute.

Wickremaratne, M.L.J. 1981. Management in the Sri Lankan environment. APO Seminar, Colombo, Sri Lanka.

World Bank. 1985. Mahaweli ganga development project supervision report. Unpublished manuscript.

APPENDIX

MEASURES

1 bushel (unmilled rice) = 20.87 (approximately) kilograms (kg)

1 bushel (milled rice) = 29.00 (approximately) kg

1 cusec = 28.3 liters per second, 0.0283 cubic meters (m^3) per second (sec)

1 acre = 0.405 hectare (ha)

1 acre-foot (ac-ft) = 1,234 cubic meters (m^3)

1 inch = 2.54 centimeters (cm)

1 foot (ft) = 0.3048 meters

1 mile = 1.61 kilometers (km)

MCM = million cubic meters