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

Namika Raby and Douglas J. Merrey

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE

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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.

Please direct inquiries and comments to:

Information Office
International Irrigation Management Institute
P. O. Box 2075
Colombo
Sri Lanka.

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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 wâter *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.

NAMIKA RABY
Postdoctoral Research Fellow
IIMI

DOUGLAS J. MERREY
Coordinator
System Management Program
IIMI

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.

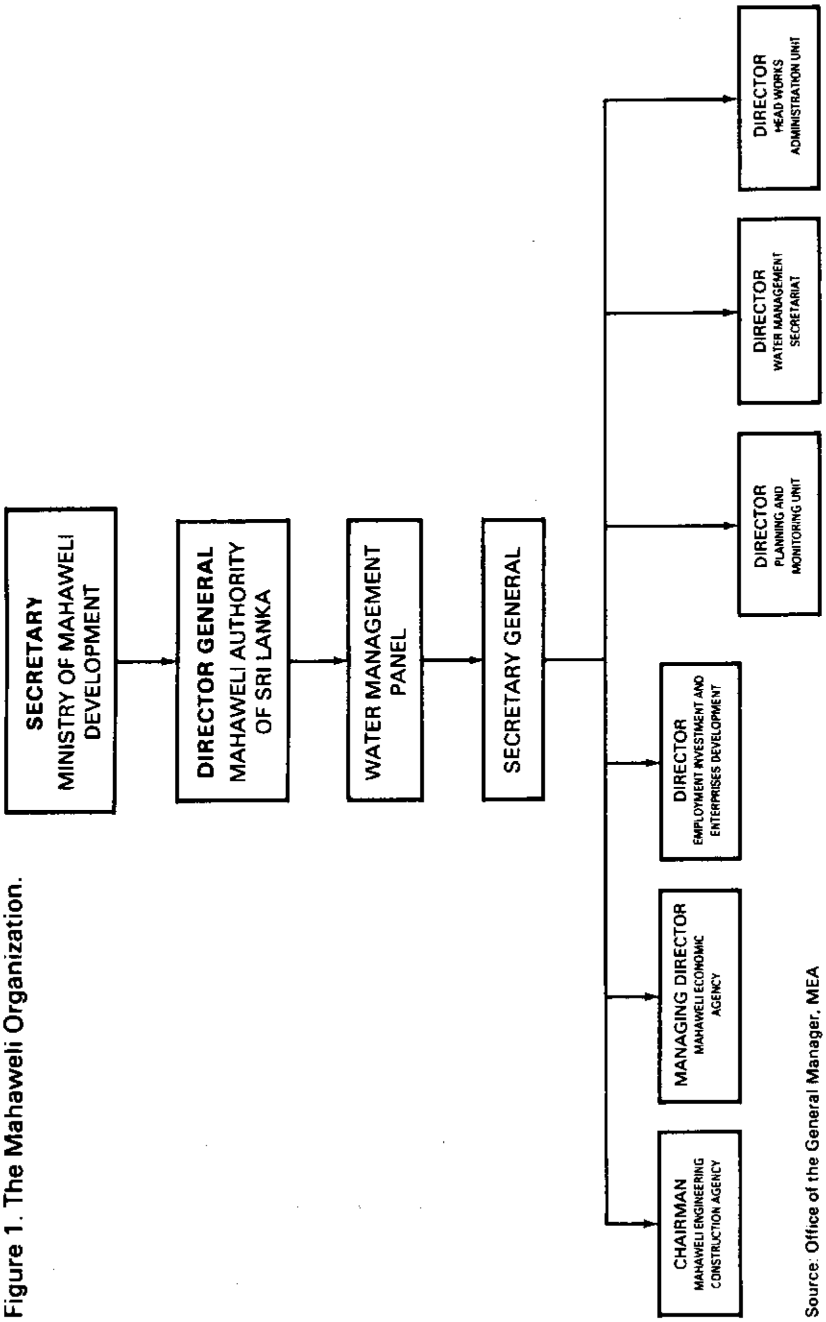
At the field level this complex, multifunctional, hierarchical, organizational setup is replicated. There is no overall system-level official at the field level. Systems are divided into projects, each under the supervision of a resident project manager (RPM). Projects generally cover an area of 8,000-12,100 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.

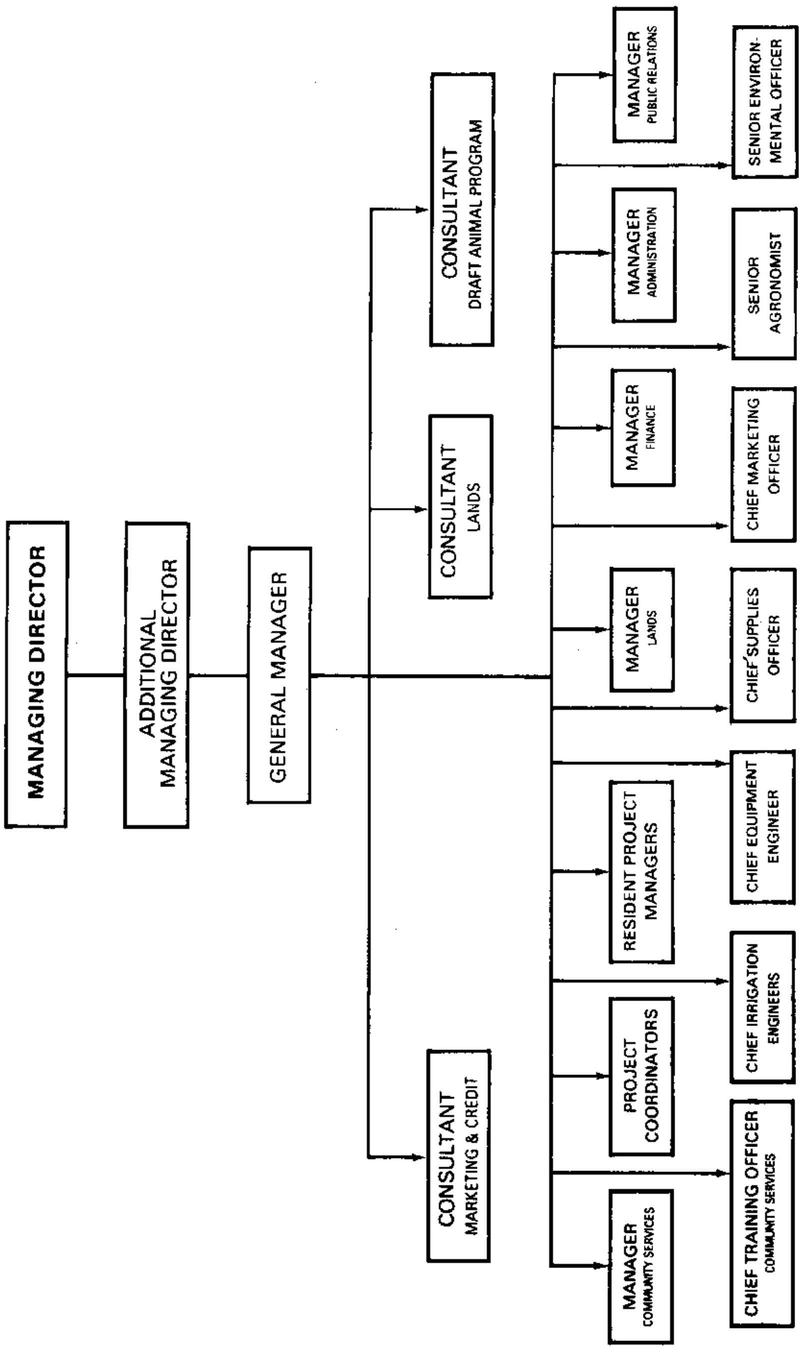
As a macroproject with a large-scale financial investment, the Mahaweli Ganga Development Program has its own styles and strategies of management, which are discussed below. Under this program, it was envisaged that nearly 100,000 ha of newly developed land would be irrigated in addition to supplementing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

Figure 1. The Mahaweli Organization.



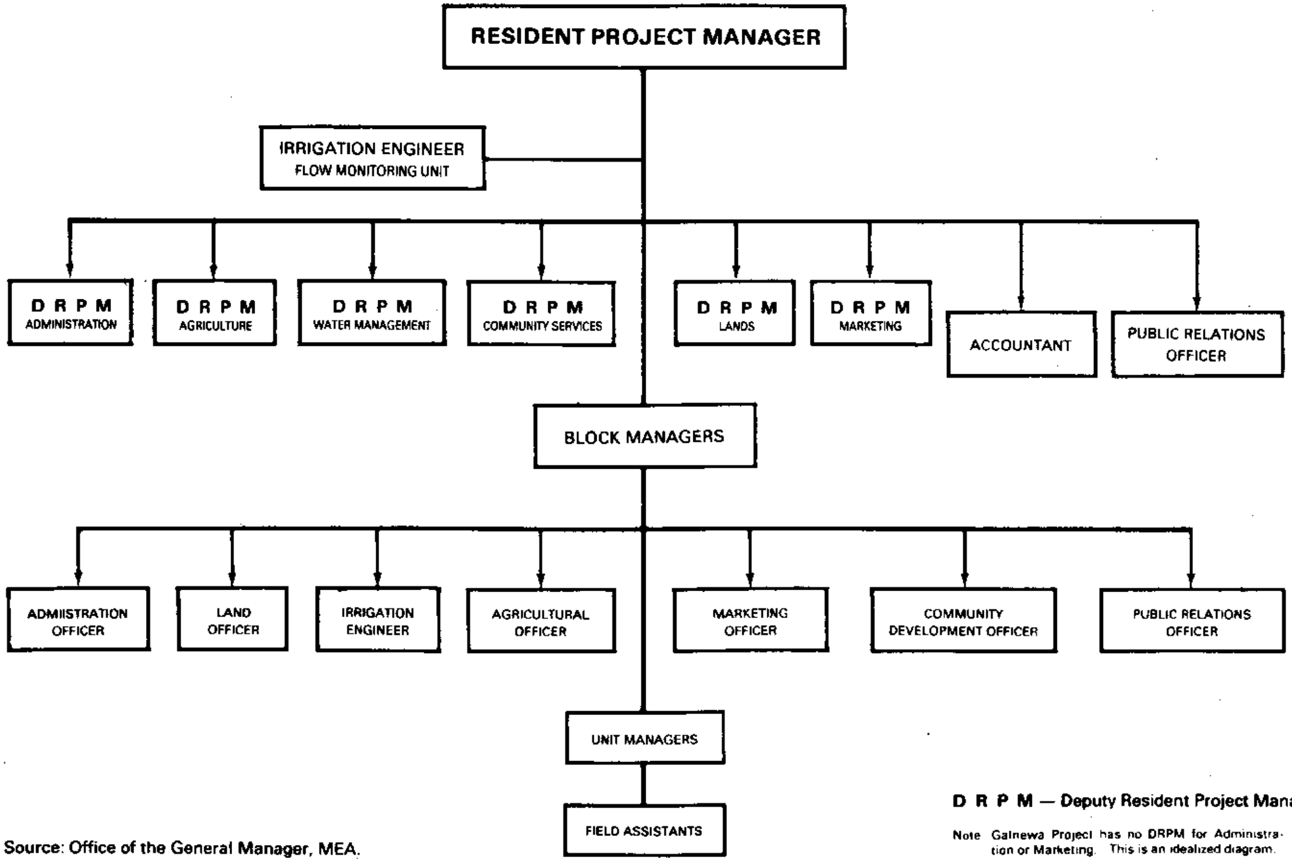
Source: Office of the General Manager, MEA

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 Galnewa 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

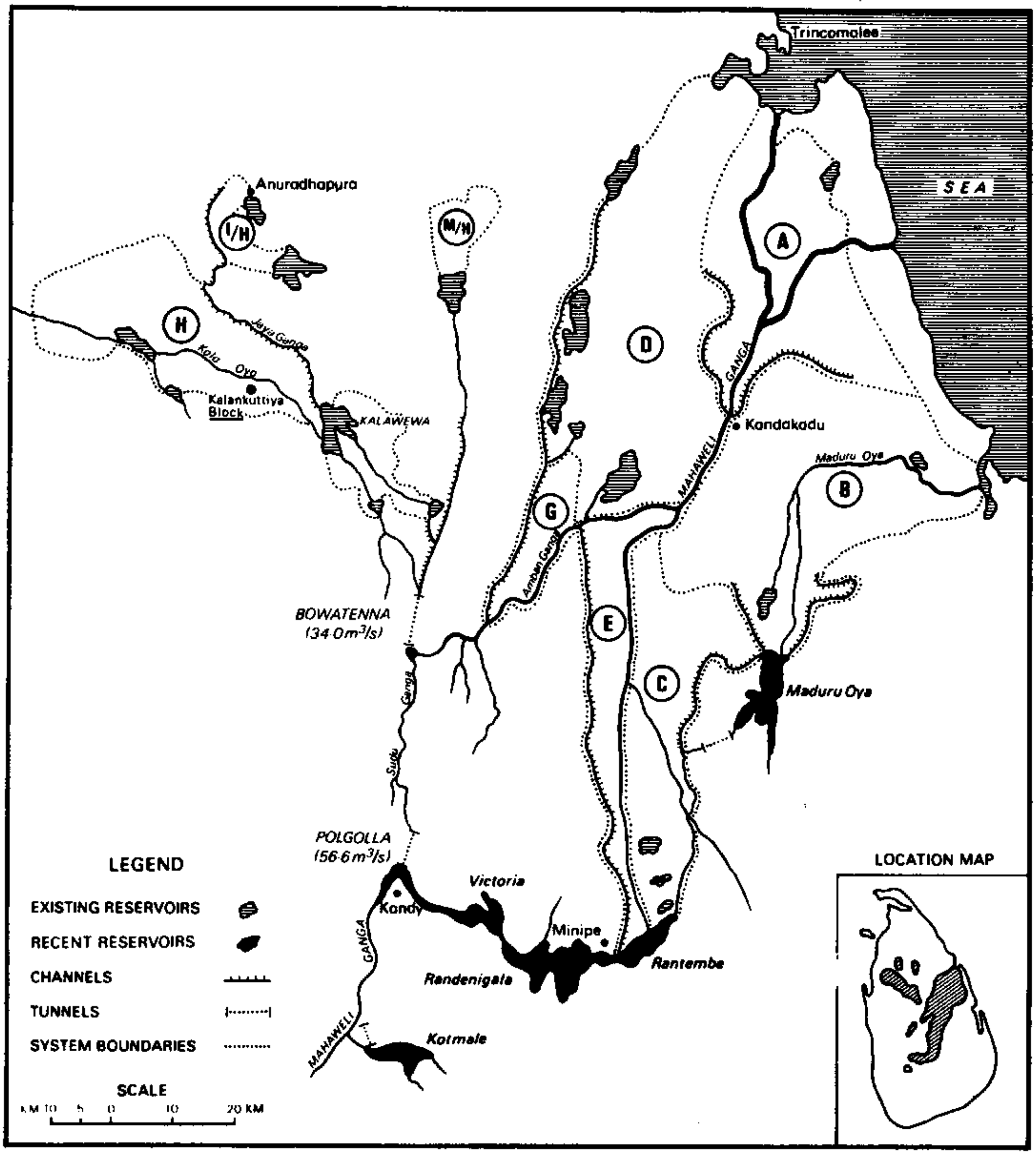
The catchment area of the Kalawewa Reservoir is 57,024 ha (MEA 1985: annex iii) and the active storage is 117 million cubic meters (MCM). The command area is 38,462 ha, divided between the left bank (LB) (12,146 ha) and right bank (RB) (26,316 ha) (MEA 1985).

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.

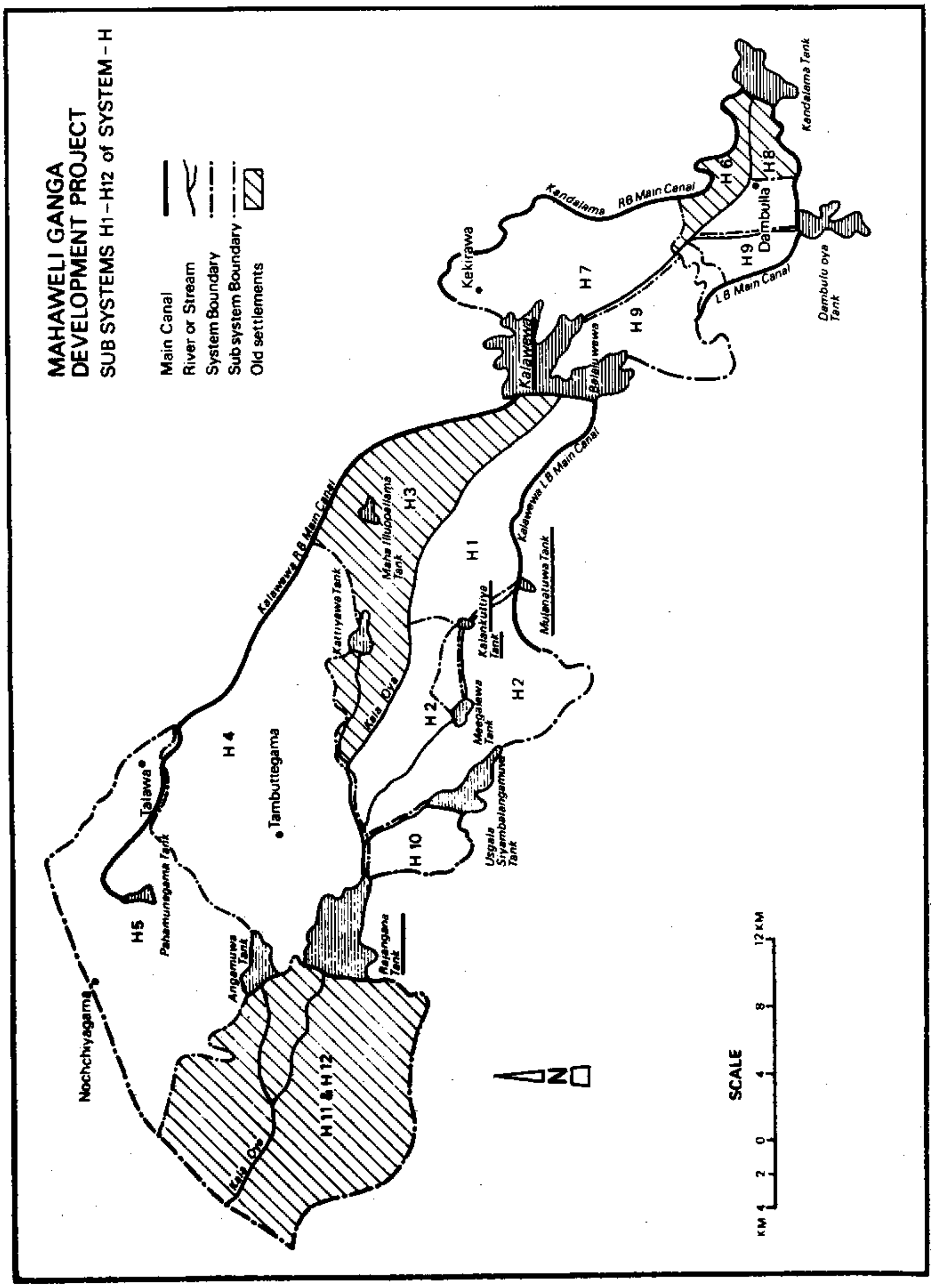
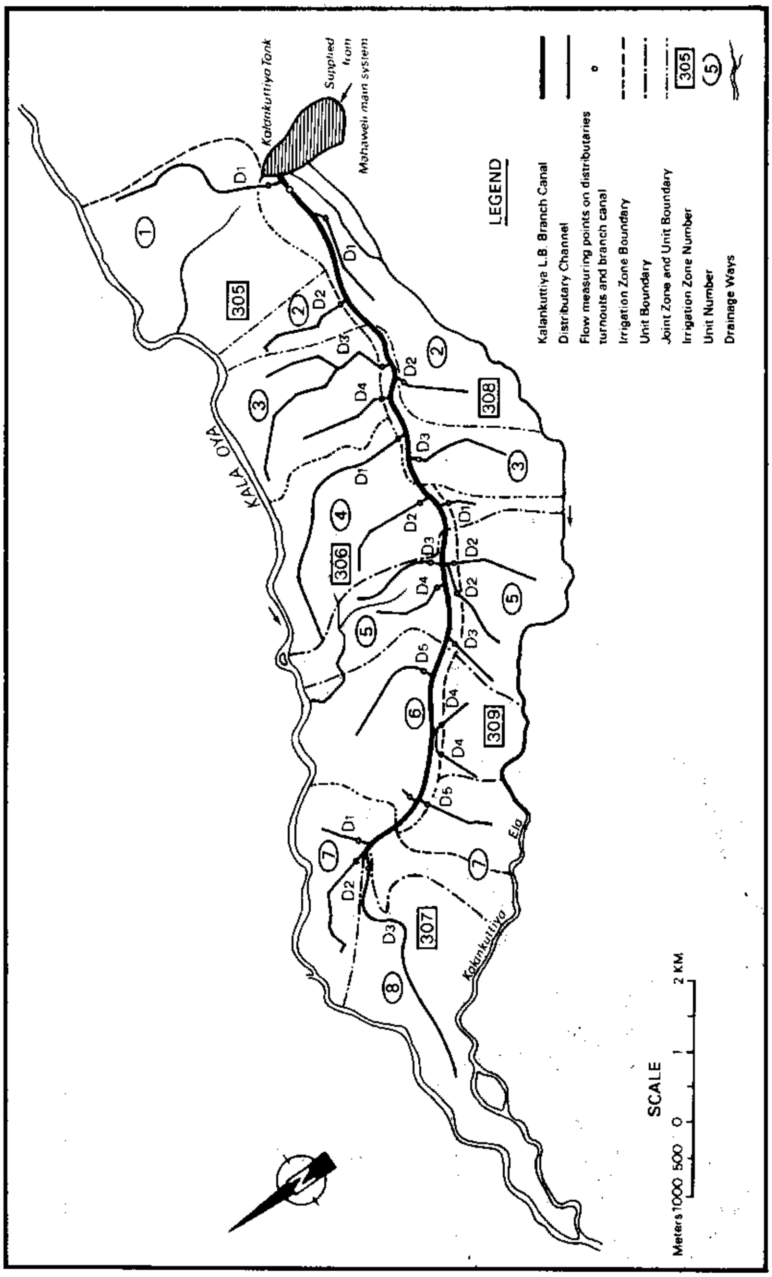


Figure 6. Kalankuttiya Block of Mahaweli System H.



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.

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