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COMPARATIVE STUDY OF THE MANAGEMENT AND ORGANIZATION
OF IRRIGATION PROJECTS

This paper is primarily concerned with development of an analytical framework for the monitoring and evaluation of irrigation project management in developing countries. It is based on an extensive review of the English language literature on the subject, and four field studies in South and East Asia. The central part of the report consists of a series of detailed arguments to explain and justify the particular evaluation framework prepared. A principal focus is the performance of the activity of water distribution since it is peculiar to irrigated agriculture. Special attention is given to identifying and recommending those organizational structures and management procedures which appear most likely to serve the interests of the rural poor, particularly small farmers and those at the tail-end of irrigation systems. The study concludes that there are immense opportunities for improvements in the performance of irrigation projects through management reform and better water distribution. Appendix A summarizes Guidelines for Analysis in a checklist format. Recommendations for further evaluation and follow-up action are given.

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FOREWORD

Benefits from irrigation projects, however well-planned and constructed, cannot be maximized unless the various systems involved are well-managed and organized. The degree to which such systems are effective and efficient, however, is still largely a subjective judgement, since there is no consensus among those working in irrigation as to what parameters should be used to make such comparisons. Furthermore, available studies on organization frameworks, operation and maintenance procedures, and principles and costs, do not provide all the information needed for fair comparisons. In addition, the relationships and allocation of responsibilities among the overall project organization, other government agencies and farmer groups, have important influences on project performance, but have often been neglected in project planning and analyses.

To improve on this state of knowledge, the World Bank decided in 1975 to initiate a study with the following three general objectives: (1) To obtain pertinent information on actual management, organization and operation of selected irrigation projects. (2) To analyze and evaluate the effectiveness of management and organizations in meeting specified objectives. (3) To develop on the basis of case studies a framework for monitoring and evaluating the efficient use of resources in the management and operation of the projects. It was envisaged that the study results would assist Bank staff in appraising and supervising irrigation projects, and would help developing countries manage and operate existing projects more effectively, and would improve the planning of future projects.

The role of executing project consultant to the Bank for this study was entrusted to the Overseas Development Institute (ODI) of London, England, who designated Mr. Anthony Bottrall as their staff member-in-charge. An advisory board, comprised of experienced Bank staff representing Regional and Central Projects Departments, served in a guidance and review capacity.

Phase I consisted of a desk study of available data, development of tentative typologies and criteria for effective irrigation management for inclusion in questionnaires and checklists, and application of the analytical framework and evaluation criteria to one specific field case. The Bank indicated special interest in the key restraints (institutional, social, political, legal, economic, technical and physical), which may limit the effectiveness of irrigation organizations and the ability of farmers to obtain water when and where needed.

Because of the considerable amount of research being performed by others focused on the role of village level and local water-user groups, Phase II research was to emphasize effectiveness and efficiency of the main delivery systems, and the management and organizational implications thereof. This was to include operation and maintenance of the systems down to the water course outlet, where water control is passed to farmers or groups of farmers. However, attention was to be paid also to operations below the outlet, insofar as they affect the operation of systems but, in large part, the details of the organizational problems of those small subsystems were to be left for research by others and for inclusion in the Bank work at a later stage. Operational studies

were to include both the engineering technical aspects of controlling and conveying the irrigation water supply, and the agricultural (demand) side of the project equation. The study, therefore, was not confined to a detailed analysis of the performance of irrigation system personnel alone, but also considered the performance of agricultural extension personnel and farmers, and the effectiveness of project management in coordinating the activities of all where interfaces occur. Attention also was given to overall countrywide or statewide policies, laws and regulations which affect project operations.

The consultant was asked to develop detailed hypotheses concerning: (a) the different types of management skills likely to be required for efficient water allocation and maintenance on irrigation projects with different sets of (physical, technical, economic, social, political) characteristics; (b) the functions which support staff (and farmers) might be expected to carry out in each; and (c) the alternative organizational forms through which the management tasks might be achieved, with special attention being paid to possible sequential changes in the allocation of responsibilities over time.

Three additional field studies were carried out during Phase II, giving a total of four field studies, one per country, located in Indonesia, India, Pakistan and Taiwan. Time for field work was limited to a maximum of about six weeks---far too short a time to permit a detailed, exacting study of any irrigation project, but sufficient to learn some of the more obvious problems and successes.

The final ODI Report was completed in the fall of 1979. It has been edited by the Bank to eliminate specific identification of country and project covered by the four field studies; but where projects and countries are identified in the literature, no editing was done. Nor has any editing been done as regards the findings, conclusions, opinions or recommendations of the ODI Report.

Finally, it should be noted that the study did not fully achieve one of the important desired objectives---that of developing a framework which could be used for evaluating irrigation projects. However, the suggested Guidelines for Analysis, set forth in Appendix A, can serve as a useful initial checklist for project managers, planners, appraisers and others concerned with irrigation project management. Additional field testing of the Guidelines and further research of this very complex topic undoubtedly are needed before any definitive manual is attempted. Nevertheless, the ODI Report is believed to present an excellent summary of the English language literature on the subject, and to be a valuable addition to that literature. It is being made available to persons outside the Bank, not only so that those involved in irrigation project conception, planning and management can benefit from many of the lessons learned but, also, to stimulate further research and progress in the field.

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COMPARATIVE STUDY OF THE MANAGEMENT AND ORGANISATION
OF IRRIGATION PROJECTS

World Bank Research Project No. 671/34

CONCLUSIONS AND RECOMMENDATIONS

by

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Table of Contents

	<u>Page</u>
<u>I. Introduction.....</u>	1
1. <u>Introduction and summary</u>	
1.1 Introduction: objectives of the study	1
1.2 Summary of findings and recommendations	4
1.3 Potential benefits of a water revolution	23
2. <u>Observations on equity and management theory</u>	
2.1 Objectives of irrigation management: a note on equity	26
2.2 Management theory and developing country agriculture	28
<u>II. Performance levels and the identification of contributory causes</u>	
3. <u>Characteristics and performance of field study projects</u>	
3.1 Characteristics	34
3.2 Performance and potential: assessment	43
3.3 Performance and potential: issues of methodology	49
4. <u>'Non-management' factors and their effect on performance</u>	
4.1 Isolating 'managment' and 'non-management' factors	52
4.2 Principal 'non-management' factors: planning, design and construction	53
<u>III. Project organisation and management</u>	
5. <u>The analytical framework</u>	
5.1 Defining spheres of responsibility	63
5.2 Assessing the management process	65
6. <u>Appropriateness of organisational structure</u>	
6.1 Influencing factors	69
6.2 Horizontal relationships: the differentiation and coordination of key activites	73
6.3 Vertical relationships: the shape of the hierarchy	86
6.3.1 Location of responsibilities: officials and farmers..	88
6.3.2 Location of responsibilities within the offical organisation	93
6.4 The superstructure: organisation at the provincial and national levels	100

Table of Contents

<u>Continued</u>	<u>Page</u>
7. <u>The project management function and its performance</u>	
7.1 The scope for project management: external limitations	105
7.2 Assessment of project management performance	108
7.3 Problems of incentive in public service institutions	118
8. <u>The performance of specialised activities</u>	
8.1 Water distribution	122
8.2 System maintenance	142
8.3 Agricultural extension	150
8.4 Watercourse improvement and advisory services	163
8.5 Management support services: finance, personnel and monitoring	175
9. <u>Priorities and sequences for action</u>	
9.1 The primacy of procedures	182
9.2 Training and the conditions for its effectiveness	188
9.3 Water charges	189
9.4 Finance and staffing levels	192
IV. <u>The farmers' role in management</u>	
10. <u>Scope and performance</u>	
10.1 Scope for farmers' participation on large irrigation projects	200
10.2 Management at the farm level	204
10.3 Watercourse management	208
10.4 Participation at the project level	212
11. <u>Government's role in stimulating farmers' participation</u>	
11.1 Conditions for small group development	215
11.2 Potential of water users' groups	220
12. <u>Some observations on small-scale irrigation schemes</u>	
12.1 Small surface schemes	222
12.2 Groundwater schemes	228
V. <u>Recommendations</u>	
13. <u>Evaluating organisation and management</u>	
13.1 The need for comprehensive evaluation	233
13.2 Proposed guidelines for analysis	236
13.3 Possible areas for further comparative research	239

Table of Contents

Continued

Page

14. Follow-up action

14.1	The approach required	243
14.2	A note on political will	246

Appendix A Evaluating irrigation management: Guidelines for analysis

Part I	The resource base	248
Part II	Indicators of project performance	252
Part III	Identification	253

Appendix B Forms of Organisation Structure..... 264

Appendix C Bibliography..... 266

Tables

3.1	Summary of project characteristics	36 - 37
3.2	Summary of project performance	46
6.1	Unified project organisation: horizontal structure	81
6.2	Patterns of responsibility distribution: a comparison between projects	92
8.1	Comparative O & M costs	146
9.1	Components of organisation and management reform - implications for sequential action	183
9.2	Comparative staffing levels (selected indicators)	194

I. INTRODUCTION

1. Introduction and Summary

1.1 Introduction: Objectives of the Study

The presentation of this report represents the completion of Phase II of World Bank Research Project No. 671-34. At the outset of the study it was agreed that its broad objectives should be:

1. To obtain pertinent information on actual management, organization and operation of selected irrigation projects.
2. To analyze and evaluate the effectiveness of management and organizations in meeting specified objectives.
3. To develop on the basis of case studies a framework for monitoring and evaluating the efficient use of resources in the management and operation of the projects.

The Bank expressed particular interest in the identification of those key restraints (institutional, social, political, legal, economic, technical and physical) which might limit the effectiveness of irrigation organizations and the ability of the farmer to obtain water when and where needed. 1/

The first two objectives have been met in previous confidential reports in which the findings of four field studies in Taiwan, Pakistan, India and Indonesia were presented. This final Report is primarily concerned with meeting the third objective - the development of an analytical framework which could be generally used as a basis for future evaluations of irrigation project management in developing countries. It has been assumed that the purpose of these evaluations would be to assess in each case the potential for improving current project performance; to identify the principal reasons for shortcomings, particularly in the field of organization and management; and to draw conclusions about appropriate remedial action.

The central part of this Report consists of a series of detailed arguments whose primary purpose is to explain and justify the particular evaluation framework which is being prepared. Wherever possible these arguments have been supported by comparative analyses of past irrigation management experience. Much of the detailed information examined in these analyses is drawn from the four field studies, though frequent reference is also made to other relevant research on irrigation management (some of which was reviewed in an initial desk study). Further valuable insights have been obtained from studies in the somewhat broader field of agricultural programme

1/ World Bank, Terms of Reference for Phase II of the Study, April 1977, paras. 2.0 - 2.1.

and project management, as well as from the extensive literature of general organization and management theory. The Report's principal conclusions are summarized in Section 1.2. 1/

In its Terms of Reference for Phase II the Bank specifically requested the development of 'prototype guidelines' for evaluating irrigation project management. 2/ Guidelines intended for this purpose are presented in Appendix A of the Report. The sequence of the proposed analysis follows the same pattern as that used in the main body of the Report, which is intended to act as a guide to the evaluation process as well as a justification for it. The Appendix is essentially a checklist of information to be gathered. Keys to the interpretation of information obtained are to be found in sections of the main text, to which frequent references are made in the Appendix.

In accordance with the Terms of Reference, the central focus of the study has been on the performance of the activity of water distribution. It is recognized that other activities of project management - particularly agricultural extension, supported by input and credit supplies and marketing - also have a vital part to play in the successful development of irrigated areas. However, these activities are not peculiar to irrigated agriculture and their management, especially that of extension, has been fairly closely studied by others. As a result only passing references are made in the report to input and credit supplies and marketing; and although the extension function is discussed at greater length, with particular attention being paid to its special characteristics and requirements under irrigated conditions, it was not scrutinized in the same detail during the field studies as water distribution or the ancillary functions of system maintenance. Water distribution was accorded its central place in the T.O.R. for several reasons. In contrast with the other activities mentioned, it is an activity peculiar to irrigated agriculture and it has not been widely studied - indeed, until very recently, it has been astonishingly neglected, both by academic researchers and professional practitioners. But the overriding reason was that there was

1/ In the Terms of Reference for Phase II the principal objective of the field studies was seen as the testing and elaboration of hypotheses about the management and organizational requirements of irrigation projects with different characteristics and at different stages of development over time (T.O.R., paras. 2.3 - 2.4). The same process of testing and refinement has been carried a stage further by the comparative analysis in this Report. Though many of the conclusions drawn from the analysis appear to have widespread if not universal validity in the light of the evidence surveyed, some can still only be regarded as hypotheses, requiring further testing in other environments (see Chapter 13, Section 3).

2/ T.O.R., Phase II, para. 2.4. It was envisaged that these guidelines "would need to be further tested and elaborated at a later stage (Phase III)".

recognized to be an immense potential, so far largely untapped, for improving current water distribution practices. 1/

By the time the T.O.R. for Phase II came to be drawn up, it was already clear from the few existing studies which had concerned themselves with the subject (as well as from the consultant's own observations during a pilot study) that major deficiencies in the performance of the water distribution function were to be found in many irrigated areas, for reasons which were attributable partly to weaknesses in technique and partly to social and political factors. It was therefore reasonable to expect that substantial benefits were likely to accrue from deeper investigations into the causes of poor water distribution and the identification of appropriate management reforms. Because it had been observed that the pattern of water distribution was often extremely unequal between the heads and tails of the delivery systems, it was further expected that reforms in present practices, besides generating large increases in overall agricultural production, would also bring particular benefits to the poorest people in the irrigated areas, especially small farmers in tail areas. Because of the Bank's well-known concern to find effective new ways of reaching and benefitting the rural poor, special attention has been given in this report to identifying and recommending those organizational structures and management procedures which appear most likely to succeed in serving their interests.

Although the Terms of Reference contained no such requirements, the report ends with a brief outline of the kind of post-evaluation action programmes for reforming irrigation management which we believe to be urgently needed in many less developed countries. Although it is recognised that further field testing of the guidelines may be necessary before a definitive handbook for the evaluation of irrigation management can be developed, there is no need to delay the planning and implementation of appropriate action programmes until such a handbook is finally produced. Enough is already known for a satisfactory evaluation to be undertaken with some confidence and the objectives of research and policy could both be met if the guidelines were to be tested in countries which had already indicated particular interest in management reform. The dimensions of the potential benefits to be obtained from implementing the kind of reforms we propose are described in Section 1.3.

Many readers will find the main body of the report too long to wish to read it in its entirety and may prefer to confine themselves to the summary in this opening chapter and to those sections of the main report

1/ Cf. T.O.R., Phase II, para. 2, where it was stated that special emphasis should be given to studying the management of the main delivery system down to the watercourse outlet (the point at which responsibility for water control is passed to farmers or groups of farmers). Main system management has been particularly neglected by researchers and practitioners, with somewhat more attention being paid to watercourse management and much more to water management techniques at the farm level -- a relatively safe and uncontentious subject.

which are of particular interest to them. Among the factors which have contributed most to the length of the main report have been a wish to substantiate propositions and conclusions with as convincing a body of supporting evidence as possible; and a wish to make the report readable as a self-contained document, without need for constant cross-reference to other documents, especially the field study reports. The report has been written primarily as a research paper. 1/

The first draft of this report was reviewed by a consultative panel of experts in Britain during July-August 1979 (I.D. Carruthers, agricultural economist; R.C. Chambers, political scientist and agricultural management specialist; D.B.A. Evans, management consultant and agricultural economist; I.S.G. Matthews, irrigation engineer; and M. T. Powell, agriculturalist). In accordance with their constructive criticisms, substantial revisions have been incorporated into this final text.

1.2 Summary of findings and recommendations

Project characteristics (3.1). The first step in any evaluation of irrigation project management must be to build up a clear and detailed picture of the local environment (the context in which management is being performed) and of the resources of personnel, finance and equipment which project managers have at their disposal. With regard to a particular project under review, the collection of information about its basic resource characteristics (checklisted in Appendix A, Part I) is needed to ensure that proposals for future action are based on a sound understanding of present conditions. The information is also needed for the development of general hypotheses and theories about the nature and requirements of irrigation management. As more evidence accumulates from particular cases, it becomes possible to draw increasingly confident distinctions between generalisations which are universally true and those which hold good only under certain (physical, technical, economic or social) conditions.

The bulk of the evidence on which conclusions in this Report are based comes from the four case study areas designated as Areas One, Two, Three and Four. Between them these areas contain a remarkably wide diversity of characteristics. Important differences in environment, with implications for the most appropriate forms of organisation and management in each case, include:

Scale of project area, ranging from 33,000 to more than 625,000 ha; rainfall pattern; cropping pattern; soils and topography; age of project; extent of public and/or private groundwater exploitation; canal technology; well technology; continuity or discontinuity of command area; farm size; land and income distribution; level of economic development; irrigated farming skills; social cohesion.

1/ Unfortunately some of the absolute value to researchers outside the Bank has been diminished by the need to respect the confidentiality of some of the data sources (Ed.).

There are also many important differences on the other side of the equation - the projects' organisational and management characteristics - which include:

Accountability of project organisation to farmers; coordination between canal and groundwater staff; combination or separation of water distribution and maintenance responsibilities; character of management hierarchy; density of coverage of irrigation staff; density of coverage of agricultural extension staff; freedom of farmers' choice of cropping patterns; water distribution methods; watercourse-level organisation.

This diversity of conditions provides a firm basis for developing a large number of hypotheses about the management requirements of large-scale irrigation projects in developing countries in general.

Performance and potential (3.2-3.3). The next step towards the evaluation of a project's management is an evaluation of its performance and potential. In the four field studies particular attention was given to assessing performance in accordance with the following criteria: productivity (especially of water); equity (especially of water distribution); environmental stability; cost; and cost recovery. Despite difficulties in obtaining accurate assessments in relation to certain criteria (particularly productivity of water) through evidence from project records, it was concluded that in all areas except Area Four there were major weaknesses in performance and hence correspondingly large opportunities for future improvement - even though the projects concerned were among the best examples of their regional type. Inequitable water distribution was particularly marked in the case of tubewell operation in Area One, and canal operation in Areas Two and Three. 1/

The standards against which the performance of each project is to be judged should not be absolute ones. They should represent that potential level of performance which a project might reasonably be expected to achieve under conditions of adequate design and good management: they must take into account the particular characteristics of each project and should vary over time in accordance with changes in the management capacities of both officials and farmers. To identify the reasons for levels of performance achieved a further process of analysis is needed which calls for a much deeper investigation into potential causal factors than is possible through conventional cost-benefit techniques.

'Non-management' factors influencing performance (4.1). Clearly the level of a project's performance cannot itself serve as an indicator of the quality of that project's management. Numerous 'non-management' factors can significantly affect project performance. Apart from major upheavals, such as international or civil wars, these include climatic and

1/ Principal indicators of project performance are summarised in Table 3.2 (p 46).

biological hazards; national and international economic policies; the quality of service provided by other enterprises on which the project is dependent; and the quality of project planning, design and construction. A comprehensive evaluation should attempt to weight the importance of all these issues. In the field studies, however, attention was focussed mainly on the last set of factors, largely because of the immediacy of their effect on subsequent management and also because many of the commonest weaknesses in planning appeared to stem from the same causes as those in management.

Quality of planning, design and construction (4.2). When the influence of these factors on performance and management is being evaluated, distinction must be drawn between design limitations which have been consciously built into the original project plan (often for cost reasons) and those which are the consequence of unplanned errors. In the former case the limitations have been anticipated and the system's management requirements can be planned accordingly; the performance 'targets' set for management may be relatively low but they are attainable. But in the latter case, systems cannot be operated according to plan and expected performance targets cannot be achieved. Two major sets of planning and design errors were encountered in the study areas: in Area Two failure to provide drainage or proper watercourse layouts and mistakes in the design of the main canal system; and in Area One, failure to enlarge watercourse channels to accommodate additional water flows from new supplementary tubewells. Another frequently noted weakness was an absence or shortage of adequate measuring devices.

Planning deficiencies of the kind mentioned above, which cause major water wastage and/or environmental damage, have been particularly common during the recent rapid expansion of new irrigation development. There appear to be three main reasons for the prevalence. The first is inadequate project formulation or appraisal; decisions have been reached on advice largely supplied by generalist administrators and/or civil engineers, with little input from agriculturalists, economists or other social scientists. Secondly, all major system design decisions tend to be taken by civil engineers in historically powerful Irrigation Departments, with minimal consultation with agricultural researchers; these engineers have focussed mainly on the design of large structures and have continued to adhere to crude and outdated assumptions about crop water requirements. A third factor has been local political interference in decision-making, which has led to unscheduled and damaging changes in system design, planned cropping patterns, etc. Political considerations have also been at the root of the over-emphasis on large structures at the expense of detailed design issues. Given the high potential value of irrigation water, it is not surprising that governments are sometimes tempted to seek short-term acclaim through those forms of investment which are most visible and spectacular. Nor is it surprising that political factors continue to be important after projects become operational.

Analysing project organisation and management (5.1-5.2). In addition to 'non-management' factors, there are many important 'management' factors affecting project performance over which project managers themselves have only limited control. They include:

- (a) Establishing clear objectives for project management;
- (b) Providing an appropriate organisational structure;
- (c) Creating a basic framework of management procedures;
- (d) Formulating policies on staff recruitment, promotion and salaries;
- (e) Creating mechanisms for the provision of adequate recurrent finance;
- (f) Providing an effective legal framework for water management.

These are essential elements of 'planning for management', which should form a prominent part of the project planning process (though it rarely does); responsibility for them lies with senior policy-makers and planners. Other clearly identifiable sets of responsibilities belong to project managers and their staff; and to the farmers. At each level of the decision-making hierarchy, capacity to perform well depends very significantly on quality of performance at the levels above it. It is very important in evaluations of management to identify correctly the levels from which strengths and weaknesses in performance stem, to ensure that recommendations for remedial action are appropriate.

Within whatever external constraints it may have to operate, the quality of an organisation's performance is partly a function of its structure (the way in which tasks and responsibilities are formally allocated among its members) and partly a function of its management process (the way in which decisions are actually made within the existing structure). Most questions of organisational structure can be answered by techniques which depend more on theory than detailed field research; but understanding of the management process can only be obtained by more intricate and time-consuming investigations, involving interviews with staff and scrutiny of their records. Methods of data collection and analysis differ markedly from those used in conventional evaluation. The object is only partly to gain information about facts; much information which has no value in terms of factual accuracy may nevertheless provide very important insights into attitudes, motives and technical and administrative capabilities. Some of the most valuable information about management performance is obtained through indirect inference.

In analyses of management performance, the possible reasons for performance can usefully be conceived as falling within three categories: resources (finance, manpower, equipment); skills (e.g. technical, management, communication); and motivation (material and non-material incentives). Again, the appropriate form of remedial action depends on a correct identification of where the major shortcomings lie. When one is wishing to establish the reasons for divergences between precept and practice, sensitive issues are often involved - particularly in the case of water allocation - and this reinforces the need for a tactful, oblique approach to information-gathering.

Organisational structure (6.1). Organisational structure has both a horizontal and a vertical dimension. The horizontal dimension is concerned with the way in which the various activities required for the achievement of an organisation's objectives may best be differentiated (in accordance with the different specialist skills associated with each activity) and subsequently coordinated, with a view to producing a unity of effort among the organisation's resulting sub-systems. "The best structure will not guarantee results and performance. But the wrong structure is a guarantee of non-performance" (Drucker). Theorists agree that there is no single 'ideal' or 'universal' structure which is best for all organisations in all circumstances. Appropriateness of structure will vary in accordance with a number of factors which are specific to each organisation's particular context.

Horizontal relationships (6.2). The principal determinants of the horizontal structure of an irrigation project organisation are its objectives and key activities; the administration and technical capabilities of its members; and the size of the irrigated command area.

The most important divergences of objective appear to be between (a) recently-established irrigated settlement schemes; (b) schemes established specifically for producing high-value crops, often for export; and (c) schemes designed to supply water to already settled areas where farmers are allowed a relatively free choice of cropping pattern.

On settlement schemes project management has direct responsibility for providing new infrastructure and social services as well as agricultural and irrigation services. Schemes of the second type are characterised by an 'integrated management system', which requires farmers to sell their produce through the project's marketing wing, and then allows the project to use deductions made at the point of sale to cover the cost of other services - irrigation, extension, credit, input supplies, and sometimes mechanised land preparation. In schemes of the third type (to which all four of the study areas belong), infrastructural development and social services can usually be left to the existing civil administration. Commercial services (marketing, credit, inputs) are often best supplied through close coordination with other agencies, since single-channel marketing (essential to integrated management) is extremely difficult to achieve in areas of multiple choice cropping. On these schemes, the crucial question of horizontal coordination is whether the key activities of water distribution and agricultural extension should be carried out by two organisations or one.

The answer depends on the size of the command area and the capabilities of staff. On schemes with large, continuous irrigated areas, there are very powerful grounds for advocating a unified project management structure wherever:

- (a) the officials in charge of water distribution (usually civil engineers) are not 'agriculture-oriented' in training and outlook; and/or
- (b) the agricultural extension service is weak, both in terms of resources and skills; and/or

(c) the average level of farmers' management techniques is low.

Where none of these conditions apply, reduced administrative costs are likely to make a division of responsibilities between two organisations preferable, with the necessary coordination effected through meetings, correspondence, etc. Although usually much closer collaboration is needed between civil engineers and agriculturalists, a unified command area organisation (with its high overhead costs) may be ruled out because the area is characterised by numerous medium-sized or small, discontinuous irrigation commands interspersed with unirrigated land. In such conditions (typical of much of S.E. Asia) the choice appears to lie between strengthened inter-departmental coordination at the district level and the more radical alternative of an area-based pattern of administration in which the units of management would be based on complete watershed and catchment areas.

In areas where unified organisations are required but do not yet exist, attempts to introduce them will inevitably face difficulties. In most cases a substantial planning period will be needed before such changes can be satisfactorily implemented and, in the meantime, other less problematic procedural reforms should be introduced.

Within the project organisation, there are strong grounds for favouring separate sections for water distribution on the one hand and construction, repair and maintenance on the other, the former to be staffed by water distribution specialists and the latter by civil and/or mechanical engineers. Separate cadres for water distribution and maintenance work, recognizing water distribution as a specialist activity of key importance were in use only in Area Four. The development of similar patterns elsewhere would require major investment in new programmes of university and in-service training.

Vertical relationships (6.3). The vertical dimension of an organisation's structure is concerned with the shape of the hierarchy of each of its sub-systems and the location of responsibilities at different levels within it. Two aspects of vertical structure are considered separately: the division of responsibility between project organisation and farmers; and the division of responsibility between different categories of staff within the project organisation. In general, the management requirements of large irrigation schemes are better met by organisations with 'bureaucratic' structures (with clear-cut lines of authority) than by those which are 'organic' (flexible, free-form) in character; but the appropriate degree of concentration or dispersal of responsibility depends on local circumstance.

The principal determinant of the appropriate level of responsibility-sharing between officials and farmers should be the farmers' 'management capacity', both at the farm and local group (watercourse) levels. By this criterion, the official agency should assume direct responsibility for more functions where farmers' management capacity is low, and delegate increasing responsibility to farmers as their agricultural experience and capabilities for group action grow. However, this simple pattern is not always easy to

detect because of additional technical factors. An official agency may have good technical reasons for imposing restrictions on farmers' choice of cropping patterns, irrespective of the farmers' management capacities: e.g. water scarcity or a need to prevent high rates of seepage or waterlogging may entail restrictions on crops with high water requirements.

This was the case in Area Four. But within the necessary limitations imposed on cropping choices, farmers and their representatives in that project are given substantial responsibilities in other respects: as farmers' management skills have developed over the past 50 years, an initial pattern of externally imposed supervision, control and discipline has evolved to one of increasing self-control and self-discipline by farmers' groups. Projects with a high degree of management control, such as Mwea in Kenya, are in many ways appropriately structured in their early development but there is a danger that institutional rigidities will prevent their continuing to be so over time. On the Indian sub-continent the pattern of official-farmer relationships falls outside the desirable path of progression from high supervision/low delegation to low supervision/high delegation. With its tradition of 'non-intervention' by officials below the watercourse, its pattern may be characterised as low supervision/low delegation.

Within the official organisation, the amount of responsibility which should be delegated to more junior staff depends on the nature of the activity concerned and the skills of staff at different levels. Wherever management skills are a scarce resource there should be advantages in delegating responsibilities as far as possible to help reduce the workload of senior staff and upgrade the capabilities of subordinates through on-the-job training. There are particular advantages in the case of activities whose effectiveness depends to a large extent on information feedback from farmers, e.g. extension or water distribution. But the level of education and experience of junior staff places limits on the amount of delegation possible. The size of the project area is another factor affecting its vertical structure. The larger the project the greater the need to delegate responsibilities from headquarters to regional offices: this helps to improve lines of communication not only vertically, but also horizontally at lower levels of the organisation. Decision-making in Areas One and Two was found to be overcentralised; in Area Three too much responsibility seemed to be delegated to field staff, whose activities required closer monitoring and supervision; but in Area Four, with its decentralised field office structure, balance between delegation and supervision appeared well judged.

Organisation at provincial and national levels (6.4). Strengths and weaknesses in project level organisation can be reinforced or counteracted by the character and structure of higher level organisations. In Area One the horizontal structure of provincial and national administration reinforces the fragmented pattern at the project level. In Area Three there are separate departments for agriculture and irrigation, but attempts are being made to coordinate their activities more closely. In Area Two improved coordination has recently been achieved at the central level by transferring responsibility for irrigation to the Ministry of Agriculture, but at the State level, where the major agricultural policy decisions are taken, there

continue to be separate Ministries of Irrigation and Agriculture; where unified Area Development Authorities have been set up at project level, the potential for better coordination has tended to be somewhat undermined by the dyarchy at State level. In Area Four it appears that whatever may have been lost through the absence of closer coordination at project level between the Irrigation Association and Local Farmers' Associations, is strongly compensated for by highly coordinated planning at the national level.

Vertical relationships between organisations at the project and provincial/central levels tend to show the same tendencies as those within each organisation. Only in Area Four are very substantial financial and other responsibilities delegated to the project management level.

Overall project management: scope, external limitations and performance (7.1-7.2). One logical starting point for the analysis of the management process is the central directing and coordinating activity of project management. However, there are difficulties in defining the meaning of 'project management' in most cases where executive responsibility is divided between two or more agencies with different areas of jurisdiction. There, in place of an assessment of overall management, it is only possible to assess the performance of the most senior executive officials in each of the leading agencies - who inevitably have a relatively specialised and limited range of activities to direct and coordinate. Moreover, in all cases except Area One, there are further major limitations on the decision-making powers and accountability of senior officials at the project level. Staff are appointed and transferred by higher departmental authorities; rules about promotion and salary scales, which reward academic qualifications and long service rather than field experience and performance, are rigidly applied; and, although project officials are responsible for raising revenue from water users (at rates determined by the government) none of it is retained locally and they are wholly dependent on government for all recurrent finance. In such conditions, senior officials become less managers than bureaucratic functionaries - particularly if, as often happens, they lack the framework of a good internal management system within which to operate.

The manager's function has been described as "getting things done by other people". His chief tasks are: setting objectives; directing the planning and budgeting processes; directing work programming; supervising the execution of the agreed programme; monitoring project performance against objectives and staff performance against agreed work targets. A comparative review has been made of the performance of the management function in the study areas, in which the limitations of the manager's powers in each case are taken as given and the main object is to judge the extent to which performance has been influenced by the quality of the management system rather than the personal characteristics of the officials themselves. Common weaknesses selected for scrutiny are: confused objectives; absence of a systematic, participative approach to budgeting and work programming; 'departmentalism'; authoritarian behaviour towards subordinates; and inadequacies in the monitoring of project and staff performance. The review strongly suggests that the quality of the management system is an extremely

significant influence on performance and that, with one possible exception, it was much more significant than managers' personal characteristics. It also makes it clear that in all the study areas except Area Four there are great opportunities for procedural reform.

Incentive in public service institutions (7.3). An explanation is needed as to why the managers of irrigation projects in Area Four have had much more power to make decisions and motivate staff than their counterparts in the other study areas. The principal reason is the source of the Irrigation Associations' finance. Instead of being fully dependent on government funds for their recurrent budget the Associations have to rely heavily on members' fees. This makes management and staff accountable to their clients and puts them under pressure to provide good service. If they do not, fees will be more difficult to recover, revenue will decline and cuts may have to be made in staff numbers and salaries. But good service encourages high fee recoveries and management can reward itself and staff members with bonuses as well as having additional funds for local reinvestment. By contrast, in the other study areas there is no direct link between a project's level of performance and its financial rewards. The level of finance received from government is determined by the availability of funds for the sector as a whole and by reference to government 'yardsticks'. Quality of performance, either in terms of increased agricultural production or recovery of revenue, is largely immaterial. Farmers have no incentive to pay water charges, since proceeds go to general revenue and have no direct effect on levels of local reinvestment; and management and staff have no incentive to improve services.

"Being paid for performance and results directs towards performance and results" (Drucker). Substantial short-term changes in government policy concerning the payment of public employees would be extremely difficult to achieve in many countries. But even modest changes in current practice designed to introduce some competitiveness into the process can be expected to bring significant improvements in performance. Possible measures are considered, which could be introduced experimentally in the first instance.

Water distribution (8.1). Wherever water is scarce in relation to demand, the most important function of project management is to distribute it efficiently and fairly. Only if the main distribution system is well operated can other important management objectives be realised (e.g. 'on-farm development' work, improved watercourse and farm level water management, higher water charges); and only then can high returns be obtained from agricultural extension and the application of complementary inputs. However, the poor quality of water distribution in most developing countries and the dimensions of the management reforms required to remedy it have been consistently underestimated by developing country governments and aid agencies.

Conclusions drawn from the field study areas fully support evidence from elsewhere that serious deficiencies in water distribution practices are widespread in developing countries. In most cases a substantial proportion of overall inefficiency of water use could be attributed to shortcomings in main system management. Head-reach farmers were taking far more than their

share of water on the canals of Areas Two and Three, leaving tail-reach farmers with insufficient and unpredictable supplies. And in Area One there were major irregularities in tubewell operation, from which large farmers (and tubewell operators) appeared to be the main beneficiaries.

The management of water distribution has two main dimensions, each with a different set of problems and associated remedies: a technical dimension, which relates to the appropriateness of water distribution methods and their capacity to secure an optimal match between supply and demand; and a social/political dimension, which concerns the capacity and will of officials to ration water equitably and resist often powerful pressures to misallocate. Good water distribution thus requires not only a high order of technical skill but a management system which will make it rational for officials to deny extra water to the more powerful and better located, despite the unpopularity and loss of 'unofficial income' this will entail. Another essential requirement is a well-designed two-way information system between officials and farmers.

In a review of performance from the technical perspective consideration is given to the kinds of procedures, skills and resources required to execute the sub-activities of planning, implementation and monitoring under various conditions of system design and distribution methods. Its most important conclusions are these:

- (a) In Areas One and Two planners had given very little thought to designing appropriate operating procedures and there was major scope for improvement. In Area Three, there were technical flaws in a theoretically attractive distribution method which may be too complex to be operated well with the management skills available.
- (b) Feedback of information on local variations in demand needed to be more frequent and/or accurate in all but Area Four. Farmers were given little information about expected supplies in Areas One and Two. In none of the project areas could farmers on one watercourse easily learn about supply patterns elsewhere on the main system.
- (c) In by far the best operated system (Area Four) the officials in charge of field operations were not civil engineering graduates but technical high school diplomates with long field experience. Excellent distribution procedures, derived from high quality agricultural research, reduced the need for highly qualified people and provided the basic framework for staff training.
- (d) Staff numbers were judged adequate in Areas Three and Four and almost certainly inadequate in Area Two. Major deficiencies in present operating procedures in Area One made it difficult to gauge what optimal staffing levels should be.

With regard to the social/political dimension of water distribution, the amount of pressure likely to be exerted on irrigation staff and vice versa will tend to vary according to the degree of water scarcity; the need to restrict the area of certain popular crops (rice, sugarcane); and the social structure of the farming community. Unusually powerful measures are required to motivate officials and staff to resist pressures to mis-allocate. These include a management system which rewards those who perform in the public interest and penalises those who do not; legislation which enables quick punishment to be given to water stealers; and, to prevent official abuses and promote accountability to the most vulnerable clients, a farmers' organisation, in which tail-enders and/or small farmers are strongly represented.

A review of experience in the field study areas considers what the degree of pressure on irrigation staff was; how effectively equipped they were to resist these pressures; and how well they performed in practice. In Areas One and Three it was clear from internal evidence that staff were failing to resist local pressures; this had also previously been the case in Area Two. In some projects, there is a need not only for comprehensive management reforms but also for basic infrastructural improvements. In the other two cases, however, there were no technical deficiencies which made the staff's tasks exceptionally difficult: it was simply that motivation to resist pressures was weak.

It has not been possible during the relatively brief studies undertaken for this project to make confident quantitative estimates of the extent to which deficient water distribution management may be contributing to poor performance. However, an action research study in the Philippines found that quite modest changes in water distribution procedures, combined with minor technical improvements, were associated with a 97% increase in production overall, and a 149% increase in the tail end of the system, over a two-year period. And a case has been recorded in Sri Lanka where the introduction of strict management procedures enabled 50% more rice to be produced within a single season than would have been possible under normal operating conditions.

System maintenance (8.2). Maintenance is an ancillary activity whose performance is essential to a high quality of water distribution. In the field study areas maintenance of civil works had substantially different management requirements from mechanical and electrical maintenance. None of the canal (or canal-cum-drainage) systems involved complex technology and their maintenance was largely concerned with civil works: the repair of earthworks and structures and the removal of weeds and sediment. These are mostly routine activities which can be satisfactorily performed by a predominantly unskilled labour force supervised by a few civil engineers. But in the Areas One and Four which have public tubewells, the level of skills required was much higher; a sizeable staff of trained field technicians was required as well as an efficient back-up service from the projects' repair workshops.

The general level of civil maintenance was judged very satisfactory in Areas Three and Four. In Area One, major canals were maintained to a high level but certain minors and distributaries were in some disrepair. In the soil conditions of Area Two, the maintenance of earthworks presented unusually severe problems and performance fell far short of requirements. A range of possible reasons was considered for variations in performance levels and it was concluded that the overriding reason for shortcomings in the latter two cases was an acute shortage of recurrent finance (estimated annual expenditure per canal km in Area Two was \$421 in Area One \$964, in Area Three \$1466, and in Area Four \$2352).

M and E work on the public tubewells in Area Four appeared to be performed satisfactorily. Responsible staff had had appropriate training and, as with the civil maintenance programme, there were clearly established maintenance procedures. But there were major problems associated with Area One maintenance programme which could only be partly explained by inadequacy of funding. An alarmingly high proportion of potential operating time was being lost because of technical faults, many of which were attributable to negligence on the part of tubewell operators. This in turn was attributable partly to weaknesses in the planning and design of the management system (there was no Maintenance Manual) and partly to the poor morale of supervisory staff. The frequency of breakdowns disrupted routine maintenance schedules and substantially increased the workload of the servicing workshops. In addition, restrictive rules concerning authorisation of expenditure led to major delays in obtaining spare parts. Most senior staff had been trained as civil rather than mechanical engineers, but new recruits were given 4-6 months' in-service training. Field engineers complained about the quantity and quality of the workshops' equipment and personnel.

Agricultural extension (8.3). Good agricultural extension is vital to the development of irrigated agriculture in developing country conditions, especially in the early stages of irrigation and/or when farmers' knowledge of agricultural and irrigation techniques is limited. Besides enhancing productivity, it can play a powerful part in promoting greater equity through its capacity to give preferential assistance to smaller farmers. Extensionists' work tends to be more easily programmable under irrigated than under rainfed conditions because of its relative predictability and homogeneity. However the range of tasks required is greater and calls for substantial additional specialist training and supervision. Besides the basic tasks (identifying farmers' problems, providing production advice, coordinating with input agencies, collecting production data), additional tasks include giving specialist advice on farm level water management, developing farm plans to encourage more economic use of water delivery patterns, and discussing water demand issues with the water distribution agency.

Extension services in most parts of Asia are grossly underequipped in terms of field staff numbers, transport and accommodation. Staff also lack the necessary technical and communication skills, particularly in the field of water management. This inadequacy of resources and skills - reflecting the low priority given by most governments to agricultural extension - guarantees ineffective performance. This in turn generates poor

morale - which further guarantees ineffectiveness and confirms official views about extension. A self-perpetuating cycle is thus established: low status - low investment - low pay - poor performance - low morale - low status. As has been recognised on some pioneering extension improvement programmes in Pakistan and India, the essential keys to breaking this cycle are adequate resources and facilities, a well-designed extension message and a well programmed and monitored management system which will ensure the message is widely communicated. Once the programme begins to be effective and stimulates client demand, this will in itself have a potent effect on staff morale even without significant changes in salary or promotion prospects. In the interests of promoting equity, the initial emphasis should be on widely imitable farmers rather than those classified as 'progressive' and extension advice should start by focussing on improved cultural techniques rather than on substantial increases in purchased inputs.

With regard to the special tasks of extension under irrigated conditions, note should be made of the almost unique farm planning programme in a Pakistan project, SCARP Khairpur, which aimed to identify periods in which scarce water supplies exceeded demand and to devise alternative cropping patterns which would reduce underutilisation of water to a minimum. How far extension staff should be involved in communicating with irrigation staff about short-term water demand issues in addition to giving water management advice to farmers depends on local conditions: where communication between irrigation staff and farmers is poor and there is scope for local supply adjustments, extension staff can be useful as farmers' negotiators. However, there is universal need for senior agricultural staff (both extension and research) to participate in the planning of seasonal schedules and in long-term reviews of alternative cropping and water distribution practices. These are crucial activities in which the agriculturalists' role is often minimal and needs to be greatly strengthened.

Watercourse improvement and advisory services (8.4). In all the study areas, operation and maintenance below the watercourse outlet is the collective responsibility of the farmers within the watercourse command. This implies the need for an effective watercourse management advisory service. But in certain adverse physical conditions an essential prior requirement is a comprehensive rehabilitation of the watercourse command. Where there are major deficiencies in surface drainage, particular problems of organisation arise: irrigation and drainage channels often need to be radically realigned and this requires the collective agreement of farmers in each catchment area to land reallocation and farm boundary realignment. To secure their cooperation as a group, the planning agency must devote substantial resources to consulting them closely, allowing them to participate directly in decision-making and keeping them fully informed of all final decisions taken; as a last resort the agency must also be able to apply legal sanctions against obstructive individuals. To encourage group responsibility for subsequent O & M, farmers should be required to contribute substantially towards the costs of work agreed to. The main design and construction work should be supervised by agricultural engineers, but close coordination is required with other professional units, especially main system

operators (to ensure conformity of assumptions about design and water distribution methods) and extension staff. On completion of construction work, adequate follow-up advice must be provided, with the respective responsibilities of official staff and farmers clearly defined and understood.

Before any major programme of watercourse improvement (whether its purpose be new construction, rehabilitation or only upgrading), the management of the main distribution system should be thoroughly investigated and, as far as possible, improved within the constraints of the existing design; the extent of the work needed at the water course and farm levels can then be seen in the correct perspective. Wherever possible, alternative technological choices (e.g. on land levelling, channel lining, farm roads) should be offered to farmers rather than predetermined 'packages'. Failure to look carefully at costs and benefits within the framework of system management as a whole leads to over-designed, unreplicable layouts. Experimental pilot projects should be established in a variety of localities and monitored with total objectivity before attempts are made to extend programmes more widely.

Wherever the physical conditions of the watercourse command provide the opportunity for satisfactory management, it should be a regular and continuing task of the operating agency to supervise farmers' activities, strengthen their capacity for communal decision-making and joint action and extend the adoption of improved O & M techniques. In fact, very little advisory work of this kind was done in any of the areas visited except Area Four, where the project authority contains a separate section for the purpose. Similar units are required elsewhere. The need appears to be for an entirely new cadre of junior watercourse management extensionists, which could be directed by the senior officials responsible for water distribution or by a small separate group of specialists.

Management support services: finance, personnel and monitoring (8.5). In all study areas except Area Four financial management consists of two separate and largely unrelated activities: (i) water charges assessment and collection; and (ii) budgeting and accounting. Both water charge rates and recovery levels are very low in Area Two (\$4/ha; 48% recovery) and Area One (\$5/ha for canal water; \$10/ha for canal and tubewell water; 60-70% recovery). Land tax rates in Area Three average \$14.50/ha. Low recovery levels reflect the low quality of water distribution services received by farmers. Meanwhile, budgeting and accounting are largely routine activities: annual budgets are little more than 'shopping lists' to government. By contrast, in Area Four with its heavy financial dependence on members' fees, revenue generation and budgeting are an integral part of the same dynamic planning process. In 1976 average fee charges were \$87/ha and recovery rates 97.8%. The annual budget is prepared participatively and involves detailed consideration of alternative fund allocations. Detailed accounts are also prepared for government and beneficiaries.

Personnel management has a much wider meaning and scope in Area Four than in the other study areas. With their greater financial autonomy,

the project managers can recruit staff, offer periodic bonuses, and promote them within the organisation. But on projects dependent wholly on external budget allocations, managers cannot influence salaries and promotions, and they and their qualified staff are frequently transferred elsewhere. Frequent transfer is particularly damaging to morale. Where managers have few incentives to offer, scope for personnel management is largely limited to supervising and controlling staff - which easily leads to authoritarianism and/or permissiveness. But managers in this project, able to use a judicious mixture of incentive and management control procedures, have far more room for manoeuvre in their relations with staff.

Large irrigation projects require a small multi-disciplinary unit at headquarters which will monitor performance against selected objectives and targets and do more specialised research in particular subject areas. At present the main weaknesses in data collection are not insufficient data but inaccuracy and a failure to select and analyse data in a way that makes it an effective tool of management. The information needs of new monitoring units should be precisely identified before hand so that appropriate management systems can be built up accordingly.

Priorities and sequences for action (9.1-9.4). Among the many possible remedies for deficiencies in the organisation and management of irrigation projects, highest initial priority should be given to improved procedures. Not only can procedural reform be relatively quickly and painlessly introduced but it is usually of central importance in its own right. Any irrigation project without detailed and carefully-designed procedures is lacking an essential tool of management, but serious deficiencies were revealed in the majority of the projects reviewed. The PIM system developed by Belshaw and Chambers for use in Kenya is briefly described to illustrate how procedural reform can produce major improvements in performance not only through more efficient use of existing resources of staff, equipment and time but through various measures which enhance the morale and motivation of junior staff. 1/

Another relatively uncontroversial measure for which there has been shown to be great need is improved training. There is a particularly urgent requirement in many countries for civil engineers engaged in O & M work to receive specialist in-service training in water distribution. In the case of programmes for junior staff, training should if possible be linked to some prospects of promotion; otherwise its effectiveness may often be severely limited.

Water charges in many developing countries tend to be very low and it is often urgent that they should be raised, principally because increased government revenue is required to provide much needed additional O & M finance. (High charges are of less importance as a means of encouraging

1/ For definition of PIM, see p 184. Also, R. Chambers, Managing Rural Development, pp. 43-54.

farmers to use water more sparingly: if scarce water is distributed efficiently and predictably, its high potential value will be their chief motivation to use it sparingly, not its cost.) But despite the desirability of raising water charges, it should be seen as a secondary issue in terms of sequential action, first because it is a highly politicised issue; and secondly because in most cases farmers will not become better disposed to the idea of higher charges unless other changes are made first - the most important of which is an improved water distribution service.

Inadequacies in recurrent finance and staffing are often very pronounced and obvious, in which case high priority should be given to seeking lasting solutions - though this will rarely be easy in the short-term. In other cases, optimal resource levels may be very hard to determine confidently because many other factors are adversely affecting management performance. In these cases attempts should first be made to improve performance through manipulating other factors - skills, motivation, quality of operational procedures - before reaching conclusions about finance and staffing. It is because of their heavy interdependence with other factors that the development of finance and staffing 'norms' is so difficult and has not been attempted in this study. One possible method of establishing such norms (as guidelines to planners) would be to compare the finance and staffing levels of well-managed projects within relatively homogeneous regions. But in regions without good irrigation management, accurate estimates could only be built up through action research.

The farmers' role in management (10.1-10.4). There is an upper limit on irrigation system size above which performance is likely to decline if responsibility for O & M is left exclusively in farmers' hands. Above this limit better results can be achieved if responsibility for main system O & M is given to an independent specialist agency, with farmer groups retaining responsibility below each watercourse outlet. Precisely where this upper limit comes on smaller systems depends on the complexity of the technology, the scarcity of water and the degree of social cohesion. But despite the limitations on their direct responsibilities on larger systems, farmers' representatives should participate in developing each season's water allocation plan and monitor the irrigation agency's day-to-day performance, wherever possible through a farmers' organisation.

For an authoritative assessment of farmers' management performance at the farm level sample surveys would be needed. These would be valuable in helping to clarify how much the quality of farmers' water management decisions was attributable to their own knowledge levels and how much to constraints imposed by deficiencies in water distribution and other services. In the field study areas (where there was insufficient time for sample surveys) there was evidence that poor water distribution had an adverse effect on farmers' ability to manage in at least two cases; and that lack of timely access to motive power for land preparation had caused major loss of income to smaller farmers in another case.

Farmers' capacity to organise themselves effectively for watercourse management is judged to be a function of the following factors: average farm size (number of farmers per watercourse); social stratification/cohesion; farmers' education and experience of irrigated agriculture; technical characteristics of watercourse command; size of watercourse command; village- or channel-based organisation; closeness of supervision by official agency; adequacy and predictability of deliveries to the watercourse outlet. Observations made during the field studies confirmed that there were much greater difficulties in establishing group responsibility in more stratified and less cohesive societies; and that irrigation organisations should be channel-based, not village-based. The need for a group to be small was assumed to increase with social divisiveness and the technical complexity of its O & M tasks; on these grounds the Area One watercourses were judged too large.

None of the areas studied has representative farmers' organisations at the project level, though Area Four had Members' Representative Committees until their suspension in 1975. Their approval was also required for the seasonal water allocation plans, but detailed O & M decisions were left to official staff. Even before 1975 the Irrigation Associations were subject to considerable intervention by government, largely because of its substantial contributions to their finances. Large Irrigation Associations in which all major strategic decisions are taken by farmers' representatives can probably only be found in relatively advanced economies, e.g. Spain or the United States.

Government's role in stimulating participation (11.1-11.2). It is possible even in markedly unequal societies for government agencies to bring about significant improvements in productivity and equity by giving weight to demands from ad hoc pressure groups from tail-end areas, which tend inevitably to be dominated by larger farmers. However, in the longer run genuinely representative farmers' organisations can be established at the project level only if effective water users' groups have first been built up at the watercourse level. One of the first priorities for the promotion of farmers' participation on large irrigation projects must therefore be the development of viable watercourse groups.

This may often be a difficult task, however, particularly where society is stratified and/or lacking in cohesion. Individual motivation to participate in group action is likely to be much less where groups have been formed, often at the instigation of an external agency, in order to carry out watercourse O & M on a large system than where indigenous groups have formed themselves for the purpose of constructing and operating their own small self-contained systems. For the successful formation of watercourse groups, particularly in unfavourable social environments, there must be clear rules and effective sanctions against those who contravene them. Initially the sanctions and rules will almost certainly have to be externally imposed, though the objective should be to get the group to apply sanctions against its own members as soon as possible. This devolutionary process will be greatly assisted if farmers are provided with a high quality of irrigation and other services.

Though watercourse groups are difficult to establish in many environments, two major advantages can follow from their establishment besides improved watercourse management. They could help provide a point of contact between government and small farmers for other supporting services, e.g. agricultural extension, credit, input supplies, marketing. And they should provide a sound foundation for representative farmers participation at project level.

Small surface schemes (12.1). Small surface schemes fall into two technical categories: run-of-the-river diversion systems, many of which are to be found in hill-stream areas; and systems dependent on 'tanks' or small reservoirs. Most of those in the first category are indigenous and are often remarkable for their social cohesion and sense of common purpose; but it should also be recognised that the simplicity of their technology, the relative abundance of their water supplies and their small size reduce the difficulties their members have to contend with. Tank systems are substantially more difficult to manage, which no doubt accounts for the much more variable quality of their performance. Their two main problems are the unpredictability of the rainfall pattern, which makes reservoir operation complex; and the other is the frequently heavy accumulation of silt.

Nearly all indigenous schemes and many small schemes initiated by government could benefit greatly from better advisory services. It is more difficult to organise services to a number of scattered small schemes than to a single large one, but increases in staff numbers and improved organisation could be expected to bring high returns. The provision of specialist advice on operation, maintenance and repairs might best be provided through the establishment of a rural engineering service, with junior field staff based at local offices like agricultural extension staff, perhaps at multipurpose Farmers' Service Centers. They would need to be in regular contact with senior engineers for advice on design work.

Groundwater schemes (12.2). The most important issues in groundwater management are the choice between public and private ownership; the choice of appropriate well and pump technologies; and the establishment of effective controls over groundwater extraction. Choices between public and private ownership and among technologies depend largely on the following: groundwater depth; abundance or scarcity of groundwater supplies; the need for drainage; water quality; opportunities for conjunctive use with surface water; size of land holdings; density of watercourse and field channel network; social structure of the farming community; and the quality of public sector management. The importance of controlling groundwater extraction increases with water scarcity and the intensity of demand. Responsibility for overall control is inevitably government's, though the mechanisms for applying it will depend on the nature of well ownership.

Under certain aquifer conditions, there is a clear case for groundwater management by a public agency, using deep tubewells with large discharge capacities; e.g. when the main purpose is drainage or groundwater quality is too poor to be used for irrigation except after mixing with canal supplies.

On the other hand, where the watertable is rather high and supplies abundant, there is a strong case for private shallow wells. The use of private wells with small-scale technology seems particularly appropriate in areas like Bangladesh where, in addition to high watertables, farm holdings are highly fragmented, watercourse channels are poorly developed and farmers' cooperativeness is low.

Between these two extremes there is substantial uncertainty. In areas where both private and public wells are operating, there is usually strong evidence of higher levels of water use efficiency under private wells. On the other hand, uncontrolled private development can be very inequitable in its effects, as well as leading in some cases to serious declines in watertable levels. Very few governments have in fact introduced or applied the necessary legislative controls, mainly from concern to avoid conflict with larger farmers. But public tubewell development does not necessarily offer a more equitable solution, as observations in Area One have shown. Like good surface water management, good groundwater management (whether in private or public hands) depends on high level commitment to serving the interests of all water users and not only minority pressure groups.

Recommendations: evaluation work (13.1-13.3). This report has demonstrated the need for a comprehensive approach to the evaluation of irrigation projects - an approach which goes well beyond conventional analyses of project performance and attempts to explain in detail the causes of performance. The evaluation advocated here is essentially an identification exercise. Resources required to carry it out would depend on the amount of recorded information already available on the project concerned; the extent of evaluators' knowledge of the local environment; and the depth of investigation contemplated. Most of the field studies were carried out by a team of three - a social scientist, a technical consultant and a local research assistant. With those resources it was usually possible to get enough information to identify major constraints after 2-3 weeks in each project area, plus 1-2 weeks' general orientation, including discussions with senior planners and administrators.

Though there is scope for further revision and refinement of the evaluation method developed here, it should be possible in the near future to consider producing a handbook on the appraisal and evaluation of irrigation management. Meanwhile, further research might be considered. The object of the one type of research would be to test the analytical framework in other, dissimilar, environments. These could include further large projects with characteristics substantially different from those already studied, but attention might also usefully be directed to the management requirements of medium and small projects. The second kind of research would relate to particular issues of uncertainty or controversy. Suggested subjects include the development of financial and staffing norms; the development of improved criteria for choosing appropriate water distribution techniques in different agro-climatic regions; cost-benefit analysis of on-farm development programmes (within the context of whole system management); and optimal sizes of watercourse and well command under different physical and social conditions.

Follow-up action (14.1-14.2). It is considered feasible and desirable that evaluation work should begin to be implemented in the field as soon as possible. There is evidence that many governments would be very responsive to constructive advice on management reform. This implies the need to consider now what kind of action programmes are likely to be required as an immediate follow-up to the initial evaluation.

The particular activities for which management reforms are most urgently needed are water distribution and agricultural extension. The basic requirements for improved extension are already fairly well understood and the high returns obtainable from improved methods have been vividly demonstrated. But this is not the case with water distribution. For a number of reasons, reforms in water distribution will have their greatest impact if they are introduced through action research, carried out on selected sections of larger irrigation schemes. Its principal objectives would be to identify the procedures and institutional arrangements most likely to succeed in similar environments; to demonstrate to politicians, administrators and farmers the precise benefits and costs of these measures; and to test certain important general hypotheses.

The action research should form part of a wider-ranging action programme. This would almost certainly include an investment in training in water distribution; improved agricultural extension; and in many cases a substantial programme of physical improvement to complement the improvements in management.

2-5 years' action research would probably be required before recommendations could be more widely extended. Where donor agencies are concerned in providing financial support, substantial external collaboration might often be needed with local institutions for planning and supervision purposes. Immediate responsibility for day-to-day operations would be in the hands of local institutions.

1.3 Potential benefits of a "water revolution"

The conclusions of Phase II of this study amply support the principal assumptions on which it was originally based: that there are immense opportunities for improvements in the performance of irrigation projects through management reform; and that - in South and South East Asia at least - the key to overall improvement in management lies in better water distribution, not only because major immediate benefits can be expected from it but also because better water distribution benefits such as improved watercourse management and improved system maintenance (as a result of farmers' increased propensity to pay higher water charges).

Because there have been so few attempts at water distribution reform so far, it is impossible to estimate with any accuracy what the benefits and costs of the action programmes proposed here are likely to be. However, it seems reasonable to assume on the basis of two well-documented pieces of evidence - the action research carried out by IRRI in the Philippines (97% recorded increase in rice production over two years) and

the results of an intervention in Sri Lanka (50% estimated increase in one season) 1/ - that in the predominantly rice-growing areas of Asia the proposed programmes should be capable of generating average production increases of at least 20%. On this very conservative assumption, which contains a probably unnecessarily large discount to allow for the effects of widespread replication, this would mean an increase in rice production in the South/South East Asian region of about 30m tons of paddy or 20m tons of rice. 2/

Though attempts have no doubt been made to introduce significant reforms in water distribution in semi-arid areas, there are no known records of their results. But the most detailed research on existing practices which has been carried out in this region - by the Colorado State University and WAPDA teams in Pakistan - has revealed very low average water conveyance efficiencies within watercourse commands (c. 50%) and similarly low levels of water application efficiency at the farm level. It was concluded in the Annex on Water Management in the World Bank's 1975 Agriculture Sector Review of Pakistan that a very substantial proportion of these water losses were attributable to weaknesses in main system operation; and this conclusion has been strongly confirmed by the field study carried out as part of this project. Some rough calculations have been made of the potential water savings which could be made in Pakistan as a result of better management, in conjunction with some fairly modest physical improvements. According to these calculations, it has been estimated that savings of over 20% could be made in the amount of water available for productive use through management alone; and that, over the 13 million ha of irrigated land in Pakistan, this would be equivalent to the amount of water available from three Tarbela dams. 3/

The financial costs of the principal ingredients of the reform programmes (action research, staff training, minor physical improvements) can be expected to be very low; and a high proportion would be recurrent rather than capital costs. Administrative costs would probably be fairly high, however, particularly in the case of the action research programmes: close supervision and monitoring would need to be carried out, both by the local institutions with immediate responsibility for planning and implementing the programmes and by the funding agencies supporting their work.

It may not be too fanciful to envisage the "water revolution" which could be brought about by these programmes as being analogous to the green revolution in its capacity to bring about major increases in crop production at a very favourable benefit: cost ratio. It also has the great additional merit that it can be expected to have a very positive effect in

1/ pp 139 - 140.

2/ On a very crude calculation of 50m ha x 1.3 cropping intensity x 2.4 tons/ha/crop x 0.2 percentage increase from reform measures.

3/ Pakistan Special Agriculture Sector Review, Vol III: Annex on Water Management, January 1976, pp. 32, 50, 55-56.

terms of equity and income distribution. In contrast to the effect of the earlier green revolution, which has often been to accentuate income differentials, the water revolution would reduce them. On canals, an automatic consequence of redistributing excess water from top-enders to water-short tail-enders should be to redistribute water, and income, from larger to smaller farmers, since larger farmers' inclination to dominate their smaller neighbours will be reduced as water supplies increase in quantity and reliability. 1/ And in public tubewell areas, evidence from Area One strongly indicates that the principal beneficiaries of bad water distribution practices tend to be larger farmers. Smaller farmers therefore stand to benefit particularly from reforms in irrigation management.

1/ This point is discussed further in Section 2.1.

2. Observations on Equity and Management Theory

2.1 Objectives of irrigation management: a note on equity

Most governments hope to achieve multiple objectives through their irrigation programmes. For example, they may be interested in some or all of the following with varying levels of priority: increasing food production to meet the demands of growing population; earning or saving foreign exchange; generating employment; and raising the incomes of the rural poor. At the level of the manager of a large irrigation project, however, it is assumed that, within whatever limits may have been imposed by the government's objectives, his main concern should be to organise the supply of water as an input to agriculture, in combination with other productive inputs, with a view to achieving an optimum balance between the goals of productivity (especially of water), equity (especially of water distribution), and long-term environmental stability, at least cost. 1/

Throughout this study it is assumed that a powerful motivating force behind the World Bank's interest in seeking ways to improve irrigation management in developing countries is its concern to develop policies which will help the rural poor - many of whom live in irrigated areas, despite the generally higher level of prosperity of those areas. 2/ This means that high priority should be attached, both by the managers of projects and those who evaluate them, to the pursuit of the goal of greater equity. However it is important to note that there are two different senses in which the term 'equity' can be used in discussions of irrigation management; and these need to be clearly distinguished. They arise in the particular context of water distribution. In his capacity as a distributor of water, a project manager's scope for providing selective or preferential assistance to the poorer people in his area - a redistribution of benefits (equity in its primary sense) - is limited by what the water distribution rules allow. Though there may be rare exceptions, it is the general pattern in most developing countries that, once construction of an irrigation project is completed, water shall be distributed

1/ Where it is government policy to try to recover a proportion of project costs from the farmer beneficiaries through water charges or some other form of taxation, a further goal of the project manager will be to achieve as high a level of recovery as the established rate of taxation permits.

2/ See e.g., Robert S. McNamara, Address to the Board of Governors, Nairobi, Kenya, 24 September 1973, IBRD, 1973.

to each farmer in proportion to the size of his holding. 1/ Water distribution is therefore considered 'equitable' (in the secondary sense of the term) if this rule of proportionality is adhered to. Moreover, for those concerned primarily with the management of large canal systems, questions of locational equity (most commonly in relation to the pattern of water distribution between the head and tail reaches of a main canal system, or of its watercourses) tend to assume as much importance as those of equity, or proportionality, between larger and smaller farmers.

In practice, as the findings of this study confirm, the pattern of water distribution between the heads and tails of canal systems is often extremely inequitable; and good management, in removing these locational inequities, can at the same time be expected to bring about a significant redistribution of benefits to the poorest. This is because, wherever water supplies are scarce and uncertain, the larger farmers within a watercourse are much more likely to abuse their position by taking what they can at the expense of their smaller and weaker neighbours than when supplies are relatively abundant and certain. 2/ Reforms in the management of canal water distribution which lead to less water being extracted by head-reach farmers and more being available to the tail should therefore generate not only much higher levels of overall production but also major increases in equity (in the primary sense) - within the limits imposed by existing patterns of land tenure. Reforms in public tubewell management can be expected to do the same. 3/

In addition, the project manager has other possible means of providing preferential support to small farmers. In particular, he can encourage the extension service to give priority to small farmers and the solution of their problems. And where special programmes have been developed with the object of helping smaller farmers by means of selective services and/or subsidies, he can try to ensure that effective use is made of them.

1/ In some areas 'indenting' systems are used in place of strict proportionality, but these tend not to work in favour of smaller farmers: see Section 8.1. Only one case is known to us of a project in which provision was made for disproportionately large water allocations to be given to smaller farmers. On a medium-sized project in Rajasthan, India, it is reported that the amount of water supplied to each farmer is only enough to irrigate 5 acres, irrespective of the size of farmers' holdings (A. S. Charan, "Investment in irrigation projects and its impact on pattern of income distribution - a case study of the West Banas project in Rajasthan", n.d., mimeo).

2/ This is at present no more than a highly plausible hypothesis which requires further testing in the field; see e.g. Section 14.1.

3/ Cf Section 1.3.

The most effective way in which a project manager can assist landless labourers (who represent a large section of the working population in many irrigated areas) is through measures which will increase overall agricultural production - and improved water distribution will usually play a major part in this. Encouragement can also be given to labour-intensive techniques of system repair and maintenance. Many important policy decisions affecting the welfare of landless labourers (e.g. the establishment of minimum wage rates, the discouragement of labour-displacing farm mechanisation) will usually be beyond the direct control of the project manager, but he may nevertheless be able to exert indirect influence by discussing such issues with local administrators and higher-level decision-makers.

While substantial claims are made here and in the main body of this report for the benefits which improved irrigation management can bring to the poorer sections of rural society, it would nevertheless be wrong to suggest that it can somehow serve as a substitute for land reform or other sets of measures which are designed to bring about more radical redistributions of income in rural areas. Because its potentialities have been widely neglected for so long, it offers great opportunities for raising the general level of living standards in irrigated areas at relatively little financial cost; but it is only one mode of reform, and in many social circumstances it will need to be complemented by others if full 'rural development' objectives are to be achieved.

As a final point, however, it is worth noting that irrigation projects do present very good opportunities for land redistribution at the initial planning stage, before project completion. This is obviously true where irrigation is being introduced into previously uncultivated areas - though the scope for this in most parts of South and East Asia (with which this study has been principally concerned) is now very restricted. ^{1/} But there are also good opportunities for the systematic transfer of land from larger landowners to smaller farmers and landless labourers in areas of previously rainfed cultivation, since the former need not feel threatened by any long-term loss of income as a result of the transfer. These opportunities are rarely taken, however.

2.2 Management theory and developing country agriculture

As an introduction to the analyses of organisation and management in the main body of this paper, it may be useful to consider in very general terms some of the peculiar characteristics of small-farm agriculture in developing countries which, particularly when combined with large-scale irrigation, have special implications for the structure and management styles of the institutions required to administer them and sharply differentiate these contexts from those largely Western industrialised contexts which have been the breeding-grounds of most 'mainstream' organisation and management theory.

^{1/} Among the few recent irrigated settlement schemes in the region are the Rajasthan Canal, N.W. India; the new tank schemes in the Dry Zone of Sri Lanka; and the settlement schemes on some of the Outer Islands in Indonesia.

Implications of developing country agriculture. Let us first consider certain key characteristics of developing country small-farm agriculture in general, which are relevant in both rainfed and irrigated conditions. The first two factors which have peculiar consequences for management requirements are related to the nature of the production process:

- (a) Production is carried out in an environment of much greater variability and uncertainty (climate, pests, diseases, etc.) than industrial production;
- (b) The ultimate producers - the counterparts of the industrial work force - are a multiplicity of widely dispersed individual farm operators who are (to a greater or lesser degree) independent decision-makers. Managers of agricultural projects or programmes therefore have much less direct control over the production process than managers of industrial enterprises. Their position may often be more closely analogous to that of managers of service enterprises, with the farmers as their clients. 1/

In most circumstances, particularly those in which an 'integrated management' system is not feasible, 2/ these factors have the following important implications for management: (i) because of the great variability in local conditions and needs, the planning and implementation of programmes designed to assist farmers needs to be based on as accurate and detailed information as possible from each locality, and the 'primary planning level' should therefore be located as close to the units of production as a government's scarce planning and management capacity permits; (ii) the nature of such of the planning carried out at this primary level will necessarily be of an 'enabling' rather than an 'executive' nature - i.e. the programmes cannot be undertaken and completed by government agencies from their own resources alone, but will also depend on farmers' decisions and participation; and (iii) successful planning and implementation will depend on the

1/ Within small-farm agriculture the extent of official management control over farm-level decisions can vary widely. Towards one end of the spectrum are certain (predominantly cash crop) outgrower or settlement projects, where inputs, production and marketing may all be subject to close supervision or direction by a single agency. The Mwea irrigated settlement project in Kenya is an extreme example of this type of 'integrated management' project (R. Chambers and J. Moris, Mwea: an Irrigated Rice Settlement in Kenya, Weltforum Verlag, Munchen, 1973; see also Report No. 1, pp.6-15). Towards the other end are the bulk of more general development programmes in predominantly food-crop or mixed farming areas, typical of much of S. and E. Asia, which are often serviced by several agencies (for extension, credit, marketing, etc.) each exerting only indirect influence over farmers' decisions.

2/ See footnote above.

formation or encouragement of local farmer groupings, not only to facilitate the flow of information and services to and from the government agencies concerned (which cannot hope to make separate contact with each individual farmer) but also to stimulate the farmers themselves to take an increasingly active part in managing their own development. 1/

These requirements indicate a need for considerable devolution of powers and responsibilities to the primary planning level, which in many countries might reasonably be expected to be capable of establishment at the District level. In practice, however, the decision-making powers of managers at the District, 'area' or agricultural project level are often severely circumscribed by policies and procedures laid down at higher levels of the administrative hierarchy. This tendency towards over-centralisation is a common feature of public service agencies in many more developed countries but it is particularly pronounced in many developing countries. 2/ In most management literature the enterprise to be managed is conceived as having a substantial degree of autonomy; government policy is treated as an exogenous factor which, though often very important, still allows managers considerable scope to make their own decisions over a wide range of issues (e.g. pricing and investment decisions, promotion policies and other staff incentives), even where the enterprise is a public service agency. By contrast, most agricultural project managers in developing countries are expected to depend heavily on their central or state governments for financial handouts and are required not only to follow their strategic policy guidelines but to adhere closely to often rigid operational rules concerning expenditure and staffing.

Finally, there is the whole question of the cultural, political and social environment within which management is carried out. Clearly the cultural contexts of agricultural management in most developing countries (ldcs) are very different from those which have formed the background to most organisation and management theory; moreover they often differ significantly from one country to another, sometimes from one region to another.

Implications of large-scale irrigation. The issues discussed so far have relevance in nearly all conditions of developing country agriculture, both rainfed and irrigated. In addition, however, there are certain common features shared by all large predominantly canal-based irrigation schemes

1/ See G. Hunter, in *Extension, Planning and the Poor*, ODI, London, 1977; and *Agricultural Development and the Rural Poor* (ed. Hunter), ODI London, 1978, pp. 40, 108. On the 'primary planning level' and its role in a nation's decision-making hierarchy, see D.G.R. Relshaw, "Improving Management Procedures for Agricultural Development", in G. Hunter et al (eds), *Policy and Practice in Rural Development*, Croom Helm, London, 1976, pp.416-417.

2/ Robert Chambers attributes it to the pervasiveness of 'urban bias' ("rural development has to fight against a silent conspiracy of centripetal forces which amass human and material resources in the towns and cities"). *Managing Rural Development*, 1974, pp. 27-31.

of the kind investigated in this study which make them a very distinctive sub-category of agricultural project as far as their organisational and management requirements are concerned. The most notable features are: (a) their capacity to reduce farmers' uncertainty by removing their dependence on the hazards of rainfall; (b) their large scale; (c) the particular difficulties they present for administrative coordination; and (d) their central concern with the distribution of water as an input to agriculture. The chief implications for management need only be touched on briefly here, since they will be discussed at greater length in the main body of this paper.

Reduction of farmers' uncertainty: the provision of irrigation water permits greater predictability and homogeneity in cropping patterns and in the timing of farming operations over a wide area. This in turn makes it possible to introduce a greater degree of forward planning and routine into many supporting activities - notably those of the agricultural extension staff, who are presented with especially difficult tasks of identifying and responding to diversity of farmers' requirements under rainfed conditions. On the other hand, it is essential under irrigated conditions that they acquire specialist knowledge on the complex subject of farm-level water management and that they are able to impart this knowledge to the farmers.

Large scale: Good communication and discipline, which are particularly important ingredients of good irrigation management, especially with regard to the activity of water distribution, become more difficult to organise as the size of the project area increases. However, in contrast to other kinds of agricultural projects and programmes whose boundaries of operation are less dependent on physical and technical factors, the geographical coverage of irrigation schemes is often necessarily large because it is naturally determined by the amount of land commanded by a single dam or headworks. Another factor, closely related to the scale of many irrigation projects, is their dependence on relatively indivisible capital works. This has especially important management implications during the initial years of a project's development; once the headworks have been completed, the whole of the commanded area will be supplied with water over a very short space of time, and in that time a whole new management apparatus will have to be mobilized.

Difficulties of coordination: there are special problems of administrative coordination on large irrigation schemes, particularly between agriculturalists and engineers, whose close collaboration is particularly important for the planning and implementation of water distribution. The problems are complicated by the fact that the boundaries of a command area, which are the natural ones for an irrigation agency to operate within, rarely accord closely with those of the civil administrative units on which agricultural organization is customarily based.

Water distribution: On all irrigation systems where water is a scarce resource in relation to farmers' demand for it (and these are the vast majority) water distribution involves a process of rationing, and if it is to be performed well it usually calls for a high degree of management skill. This skill has two dimensions: the first is technical and the

second may be described as political; each has its own implications for the special kind of training and motivation needed by water distribution personnel.

The purpose of emphasizing the distinctive features of agricultural and irrigation projects in developing countries (ldcs) and the peculiarities of their surrounding cultures is not to suggest that the existing body of 'mainstream' organization and management theory has nothing useful to offer with respect to the analysis of their management problems or the identification of appropriate remedies. It has. On the other hand, it is clear that accepted theories, as well as accepted management techniques, should be used cautiously and selectively; in many cases they may need to be substantially adapted or modified if they are to be relevant or useful in the contexts we are concerned with. Both for analysis and prescription, a clear understanding is required of the particular local context, and especially the social context, in which management is being carried out; it is therefore essential in each case that specialist knowledge of management theory and techniques should be supplanted (and influenced) by detailed local knowledge and by insights from other relevant disciplines, including sociology, social anthropology and/or political science.

Few systematic attempts have been made so far to test the validity and usefulness of established organisation and management theories in the alien contexts of developing country agriculture. A rare exception has been the work of David Leonard in his analytical study of the organisation of the agricultural extension service in Kenya. Leonard observes that "our problem ... is not to accept or reject organisational theory as a whole, but to sort out which of its propositions transcend their industrial western origins." 1/ In his study, which focuses in detail on a limited area of organisational activity - the behaviour of subordinate staff within the extension organization and its effects on productivity - a remarkably high proportion of the theories tested were found to be useful in explaining staff behaviour. Some hypotheses, however, were found to be inapplicable, usually because they contained a hidden assumption that certain types of behaviour were universal whereas in fact they were only common to the environments in which they had been studied.

Apart from its general value as a guide to the potential utility (and limitations) of established theory, Leonard's work has also been of

1/ "Fundamental differences between the rural areas of poor countries and the urban West do not mean that they have nothing in common. Power and authority, for example, may take different forms in different societies, but they do exist throughout. To the extent that a given theory is dependent on the existence of authority and not on any particular form of it, that theory will be useful in all cultural settings. Bureaucratic organisations are universal in today's world and their distinctive authority systems tend to produce common patterns of behaviour in all cultural settings" (David E. Leonard, Reaching the Peasant Farmer: Organisation Theory and Practice in Kenya, University of Chicago, 1977, p. 17.

particular value to this study because of its concentration on an important aspect of administrative behaviour which we were unable to study in the same detail. Its clear conclusions on the adverse effects of over-authoritarian management styles on the performance of junior staff may not be particularly surprising but it has helped to fill a gap in our previous approach to questions of motivation. It has also been encouraging to find such strong support from Leonard, as well as others such as Belshaw, Chambers and Wade, in favour of strengthening formal operational procedures, not simply as a means of developing more efficient methods of work organization but also as a means of improving the morale of junior staff through greater participation in decision-making. 1/ The study of the writings concerned with organization and management theory has also been helpful, sometimes because they have provided support for views already formed, sometimes because they have suggested better ways of organising ideas and material. There is also a valuable and rapidly growing literature on agricultural administration, farmer groupings etc., to which frequent acknowledgement is made.

1/ Op. cit., pp. 218-223; R. Chambers, Managing Rural Development, p. 27 passim: also Robert Wade, in an unpublished paper on his studies of irrigation management in Andhra Pradesh, concludes that authoritarian administrative behaviour would be reduced "through the application of regular and formalised control procedures".

II. PERFORMANCE LEVELS AND THE IDENTIFICATION OF CONTRIBUTORY CAUSES

3. Characteristics, performance and potential of field study projects

3.1 Characteristics

It was seen as an essential first step in the valuation of the performance and potential of each of the field study projects that as clear and detailed a picture as possible should be built up of the local environment (the context in which management was being performed) as of the administrative and other resources which the project managers had at their disposal. On an irrigation scheme, the local environment or context can be defined in terms of the physical characteristics of the project area (climate, soils, etc.) and the nature of its crops and cropping patterns; the technical characteristics of the irrigation system; the social characteristics of the farming community (population density, social structure, land tenure, agricultural experience, local groupings, etc.); and the economic environment (level of economic development, prices, subsidies, taxes, etc.) The administrative resources can be defined in terms of organisational structure, and the numbers, salaries, qualifications, etc. of project staff. Other important resources of management include supporting services (transport, telecommunications) and, of course, finance. 1/

In the areas studied most of this basic factual information was available from project reports and files, though certain essential information on the social characteristics of the farming community usually had to be sought elsewhere (e.g. agricultural censuses, other socio-economic surveys, sociological or ethnographic studies). In any case where a significant proportion of the information proved difficult to obtain from project records this would in itself be a likely indication of management weakness.

The most obvious reason why any evaluator should be required to collect this information is that it is essential to understand what exists before one ventures to suggest how it should be improved. However, the information also has other valuable uses. As far as the particular project under review is concerned, it can be very helpful in suggesting what the focus of further investigation should be. From an examination of the context, hypotheses can be made about the key activities likely to merit particularly close attention in the analysis of the management process. Thus, if the project's water supplies are frequently scarce in relation to demand, water allocation is likely to be one key activity. On the other hand if water supplies are relatively abundant but the project has been recently completed,

1/ A detailed checklist of the information required on an irrigation project's basic resource characteristics is given in Appendix A, Part I.

with newly-settled farmers who have no previous experience of irrigated agriculture, the most important activity is likely to be agricultural extension.

In addition, the collection of detailed information about a project's characteristics is necessary for the development of general hypotheses and theories about the nature and requirements of irrigation management. These can only be built up through the study of particular cases, and comprehensive evidence about each case is required in order to help distinguish between those generalisations which are universally true in any environment and those which hold good only under certain (physical, technical, economic or social) conditions. 1/ The accumulation of such information may also be able to help in developing 'norms' for project funding and staffing under different sets of conditions. It is clear that, for example, an area with relatively heavy rainfall, heavy clay soils, extensive weed infestation, numerous canal structures and an inexperienced farming population will have substantially higher operation and maintenance and staff requirements per hectare than another area with opposite characteristics. A wide range of evidence may be needed, however, before a consistent basis for calculating such norms can be developed. 2/

Some of the salient characteristics of the field study project areas and their administrative resources are summarised in table 3.1. Their most distinctive features can be considered briefly in turn.

(a) Area One: (i) Physical/technical. Very large command area; low rainfall; gentle gradient; good soils; simple and inflexible canal design, with few control structures; canals planned for low cropping intensities - 75%; but potential flexibility of part of system much increased since

1/ The practical utility of much anthropological work on the management of small irrigation systems (or small units within larger systems) has been diminished by the researchers' failure to pay sufficient attention to certain technical factors (water scarcity, complexity of water distribution and maintenance functions, etc.) which are likely to be important determinants of a group's capacity to collaborate in common tasks. Project planners from other disciplines have been equally at fault in failing to comprehend the wide range of factors which need to be taken into account when attempting to develop active local water users' groups. See Chapter 11.

2/ For the difficulties associated with the development of funding and staffing norms, see Section 9.4.

TABLE 3.1 Summary of Project Characteristics

	Area One	Area Two	Area Three	Area Four
<u>Physical/Technical</u>				
Net Command Area (ha)	628,000	229,000	33,000	67,670
Rainfall (mm)	400-450 (70% July-Sep)	840 (90% June-Sep)	1,940 (85% Nov-May)	1,550 (85% May-Aug)
Soils	Sandy/clayey loams low permeability	Heavy clays poor drainage	Loams/clays	Clay - loam - sand
Topography	0.2m/km slope	Undulating	Steeply sloping	Steeply sloping
Canal headworks	Barrage + upstream reservoirs	Barrage + upstream reservoirs	Run-of-river (numerous systems)	Run-of-river (numerous systems)
Construction date	1905	1960	early 1900s	1927 (+ earlier + later sections)
Max design discharge (lit/sec/ha)	0.21	0.32	3.0	1.5-3.0
Length of main canals (km)	2,250	2,500	205	1,255
Length of main canal lining	1%	little	c.30%	100% (+ 10% on watercourses)
Control structures	333	n.a.	273	2,431
Watercourse outlet structures	APMs	Open pipes	Lifting gates/measuring structures	Lifting gates/measuring structures
Public tubewells	1,372	-	-	470 (+ 45 pumping stations)
Average capacity/well (lit/sec)	110	-	-	32
Private wells	Few	Some (little used)	None	Many
Main drainage (km)	2,120	Very little	20	1,125
Main crops	Wheat, cotton, sugarcane, sorghum	Wheat, sorghum, rice, chickpeas	Rice, soyabean, maize, tobacco	Rice, sugarcane, sweet potatoes, groundnuts
Cropping intensity	90-110%	40-140% (wide variation within system)	263%	300%+
Water scarcity	Yes, esp. for land preparation	Head: no; tail: yes	Yes, in dry season	Yes, in dry season
<u>Social/Economic</u>				
Farm units	c.150,000	69,000	c.150,000	c.150,000
Average farm size (ha)	4.2	3.3	0.2-0.25	0.5
Land distribution	Highly skewed	Fairly skewed	Not greatly skewed (exc. headman's land)	Little skewness
Owners/part-owners/tenants (ratio)	42 : 24 : 34	n.a.	712 : ? : 63	94 : 4 : 2
Landless labour	Large number	n.a.	25-45% of working population	Few
Working population in agriculture	72%	780%	65%	36.6%
Experience of irrigated farming	Long	Short (pre-1960 rainfed)	Long/skilled (rice + 'dry' crops)	Long/skilled (rice + 'dry' crops)
Literacy rates	Low	16%	n.a.	87%
Average watercourse size (ha)	225	33 (wide variation)	116	40
Average Farmers per watercourse	c.50	c.10	c.460	c.80
Watercourse organisation	No formal organisation; rotation set by officials	No formal organisation; no adherence to rotation	Strong village organisation with irrig. officials; rotation	Small Groups at 150ha level; Rotation Area groups at 50ha level; rotation

TABLE 3.1 Summary of Project Characteristics (continued)

	<u>Area One</u>	<u>Area Two</u>	<u>Area Three</u>	<u>Area Four</u>
<u>Administrative</u>				
Operating agency - structure	1 Canal Group 1 Tubewell Group 1 Drainage Group 1 Agriculture Department (District Office) All with different areas of jurisdiction	1 Command Area Development Authority	1 Public Works Department section office 1 Agriculture Department (District Office) Different areas	1 Irrigation Association plus Farmers' Associations in different areas
Powers over farmers' choices	No control over cropping pattern	No control over cropping pattern	Restriction of rice area in dry season	Choice of cropping pattern controlled by water distribution pattern
Distribution of staff: (Irrigation only) (%) ^{/1}				
Senior officials	1.6	1.5	0.5	1.4
Junior officials (field)	4.4	4.7	3.3	20.1
Skilled field staff (matriculates)	12.1	4.7	28.8	47.3
Unskilled field staff	67.0	79.5	51.3	12.9
Clerical/office support staff	14.9	9.6	16.1	18.3
Salary ratios - senior officials; junior officials; skilled field staff	6 : 1.7 : 1	7.5 : 2.2 : 1	3.7 : 2.2 : 1	1.6 : 1.25 : 1
Area covered by junior qualified water-distribution official	12,800 ha/50 canal km	7,500 ha/80 canal km	700 ha/4.4 canal km	350 ha/7.5 canal km
Area covered by junior maintenance man (canal km)	5.6	3-6	4.4	7.5
Field assistant : farmer ratios	1 : 1,000-1,500 (4,200 - 6,300 ha)	1 : 500 (1,600 ha)	1 : 3200 (600 - 1000 ha)	1 : 300 (150 ha)

^{/1} The breakdown is based on clear divisions which exist in Areas One and Two between engineering graduates, diploma-holders and skilled and unskilled supporting staff; the distinctions are not so clearly made in Area Three and hardly apply at all in Area Four.

installation of large public tubewells in fresh groundwater areas over a 10-year period; actual cropping intensities in fresh groundwater areas increased to about 120-125%; major environmental problems (waterlogging and salinity) much reduced since introduction of tubewells. (ii) Social/economic. Relatively large average size of farm units, but distribution of rural income and land markedly skewed; low average incomes and literacy levels; long experience of irrigated farming within limitations of inflexible canal supplies, but introduction of supplementary tubewell water only recent; average watercourse sizes very large (with 3.3 km of main channel and almost 40 km of farm ditches) and often difficult to maintain (silt accumulation, difficulty of maintaining correct elevation in flat topography); level of local cooperative activity, both at village and water course levels, low. (iii) Administrative. Responsibilities for canal O & M, tubewell O & M, drainage and agricultural extension divided among four separate agencies, each with different areas of jurisdiction; farmers have free choice of cropping patterns; irrigation administration performed by small number of trained professionals (civil engineers) with very large territorial responsibilities and large supporting staff of skilled and unskilled labourers (mainly for maintenance); decision-making on canal operation (relatively simple) and canal-cum-tubewell operation (much more complex) highly centralized; sharp division between different categories of staff, based mainly on academic qualifications, with little scope for promotion from one category to another; large salary differentials between grades; Agriculture a relatively weak department, with very large Field Assistant: farmer ratios.

(b) Area Two: (i) Physical/technical. Large area, with broken terrain and poor road network; high summer rainfall, during which period irrigation supplementary only; undulating micro-topography; heavy black soils with poor drainage qualities, subject to erosion; canals with few control structures and planned for low cropping intensities - 76%; few drainage facilities; watercourse commands often poorly developed and served by crude, uncontrolled pipe outlets; some private wells, little used since arrival of canal water; actual cropping intensities vary widely, with much water being retained in head reaches and tail reaches often going short; major environmental problems of canal seepage, waterlogging, weed infestation and erosion; substantial redesign and rehabilitation work in progress since 1974. (ii) Social/economic. Average farm size smaller than Area One; rural income and land distribution skewed, but less than Area One; low average incomes and literacy levels; limited experience of irrigated farming; watercourses of varying sizes, ill-developed and difficult to operate and maintain; level of local cooperative activities is low. (iii) Administrative. Single unified Authority, including Canal, Drainage, Land Development, Agricultural Extension and Cooperative wings; farmers have free choice of cropping patterns; staffing structure on irrigation side similar to Area One; much stronger agricultural extension service, with good Field Assistant: farmer ratios.

(c) Area Three: (i) Physical/technical. Several interdependent run-of-the-river systems, small in the hilly upstream reaches but medium-sized (up to 9,000 ha) in the downstream coastal plain; sharply contrasting wet season (supplementary irrigation for rice) and dry season (mixed rice and 'irrigated dry' crops); good soils, good natural drainage; simple canal

design, but relatively flexible; numerous control structures in downstream areas for canal rotation; gates and measurement structures at watercourse head; no use of groundwater or low-lift irrigation; no serious environmental problems within command areas, but some erosion in upper catchment areas.

(ii) Social/economic. Very small average farm size; distribution of income and land not markedly skewed but large and increasing population of landless; low average incomes; farmers highly skilled in intensive irrigated agriculture; watercourse areas large but farmers organised into sub-units for internal operation and maintenance; social cohesion high; strong village councils, with locally appointed irrigation officials: (iii) Administration. Responsibilities for canal management and agricultural extension divided between two departments with different areas of jurisdiction; some provision for periodic inter-departmental meetings under District Administrator; farmers' choice of cropping patterns limited by statutory restriction on rice area in dry season; shortage of highly-qualified technical personnel at higher levels of project management but territorial responsibilities small; complex procedures for water distribution which require frequent meetings between senior and junior staff; limited upward mobility between staff grades; poor but improving Field Assistant: farmer ratios.

(d) Area Four: (i) Physical/technical. One large run-of-the-river system in coastal plain (40,000 ha), with numerous smaller systems, including independent hill-stream systems; sharply contrasting wet and dry seasons; mixed rice, sugarcane and 'dry' crop rotations; good soils, good natural drainage except in coastal plain; lined canals, relatively flexible in operation; gates and measurement structures to 50 ha level; significant use of groundwater and low-lift irrigation, both by Project Authority and private users; vulnerable to flooding in coastal plain despite large drainage network; declining groundwater levels in some areas with danger of saline intrusion.

(ii) Social/economic. Very small average farm size; land evenly distributed (post-land reform); mainly owner-operators; relatively high incomes (almost half from non-farm sources); high literacy levels; farmers highly skilled in intensive irrigated agriculture; watercourse areas compact, with strong organisations at 150 ha level and sub-units at 50 ha and 15 ha levels; social cohesion high. (iii) Administration. Water distribution and maintenance organised by Irrigation Associations (with farmers' representative committees, temporarily suspended), and agricultural extension, credit and marketing by Farmers' Associations; different areas of jurisdiction; choice of cropping patterns controlled by pattern of water deliveries; irrigation administration performed by highly trained field staff (mainly technical high school) supported by small number of graduates; many important management decisions on lower sections of system delegated to local offices at 20,000 ha and 1,500 ha levels; high degree of mobility from lower to higher levels of administrative hierarchy; low salary differentials, but substantial bonuses and security benefits; strong Farmers' Associations for extension and other supporting services.

The significance of these characteristics for the analysis of management performance on each individual project has already been discussed in the field study Reports. The main question we need to be concerned with here, for the purposes of comparative analysis, is the extent to which these four

projects represent an adequate sample of large-scale irrigation projects and their management problems in developing countries in general. If we think in terms of certain distinct 'types' of irrigation project (whether these are classified according to their physical/technical, social/economic or administrative characteristics) it is clear that a number of important categories have not been covered. All the projects studied are in Asia; all except one are long-established; and all are organised in such a way that direct official responsibility for operation and maintenance ends at the watercourse, with farmers being left collectively responsible within the watercourse command. Their age and the long history of settled agriculture in all the areas concerned (most of which had minor irrigation sources before the arrival of the larger systems) set them clearly apart from certain other projects, particularly those of sub-Saharan Africa, which are nearly all recently-established settlement schemes. Most of the African schemes have very distinctive and highly-controlled 'integrated management' systems and their most typical management problems appear to be significantly different from those most commonly encountered in the field studies (problems of too much, rather than too little, management control). There are also a number of other categories, or sub-categories, which are less sharply differentiated from the field study areas than the African settlement schemes in character but are still sufficiently different in certain respects to suggest that conclusions drawn here might have only limited relevance to them. These would include projects in Latin America and the Middle East, where cultural differences could be expected to have a significant influence on farmer-management relationships: many of these are post-land reform projects and that too should be an important distinctive factor. Separate consideration might also need to be given to projects in delta areas (where excess rather than scarcity of water is often the major problem); projects in which public canal operation is combined with private groundwater extraction (large parts of North India and Pakistan); and projects with high-technology water delivery systems. Small-scale projects, which tend to have a different set of management problems from large ones and are outside the main scope of this study, are discussed briefly in a later section of this paper.

If classified according to certain simple and very broad typologies, the four field projects might seem to cover a fairly small range within the total spectrum, falling into two main groups; large-scale, simple technology, free choice of cropping, centralised administration, etc.; and small-scale, hill-stream systems with narrow coastal plains, bimodal rainfall, tiny farms, mixed rice and 'irrigated dry' cropping, with some restriction on rice, etc. However, there are a large number of features which distinguish projects within groups, quite apart from the presence of large public tubewell systems in two projects. These make it clear that Area Two, although designed and operated similar to Area One, belongs agroclimatically to a very different 'type': the difficulty of its terrain and its relatively high summer rainfall (leading to a strong farmer preference for rice cultivation, which can only be done on restricted areas) and its 'unfinished' state all indicate that it belongs together with many other recently-constructed projects, which share many of its technical and management problems. Physically and to some extent socially (in terms of cohesion at the village level) conditions in Areas Three and Four are much more alike. However, the higher level of economic

development in Area Four and much larger resources of well-trained professional manpower puts clear limits on the extent to which its management methods could be replicated in Area Three - or indeed in any of the other areas studied.

If we turn our attention away from the factors which help us to see broad similarities between certain groups of irrigation projects and concentrate instead on the factors which differentiate them, it will be seen that, between them, the four projects contain a wide diversity of characteristics. Among those which one would expect to have significant implications for the type of organisation and management best suited in each case are:

Project scale: Large (One, Two) - Small (Three, Four)

Rainfall/cropping pattern: Mainly 'dry' crops (Area One) - Mixture of rice and 'dry' crops (Two, Three, Four)

Soils/topography: Difficult (Two) - Favourable (One, Three, Four)

Length of operation: Long-established (One, Three, Four) - Recent (Two)

Public groundwater: Yes (One, Four) - No (Two, Three)

Private groundwater: Yes (Four) - Little or none (One, Two, Three)

Technology (canals): Medium-advanced (Four) - Simple-medium (three) - simple (One, Two)

Technology (public tubewells): Advanced (Four, One)

Continuity of command area: Continuous (One, Two) - Interspersed with rainfed agriculture (Three, Four)

Farm size: Medium small (One, Two) - Very small (Three, Four)

Land and income distribution: Highly skewed (One, Two) - Not greatly skewed (Three) - Even distribution (Four)

Level of economic development: Low (One, Two, Three) - High (Four)

Irrigated farming skills: Low (Two) - Medium-high (One) - Very high (Three, Four)

Social cohesion: Low (One, Two) - High (Three, Four)

There is also great diversity on the other side of the equation - the projects' organisational and management characteristics. Here there are many important differentiating factors, of which these are among the most immediately apparent:

Accountability to farmers: Significant (Four: heavy dependence on direct funding from Farmers' Association membership fees) - Insignificant (One, Two, Three: exclusive dependence on government finance, the scale of which is unrelated to level of farmers' payment of water charges)

Coordination - Irrigation/Agriculture: Unified organisation (Two) - Separate organisations (One, Three, Four)

Coordination - Surface water/groundwater: One agency (Four) - Two agencies (One)

Specialisation of functions: Water distribution/maintenance: One cadre (One, Two, Three) - Two cadres (Four)

Character of organisational hierarchy: Centralised/highly stratified (One, Two) - Moderately centralised/moderately stratified (Three) - Relatively decentralised/not highly stratified (Four)

Coverage of water distribution staff: Large area/many watercourses (One, Two) - Small area/few watercourses (Three, Four)

Coverage of agricultural extension staff: Good (Two, Four) - Poor (One, Three)

Water distribution - Cropping choices: Free choice cropping (One, Two) - Free choice, except for restriction on dry season rice (Three) - Crop rotation controlled by water distribution pattern (Four)

Water distribution - Proportionality/responsiveness to demand: Proportional to area (One, Two) - Proportional within each crop rotation area (Four) - Responsiveness to local variations in demand (Three)

Water-level organisation: Channel-based, weak (One, Two), Channel-based, strong (Four) - Village-based, strong (Three)

It should be clear from these lists that the four field studies between them contain a sufficiently wide range of contrasting characteristics to provide a firm basis for developing a large number of general hypotheses or theories about large-scale irrigation projects and their management requirements. Because the contrasts are so numerous, many of the generalisations will be conditional in form: i.e. if x, then a; if y, then b. However, when a proposition appears to hold true in all four cases, irrespective of variations in local conditions, there will be reasonable grounds for hypothesising that it has universal validity. Further research in other diverse contexts could be expected to swell the number of conditional generalizations; it might also make it necessary to modify some of the hypotheses which on the strength of the present studies (and known evidence from other studies) appear to be universally valid.

3.2 Performance and potential: Assessment

After an assessment of a project's salient characteristics, the next step in the analytical process should be to attempt an evaluation of project performance and potential. In the four field studies particular attention was given to the following as criteria by which performance should be judged:

- productivity (especially of water) 1/ -
- equity (especially of water distribution)
- environmental stability
- cost
- cost recovery.

Other criteria might well have been added - notably employment generation - and further additions could of course be made in subsequent evaluations, depending on the objectives and priorities of the country concerned.

In none of the field studies was any attempt made to carry out a detailed economic or financial analysis of project performance. The main reason for this was that the principal purpose of the commissioned study was to extend the scope and utility of the conventional project evaluation process by developing a new methodology for evaluating the management aspects of large irrigation projects. The techniques for evaluating performance were recognised as already well developed; but there was an urgent need to provide conventional evaluations of performance with much greater depth by grafting on to them new techniques of analysis which would make it possible for the causes of different levels of achievement to be systematically investigated. There was therefore no need to carry out comprehensive evaluations of performance in these circumstances; and in any case the data collection and analysis required for such evaluations would have entailed the use of more specialist expertise and time than we had at our disposal. The main object of the exercise was consequently limited to obtaining approximate indicators of performance with regard to each of the principal criteria and to seeing to what extent these helped to illuminate subsequent stages of the analysis, particularly those relating to organisation and management. In this connection it is worth noting that for the purposes of evaluating management single composite indicators of performance are of relatively little use. Performance against each criterion needs to be clearly distinguished, so that

1/ This is a function not only of the quantity of water delivered but also of the timeliness and reliability of deliveries.

the possible reasons for observed shortcomings with regard to a particular criterion can then be investigated in further detail. 1/

An interesting consequence of being obliged to assess project performance largely through reliance on project records, in the absence of the resources to carry out detailed independent surveys, was that it also shed valuable light on certain central aspects of project management. One of the essential ingredients of good management is a good internal information system which will enable performance in certain key areas to be regularly planned and monitored. 2/

In most cases it was found that information on environmental factors (extent of waterlogging and salinity, depth and quality of groundwater) and on cost and cost recovery had been recorded relatively fully, though it was not always well ordered or analysed; and in the case of the environmental data its accuracy was sometimes doubtful. On the other hand, the necessary data on which to base an accurate estimate of productivity - particularly productivity of water - was not available in any of the cases. This meant that simpler proxy indicators had to be resorted to, such as water losses and production - though the latter is obviously a very imprecise guide to the productivity of the single factor of water. 3/

Even then there were problems. Information on water losses was usually not readily available, though in most cases (given the necessary time) it would have been possible to estimate main system losses from an inspection of the records, by comparing water deliveries at the headworks with the sum of deliveries to the watercourse heads (or wherever the lowest measuring points happened to be). Assessment of water losses at watercourse and field levels would have required very time-consuming independent measurement, although in certain cases - it was possible to draw on recent experimental research to fill this gap. And even when production was used as a proxy indicator, accurate estimates often proved surprisingly difficult to make because the available information on crop areas and yields tended to be unreliable (especially so in the case of yields).

Information on equity of water distribution was hardly ever directly presented in the principal records held at project headquarters, but it was usually fairly easy to obtain indicators of locational equity between different parts of the main canal system simply by examining available data in a disaggregated form. A random selection of watercourses towards the head and the tail of the system was made in each case and the canal flows, cropping intensities in the different areas were compared. Visits to the selected

1/ A list of useful indicators which could be used in the analysis of project performance is given in Appendix A, Part II.

2/ See especially Chapter 7 and Chapter 8, Section 5 below.

3/ Assessments of the timeliness and reliability of water deliveries were made on the basis of interviews with farmers and analyses of official water distribution records, and formed part of the evaluation of water distribution management. See Section 8.1.

watercourses were also made to obtain farmers' views on the quality and timing of water deliveries. For information on equity of water distribution at more micro-levels (within watercourses or between larger or smaller farmers), field inspections and interviews with farmers were able to give some insights, but in most cases a well-informed and objective assessment would have required a detailed farm survey. 1/

Some of the most important indicators of performance obtained in the four study areas are summarised in Table 3.2. The main verdicts reached in each case were these:

(a) Area One: (i) Productivity. Before the introduction of the public tubewells in the mid-1960s farmers had been attempting to maximise returns from the scarce water they received by spreading it extensively, achieving a cropping intensity of c.90% against the canal design intensity of only 75%; this pattern may be assumed to have continued in those parts of the command area (about 43% of the total) which have not been benefited by additional tubewell water. The overall rate of increase in cropping intensities has, however, been low since the introduction of the tubewells and, even if a significant movement towards crops with higher water requirements (sugarcane, rice, citrus) is taken into account, it can be concluded that productivity in the canal-cum-tubewell areas has been disappointingly low. This is supported by the very low crop yield figures and the evidence of very high watercourse and field level water losses, particularly in watercourse commands which are supplied with supplementary tubewell water. (ii) Equity. Water allocation between tubewell and non-tubewell areas was manifestly inequitable but only marginal re-allocations would be feasible without major canal remodelling. Spot-checks revealed no obvious disparities in the amount of canal water being distributed to head and tail reaches of the main system. Detailed research has however shown that, because of the high levels of water loss in the very large watercourses, much more water reaches farmers near the watercourse heads than those at the tails; there is also evidence that larger farmers tend to benefit more than smaller farmers, and this pattern is likely to be particularly pronounced in tubewell areas. 2/ (iii)

1/ Except, again, where good information already existed as a result of other recent surveys at the watercourse and farm levels.

2/ Although larger farmers tend to gain some benefit from their often more favourable location on watercourses, they were capable of obtaining much more pronounced advantages from the maladministration of tubewells. Since tubewell supplies can be switched on and off at will, they are more open to exploitation for exclusively private benefit than canal supplies, which run continuously. In the latter case, if individual farmers succeed in acquiring additional water for themselves, every one else on the same watercourse - larger and smaller farmers alike - will also stand to benefit. Thus, while the dominant form of inequality on canal systems tends to be between head and tail, public tubewells - unless their operation is closely supervised - can be used more directly to benefit the richer at the expense of the poorer.

TABLE 3.2 Summary of Project Performance

	Area One	Area Two	Area Three	Area Four
1. Productivity				
(a) Crop area	Canal design intensity 75%; actual intensity pre-tubewells c.90%. Rate of increase in intensities since tubewell introduction disappointingly low, even allowing for some movement towards crops with higher water requirements.	Design intensity 76%; actual intensity c.66%, with little variation between 1970-1 and 1975-6; but rice area more than doubled.	Claimed intensity 263% in 1975/6; probably less. No time series data.	Intensity probably above 300%, including short-season crops. No time series data.
(b) Yields (tons/ha)	Cotton 0.19 (1975/6) Sugarcane 44.23 Rice 1.5 Wheat 1.39	Rice 3.61 Sugarcane 59.38 Wheat 1.95 (Crop-cutting, 1976-7 - probably above average)	Rice 2.5 - 4.5 Maize 0.78 Soyabeans 0.65	Rice 4.25 Sugarcane 92.9 Sweet potatoes 16.7 Peanuts 1.8
(c) Water losses	Main system 20-25% (assumed) Watercourse 53% (w. + 'wells) Watercourse 46% (canal only) Field 56% (w. + 'wells) Field 43% (canal only)	Main system high Watercourse } very high Field }	Primaries 20-25% Secondaries 22.27% Watercourse } 20% Field } (all assumed)	Main system 10-15% Watercourse 25% Field n.a. (rough estimates)
2. Equity				
a) Tubewell v. non-tubewell areas	Inequitable	-	-	Between IAs/crop rotation areas: Inequitable
b) Main canal head v. tail	Fairly equitable	Very inequitable	Inequitable	Within crop rotation areas: Equitable
c) Watercourses, head v. tail	Inequitable	Very inequitable	Uncertain	Apparently equitable
d) Larger v. smaller farmers	Rather inequitable	Probably inequitable	Probably rather inequitable	Apparently equitable
3. Environmental Stability	Waterlogged, saline areas substantially reduced since tubewell introduction. Groundwater quality deterioration in limited areas.	Waterlogging increasing: effect of on-farm development + drainage programmes limited so far. Serious soil erosion.	No hazards in command area but encroachment leading to soil erosion in upper catchments.	Poor drainage in coastal plain; rapid decline of groundwater levels in some areas, with dangers of saline intrusion.
4. Cost (\$)				
(a) Canals O & M + staff	3.75/ha 964/canal km. 7062/control struct.	4.60/ha 421/canal km.	9.07/ha 1466/canal km. 1098/control struct.	43.61/ha 2352/canal km. 909/control structure
(b) Tubewells Electricity, O & M + staff	10.77/ha 43257/cumec of capacity	- -	- -	26.02/ha 19977/cumec of well capacity
(c) Drainage O & M + staff	n.s.	(0.60/ha	-	9.34/ha
5. Cost Recovery (\$)				
(a) Charges recovered	4.62/ha	1.94/ha	No water charges; \$14.50/ha land tax charged.	86.69/ha
(b) Recovery rate of charges due				98%
(c) % of recovered charges retained by project	Nil	Nil	c.20% of land tax possibly spent on minor capital improvements.	All

Environmental stability. Water-table levels, in many areas not particularly high before tubewell installation, have been somewhat reduced and substantial proportions of waterlogged and saline areas have been reported reclaimed. A limited number of wells have hazardous or potentially hazardous water quality.

(iv) Cost. Even with additional 'special' funds to supplement the basic allowance provided for 'ordinary' maintenance, finance for canal O & M is judged insufficient, though staff members are quite adequate for the rather limited tasks they are currently expected to perform. Funds for tubewell O & M also appear insufficient (of the \$10.77/ha total costs, \$6.59/ha went on electricity and only \$4.18/ha was available for O & M and staffing). A major reason for restrictions on recurrent expenditure is that the Irrigation Department as a whole is in deficit. (v) Cost recovery. The level of water charges is very low. The revenue from them, even if it were fully recovered, is substantially less than actual O & M costs; the deficit is particularly large for the (double-rated) tubewell areas. Recovery rates are also low, perhaps particularly in tubewell areas. Such charges as are recovered become general government revenue and the amount which the project receives back for recurrent expenditure is unrelated to the amount of revenue gathered.

(b) Area Two: (i) Productivity. Average cropping intensities (66%) have been substantially lower than design intensity (76%), showing little change between 1970-1 and 1975-6; summer/wetter season intensities have been particularly low, though the rice area has more than doubled over the five-year period and has already exceeded the 20,000 ha level expected by the World Bank at "project completion". Recorded yields from crop cuttings are quite good but may well be substantially higher than the project average because of bias towards the Extension service's contact and "follower" farmers. Water losses throughout the system have not been accurately measured but are very high, especially within the essential incomplete watercourse commands. (ii) Equity. Because of numerous "illegal" outlets in the head reaches and the development of relatively high cropping intensities in these areas (up to 140%), often including heavily water-demanding crops like sugarcane and rice, watercourses in the tail reaches of the main system tend to receive little water. Because of the high water losses in the watercourses it may also be assumed that distribution within each watercourse is also very inequitable; and since there is no established pattern of water rotation by time within the watercourse, larger farmers may be assumed to benefit disproportionately. (iii) Environmental stability. Serious waterlogging, through lack of adequate drainage in heavy clays soils; counter-measures have been able to achieve only a limited impact so far. Soil erosion is also occurring at a dangerous rate and presents hazards to the rapid expansion of a drainage system. (iv) Cost. Since this is a very difficult canal system to maintain (difficult soils, abundant weed growth, crab infestation of canal banks, etc), recurrent finance would appear far from adequate: O & M costs required per canal km are much higher than in Area One but the level of provision is under half that of Area One. Because of heavy commitments to design and construction works, staff numbers are almost certainly insufficient for maintenance, and certainly so for operation. (v) Cost recovery. The level of water charges is low. The revenue from them, even if fully recovered, is substantially less than actual O & M costs. Recovery rates are very low. Such charges as are recovered become general government revenue and the amount which the project receives back for recurrent expenditure is unrelated to the amount of revenue gathered.

(c) Area Three (i) Productivity. Data for cropped area, yields and water losses are all somewhat unreliable. But intensities are undoubtedly high despite evidence of overwatering in head-reach areas; adoption of improved varieties and increased fertiliser use appears to be spreading quite rapidly, especially in the case of rice; crop husbandry was generally of a high standard and there was little evidence of water wastage. However, lack of uniformity in cropping calendars may have contributed to unnecessary losses at watercourse level and more use might have been made of return flow water in downstream reaches. (ii) Equity. Within each river system, upstream canal systems were receiving much more water than downstream canal systems; and there were similar disparities within single canal systems. Insufficient evidence was available to judge equity of distribution within watercourses, though it seemed likely that village heads and their officials often got preferential treatment. (iii) Environmental stability. Some soil erosion in upper catchment areas as a result of encroachment by cultivators into previously forest areas; but less severe than in many other parts of the country. (iv) Cost. After a long period of almost nil maintenance and progressive physical deterioration, funds received for O & M have increased rapidly since the completion of rehabilitation work in 1973 and now appear to be adequate. Staffing is also probably adequate for current functions. (v) Cost recovery. There are no water charges but farmers have to pay a substantial land tax (c. \$14.50/ha) and may also be contributing up to \$14/ha to village funds for watercourse O & M. Possibly 20% of the land tax is reinvested by the District Administration in the project area; the rest becomes general government revenue.

(d) Area Four: (i) Productivity. Despite certain deficiencies in the production data, it is clear that cropping intensities are very high and yields fairly high (widespread use of short-maturing rice types, combined with the practice of inter-cropping, inevitably leads to some reduction in yields). Other research indicates very high efficiencies of water conveyance and use, especially at periods of scarcity. (ii) Equity. The most obvious inequities in the pattern of water distribution (between different projects, and between different crop rotation areas within the same project) are the consequence of legislation concerning prior water rights and are unalterable in the short term. Within the constraints imposed by the need to observe this legislation, water distribution appears to be remarkably equitable at all levels. (iii) Environmental stability. Problems of flooding in the coastal plain, as a result of which high priority has been given to new drainage and flood protection works. Rapid decline of groundwater levels in the coastal areas, with dangers of saline intrusion. Also evidence of shorter seasonal water flows in hillstream areas as a result of deforestation in the upper catchments. (iv) Cost. Expenditure on O & M and staff is far higher than in any other of the projects studied (and in addition to the \$64.8/ha spent on canal, tubewell and drainage O & M, a further \$40.5/ha was spent in 1976 on new construction and rehabilitation work). Expenditure covers services not necessarily provided elsewhere (notably training in watercourse O & M); the cost of labour is substantially higher in Area Four than in the other cases; and there is a higher density of canal networks and control structures; but the length of canal lining is a cost-reducing factor. Staffing is considered adequate for current requirements. (v) Cost recovery.

Project membership fees are very high and so are the recovery rates. Total recoveries exceeded O & M costs and contributed significantly towards new construction and rehabilitation work. All the revenue raised from membership fees is retained by the Project Authority for reinvestment in the project area. 1/

Despite certain deficiencies in the quantity and quality of data obtainable, it should be apparent from this summary - and still more so from a more detailed perusal of the case study reports - that in all the field study areas except Area Four there were major weaknesses in performance and that there is therefore correspondingly large scope for future improvement. The conclusions reached in the case of Area One indicate particularly great potential for improving the operation of the public tubewells. In Area Two major physical and technical problems have clearly contributed to the generally low level of project performance, but the evidence also points to the need for substantial management reforms. And in Area Three, there is a clear need for more equitable water distribution as well as probably scope for significant increases in overall productivity. In all cases, poor performance is associated with inadequate funds, for O & M and other recurrent expenditure. All these issues are investigated more deeply at later stages of the evaluation process. But the main point to note at this stage is that, although the projects studied were among the best examples of their regional type, their levels of performance lend strong support to an increasingly large volume of evidence from elsewhere which indicates that the general potential for improved performance on large irrigation systems is immense. 2/

3.3 Performance and potential: issues of methodology

Any conclusions about the quality of a particular project's performance implies the presence of some set of performance standards in the mind of the evaluator against which actual performance can be compared. One of the methodological problems associated with the evaluation of performance is to decide, first, what these standards should represent and, secondly, how they should be estimated. The answer to the first part of the question would appear to be that they should represent that potential level of performance which a project might reasonably be expected to be capable of achieving under conditions of good management; some minimum conditions with regard to the physical and technical characteristics of the project's design would also need to be included. However it is inevitable that standards for each project can be only approximately estimated in the course of relatively

1/ The significance of this point is discussed further in Section 7.3.

2/ For a more detailed discussion of the evidence, particularly with regard to deficiencies in water distribution, see Section 8.1, especially p 138 ff.

brief evaluations of the kind undertaken during this study. For more precise estimates a detailed programme of action research would be needed. 1/

From our definition of what a standard of performance should be it is clear that there can be no question of trying to establish a single absolute and universal standard. Not only do the physical, technical, social and economic characteristics of projects vary from one environment to another but so do management capacities within different countries or parts of countries. Standards of performance must therefore be relative to the particular characteristics of each project and they should vary over time in accordance with changes in local management capacities: as the capacities, both of the official management and farmers, increase so the standards should be raised. Where there is considerable physical and social homogeneity over a large area (as for example in the western parts of the Indo-Gangetic plain) it may well be feasible and useful to try to develop generalisable standards or norms for the purpose of evaluating the performance of similar projects within that area. But where the object of developing performance standards is primarily for management purposes and only secondarily for external evaluation, the most useful approach will be to aim at the achievement of certain realisable standards by building into each project's planning and programming process a series of specific targets to be achieved at various intervals over time.

Although there were considerable deficiencies in the 'objective' data on which assessment of performance in the field study areas was based, this was not in fact a major obstacle to the achievement of the studies' main objectives. This was largely because the field studies went much more deeply than conventional economic and financial evaluations into the causes of the performance levels achieved. The loss of surface precision which might have been gained through a more comprehensive evaluation of performance was more than compensated for by the insights into the inner workings of each project which were obtained through the use of partial indicators of the quality of management and other contributory factors. Indeed, it is extremely doubtful whether, for the purpose of identifying the essential underlying causes of performance, any additional insights would have been generated through the use of a fully-fledged cost-benefit analysis.

In another study of agricultural management, Leonard found that, for the rather specialised purposes of his study of behaviour of junior extension staff in Kenya, the use of "comprehensive measurements of goal achievement" such as those provided by cost-benefit analysis were actually likely to hinder understanding of the determinants of field agents' work performance. Partial indicators were found to be more useful. "Cost/benefit ratios are appropriate to study at levels of analysis with which we are not dealing. Cost/benefit analysis measures the productivity of the project as a whole and this gauges the final impact of all the possible

1/ See Section 14.1

influences on the project". 1/ It is not particularly helpful in identifying the respective importance of each of these influences - which is the primary concern of the student of management. So, although the valuation methods advocated in this report could easily be grafted onto conventional cost-benefit analyses, such analyses are not themselves an essential component of evaluating institutions and management processes.

1/ Leonard, op. cit., pp. 24-25

4. 'Non-management' factors and their effect on performance

4.1 Isolating 'management' and 'non-management' factors

It is clearly simplistic to suppose that the level of a project's performance can serve by itself as an indicator of the quality of that project's management. Before it can be decided to what extent organisation and management factors have contributed to the level of project performance it is necessary to isolate other contributory factors and identify their significance. There will then be further questions to be asked within the context of organisation and management in order to distinguish between those factors which project management has the powers to influence, either directly or indirectly, and those which are the responsibility of higher policy-making authorities. At this stage of the analysis we are concerned only with the first of these two stages of distinction. 1/

Numerous 'non-management' factors can have a significant effect on project performance. Apart from major social and political upheavals, such as international or civil wars, these include: (a) climatic and biological hazards (e.g. typhoon damage; damage by pests) (b) national economic policies which, together with international factors (e.g. world inflation, shortages of imported materials), affect the viability of the production process; (c) the quality of service provided by other enterprises on which the project concerned is dependent (e.g. poor road and transport facilities; voltage fluctuations or power breakdowns in areas using electric pumps); and (d) the quality of project planning design and construction. A comprehensive evaluation should attempt to weight the importance of all these factors. In the field studies, however, attention was focussed mainly on the last set of factors, largely because of the directness and immediacy of their effect on a project's subsequent management but also because some of the most common weaknesses in project planning appeared to have very similar root causes to those encountered in organisation and management.

The importance of trying to isolate the degree of influence on performance which can be specifically attributed to different major factors besides those directly related to management, should need no emphasising. It is crucial to the main purposes of evaluation, since different conclusions will imply different recommendations for action. For example, if the technical deficiencies of a project are judged to be so great that any immediate attempts to improve organisation and management would bring only marginal benefit, the priority would clearly be for major capital investment as soon as possible. On the other hand, it might be concluded in the case of another project that it was operating well below its technical potential but was

1/ The second is discussed in Chapter 5.

being hampered by an inappropriate organisational structure and an absence of well-designed management procedures; in that case very different recommendations, with very different investment and policy implications, would follow.

It is true that it is perfectly possible for people with the necessary expertise in the subject to undertake independent and partial analyses of organisation and management factors alone, without detailed reference to all the other factors affecting project performance as a whole. These can often be very valuable. ^{1/} However there are dangers, particularly in the case of irrigation projects, where technical factors are usually of central importance, that such an approach will lead to an over-emphasis of the significance of management factors and to conclusions that management reforms on their own are capable of achieving more than is in fact possible. In other words, such partial analyses are in danger of being affected by 'management' bias, just as most current analyses of the causes of poor performance on irrigation projects are affected by a marked 'technical' bias - reflecting the dominance of engineering thinking in conventional project evaluations. On most projects there is likely to be a need for a mixture of both technical and management improvements. And since the purpose of this study is to find a way of reaching objective and balanced judgements about the causes of performance and their most suitable remedies, an attempt has been made to give due weight to the processes of planning, design and construction which have been responsible for the basic technology of each project's irrigation system as well as to the subsequent process of management.

4.2 Principal 'non-management' factors: planning, design and construction

The technical characteristics of a project place an upper limit on the level of performance which the human agents concerned (policy-makers; project management and staff; and farmers) are capable of achieving. For this reason, and also because technical factors and their effects are relatively easy to identify and isolate, it is convenient to review them before going on to more detailed discussion of organisation and management.

The first important distinction to be made with regard to a system's technical design is between those limitations which were consciously built into the original project plan and those which are the consequence of unplanned errors. The field studies contain two good examples of the first type:

- (a) The Area One project which, was designed with the following principal objectives in mind: the prevention of famine over as large an area as possible by means of a water delivery system which could be operated at low cost, both in terms of finance and skilled manpower. The resulting design (low cropping intensity, few control structures,

^{1/} As for example, in the case of Leonard's work. See p 50, last paragraph.

inability to operate outside a small discharge range) provides very limited scope for flexibility in canal operation and is not well suited to meeting the very different demands now being placed on it by current agricultural objectives - except where it has been possible to provide additional supplies and flexibility from ground-water sources.

- (b) The Main Canal system in Area Four, one of the most difficult in the country to operate owing to its dependence on temporary diversion structures (which are frequently damaged by floods) and its high sediment content. Although measures have been taken to upgrade the system over the years since it was first constructed, no economic means have yet been found which would enable fundamental changes to be made to its design characteristics; and the project management therefore tries to operate it as well as possible within its present known limitations, in the knowledge that it is technically incapable of achieving the same level of water use efficiency as many other systems.

Where design limitations are of this kind, the problems posed for a system's subsequent management are likely to be relatively less severe; in as much as the limitations have been anticipated, the system's management requirements can be planned accordingly. In such cases the performance 'targets' set for management may be fairly low but they are also attainable. Much more serious difficulties are likely to arise where major mistakes have occurred in the planning, design or construction process. Here systems become incapable of being operated according to plan and expected performance targets are impossible to achieve. The case studies also contain two notable examples of this type:

- (c) On the Area Two system, despite the problematical soil characteristics of the area, no drainage facilities were provided; watercourses were left for farmers themselves to construct, despite the difficulty of conveying water over the uneven micro-topography; crude open pipes with a limited choice of sizes (mostly 4" and 6" diameter) were provided at watercourse outlets, making it impossible to control flows accurately, either on a proportional or differential/zonal basis; and there were further deficiencies in the design assumptions used in the construction of the main canal system.^{1/}

^{1/} A major weakness of the main system design was that it was based on a pattern, in which water is supposed to be allocated uniformly to all farmers in accordance with their land area. However, with the development of rice as the only major (summer/wet season) crop, a system designed for differential or zonal cropping might have been preferable. Such a system would have required a fundamentally different design and many more control structures, down to the watercourse level. Even at present low levels of cropping intensity, a simulation study has shown that even if the system is operated at full supply level, total demand cannot be met effectively.

- (d) During the planning of the tubewells for Area One, a decision was taken to locate them at the heads of the existing watercourses; yet, despite the obvious consequence that this would lead to a doubling of previous flows into the watercourse channels, no provision was made for a supervised programme of watercourse remodelling. It was left to the farmers themselves to make the necessary adjustments unaided - a task well beyond their capacity in most cases.

Besides the kind of weaknesses found on the two projects, there are others - such as the absence or shortage of adequate measuring devices - which can be a serious obstacle to good management but can at the same time be relatively easily put right. But the planning deficiencies in the Area One and Two cases must be a matter of particular concern because of the high costs they have entailed (a) in terms of water losses and/or environmental damage and (b) in terms of subsequent rehabilitation work. They have led in both cases to large-scale water wastage below the watercourse outlet and in the case of Area One the whole project became virtually unmanageable until remedial action began to be taken in 1974. Serious planning weaknesses of this sort have occurred frequently during the rapid expansion of new irrigation development in developing countries. The underlying reasons for them may be briefly reviewed, since they are closely connected with many of the reasons for subsequent deficiencies in organisation and management; and lessons can be drawn from this experience which undoubtedly have relevance in many other countries.

The first criticism which has been levelled against the planning of several projects is that fundamental decisions were reached about their location and basic technical characteristics without a proper process of project formulation or appraisal. The advice on which these decisions were taken was largely supplied to the decision-makers by generalist administrators and/or civil engineers. There was very little input from agriculturalists, economists or other social scientists. This type of criticism has been made in India, e.g. the Director of Agriculture for Haryana comments on three large canal projects constructed in his State in the late 1960s (with combined command areas of over 220,000 ha.):

"The three projects were formulated by the State Department of Irrigation and also implemented by it Even though they were primarily agricultural projects, [they] were conceived as isolated irrigation projects, as ends in themselves and they do not seem to have been conceived or formulated (or implemented) as inter-disciplinary exercises. No economist, agricultural economist or management expert participated in the process of formulation nor was any serious attempt made to collect or even to cross-check data or, wherever collected, to present a systematic interpretation."^{1/}

^{1/} A.K. Sinha, "Formulation and Appraisal of Agricultural Projects: a Case Study", Indian Journal of Agricultural Economics, XXXIII, 4, October-December 1978, pp. 39, 41.

The same theme was taken up in more general terms in a review of papers presented to a recent conference of Indian agricultural economists on the subject of agricultural project formulation and appraisal. The reviewer, who had had long experience of working in the Planning Commission, also took into account a much larger body of literature on the same subject in reaching his conclusions. On project formulation his verdict was as follows:

"It is apparent that formulation of agricultural projects suffers from several serious deficiencies. These include inadequacy of basic surveys, major changes in project scope and design after approval; incomplete coverage in the sense that all the ingredients which determine the eventual outcome of the project are not included in the project proposal; the general failure to explicitly evaluate alternative location, designs and use of resources generated by the project before its design is finalised; and the failure to view individual projects in the wider sub-sectoral/regional perspective, keeping in view the needs and possibilities of each sub-sector/region, the constraint of resource availability and the relative priorities attached by the Government to different social objectives."

He went on to suggest reasons for this state of affairs:

"The obvious question for consideration is why, after nearly three decades of planning, the concerned agencies of the State and Central Governments failed to build up organizations and procedures for eliminating these defects which everyone recognizes to be widespread? Among the possible explanations are: The rapid turnover in the leadership of bureaucracy and at the political level generally tends to reduce the time horizons of decision-makers. The persistence of a bureaucratic set-up in which the general purpose civil servant holds sway over professionals and specialists has not been conducive to building organizations in which the latter would inevitably play a prominent role. Integrated planning of related activities and programmes, which is particularly important in agriculture, is also the more difficult to achieve because of (a) the fragmentation of planning and decision-making for this sector at the ministerial and civil service levels, and (b) the inherently difficult and sensitive questions of institutional reform which they involve. There is also the tendency for political power centres to view and demonstrate their performance in terms of the number of projects they are instrumental in getting approved and started irrespective of whether the projects are sound and irrespective of the number which can be efficiently implemented within the given overall resource constraints." 1/

1/ A. Vaidyanathan, Report on Identification, Appraisal and Evaluation of Agricultural Projects, Indian Journal of Agricultural Economics, XXXIII, 4, October-December 1978, pp. 282-283.

The reviewer also concluded that even where some systematic economic or financial appraisal had been attempted, as in the case of some large irrigation and rural electrification projects, the results had not been satisfactory: "At the conceptual level, despite considerable advances in evaluation techniques, the prevailing practices remain crude and highly heterogeneous." ^{1/} This again could be interpreted as a reflection of the low status accorded to economists and other social scientists in the planning process: if they have been employed at all, it has often been only to "rubberstamp" a decision already taken by others.

The second criticism concerns the way in which detailed technical design decisions have been taken. Here again the cause of the trouble is seen as the failure to adopt a sufficiently inter-disciplinary approach. All major decisions tend to be taken by civil engineers within Irrigation Departments with little or no reference to people engaged in various relevant aspects of agricultural research (agronomists, soil scientists). Thus the Secretary, Command Area Development, Andhra Pradesh, comments on design procedures in his State:

"The designing of projects is done in isolation by irrigation engineers, though a formal consultation is made by the Department of Agriculture. In one recent case when the Department of Agriculture was consulted on a scheme covering an area of over a million acres, comments of only a few lines were given The reason being that neither in the Department of Irrigation nor in the Department of Agriculture has expertise been built up to deal with problems of water management. Projects therefore continue to get designed and constructed towards the end of the 20th century with the techniques of the 19th century." ^{2/}

Lack of influence on decision-making by agricultural agencies also appears to have been the prime reason for the failure to include drainage in some original designs:

"Soil surveys were carried out before the irrigation scheme was built and it is quite clear from the reports that the two major problems of the scheme, waterlogging and salinity, were foreseen

^{1/} ibid., pp. 283, 284.

^{2/} Syed Hashim Ali, "Problems in the Management of Large Irrigation Schemes", Proceedings of the Commonwealth Workshop on Irrigation Management, Hyderabad, India, Commonwealth Secretariat, October 1978, pp. 189-190.

.... No drainage was included in the plan although it was known that water-logging and salinity were major hazards in the scheme."1/

The unfortunate historical legacy which has led (not only in India, but in most S. and S.E. Asian countries) to the design process being dominated by Irrigation Departments and their civil engineers also explains why on so many recent projects the main focus has been on the design of large structures, while the development of detailed layouts below the watercourse outlets (traditionally outside the responsibility of the Irrigation Department) was almost entirely neglected. This has had particularly unfortunate consequences in environments, where the micro-topography is far more undulating than in the older-established river basin or delta projects and has therefore presented farmers with much greater problems of local water distribution. 2/

In recent years important steps have been taken in India and elsewhere towards overcoming these deficiencies through the introduction of improvement programmes in which particular emphasis has been given to 'on-farm development' - i.e. the development of adequate watercourse layouts. However, there is a further very serious weakness, also attributable to the absence of an interdisciplinary approach to design, which has so far been given relatively little attention. This concerns the design of the main water delivery system above the watercourse outlet. Again, the greatest problems have tended to arise in Central and South India, where until the post-war period irrigation was largely confined to water-abundant delta areas and was used exclusively for paddy cultivation. 3/ The newer projects have been planned with the objective of spreading relatively scarce water more extensively over large areas of land, much of it consisting of porous soils on which paddy cultivation is highly undesirable in view of the very high water losses involved. This has led to the adoption of plans for a differential pattern of cropping and water distribution, in which some areas (usually those with heavier soils) are designated - or 'localized' - for paddy, while others are designated for 'irrigated dry' crops only.

Even if the delivery systems for such controlled cropping patterns had been well designed, they could have been expected to be quite difficult

1/ Comment of a joint FAO-UNDP-Government of India report, quoted in B.B. Vohra, Land and Water Management Problems in India, Training Division, Department of Personnel and Administrative Reforms, Cabinet Secretariat, New Delhi, Training volume No. 8, March 1975, p. 77.

2/ For a trenchant attack on the record of the Indian States' Irrigation Departments in the 1950s and 1960s - their concentration on the construction of large projects ("the disease of gigantism"), their relative lack of interest in minor projects and groundwater development, their neglect of drainage and watercourse development - see B.B. Vohra, *op. cit.*, pp. 2, 62-63, 94 and passim.

3/ In Maharashtra the emphasis was on sugarcane.

to manage owing to the traditional preference of farmers in these higher rainfall areas for paddy cultivation. In most cases, however, designs have been very imperfect. Not only have many of the control structures which are essential for differential water supplies not been provided for, 1/, but engineers have also continued to base their calculations of canal capacities on crude and outdated assumptions about the water 'duties' of different crops. The 'duty' concept, which has dominated irrigation engineering thinking in South India and Sri Lanka since the early years of this century, was originally developed for the design and operation of canals in relatively homogeneous and water-abundant areas. In those conditions it may have served its purposes adequately. However, it is quite unsuited to present conditions, in which water supplies are much scarcer, soils have widely varying characteristics, a large proportion of the cropped areas is supposed to be devoted to 'irrigated dry' crops, and the need for precision of control over timing and quantity of water deliveries has greatly increased as a result of the development of improved and high-yielding crop varieties. 2/ A notable fact, which underlines the gap in communication between disciplines, is that the engineers continue to use the 'duty' concept in their design work despite the existence of several well-established agricultural research institutions in the region which have been doing detailed experimental work on soil-plant-water relationships. When challenged on this issue, engineers tend to argue that the results of this research cannot be relied on, since it has been carried out under laboratory conditions and not in farmers' fields. This is a very valid criticism and underlines the need in many Asian countries for changes in the attitudes and methods of agriculturalists as well as engineers before a genuinely interdisciplinary and empirical approach to system design can be developed. Meanwhile, major design faults continue to occur, with

1/ Quite often different watercourses under the same minor have been designated for different cropping patterns despite the absence of gates at the watercourse heads. 'Localisation' on this basis is obviously impossible to enforce. (Cf S.K.S. Hussain and N. Seetamaraiah, "Water Use Concept as Design Criteria for Irrigation Systems of Nagarjunasagar Right Canal", Paper to Commonwealth Workshop on Irrigation Management, Hyderabad, India, October 1978, p. 22).

2/ In South India a crop's 'duty' represents the number of acres assumed to be irrigable if the crop is supplied with 1 cusec of water on a continuous flow basis throughout its growing period. The concept is clearly faulty, since it does not take into account variations in water requirements at different stages of crop growth. Moreover the fact that it is based on assumptions about continuous flow makes it particularly unsuitable for calculations where crops other than rice are concerned. Assumed duties in many parts of South India (irrespective of soils) are 60 for rice and 120 for all 'irrigated dry' crops. See also R. Wade, "Rationing Water: principle and practice", Paper to ODI Workshop on Choices in Irrigation Management, Canterbury, September 1976, pp. 7-8.

canal capacities frequently insufficient to meet delivery requirements at periods of peak demand. 1/

The sort of management problems which arise where deficiencies in main system design have been combined with only rudimentary watercourse development, as in parts of Andhra Pradesh, have been described by Hashim Ali:

"Traditionally the potential is said to be created when water is let out in the system, but in practice the potential is declared sometimes even without construction of minors, not to say of [water-course] outlets. The canal system is incapable of being operated in the absence of cross regulators, control structures and the low estimation of transmission and system losses, resulting in the actual command area being much less than the original command area [At the watercourse level] it was found that as the outlets were designed to operate at full supply level whether they were located at the beginning of the minor or at the end of it, the last few outlets could never get the designed discharge. This basic miscalculation resulted in the situation that, when two minors had to be selected in each project for the introduction of rotation system (warabandi) below the outlet, not a single minor could be found in which each outlet was capable of discharging the designed discharge." 2/

In another detailed study recently carried out in Andhra it has been clearly demonstrated that on the Nagarjunasagar Right Canal system, which was designed in accordance with the traditional 'duty' criteria, the canal capacities of the minors and sub-minors were far below the level required to meet the peak demands of the planned cropping patterns. On the basis of their evidence the authors of the study advocate "the need for changing design criteria of irrigation channels from the present overall duty concept to one of water use concept, taking into account the water requirement of crops." 3/

Finally, in addition to weaknesses in the planning and design processes there is a third factor which has often added to the subsequent problems of project managers: local political interference in the decision-making process. In the planning of most large irrigation projects there are likely to be some political considerations which will influence a government's final decision as to the precise areas to be benefitted, and many of

1/ Levine observes that one of the reasons for high levels of water use efficiency in Taiwan has been that "system design, and the associated operational plan, are not based upon an estimated water use efficiency, but upon specific identification of the water used for the various stages of crop culture". (G. Levine, "Management Components in Irrigation System Design and Operation", Agricultural Administration, 4, 1, January 1977, p. 43).

2/ S. Hashim Ali, op. cit., pp. 81.

3/ S.K.S. Hussain and N. Seetamaraiah, op. cit., pp. 1-3, 22.

them may be perfectly justifiable. For example, there may often be persuasive social arguments for giving priority to the objective of developing certain backward regions and modifying economically optimal solutions accordingly. This should be regarded as a legitimate component of the official planning process. However, when the course of events is allowed to be influenced by unofficial action - lobbying on behalf of powerful local interests - the effects can be very damaging, especially if they involve last-minute revisions to the officially approved plans and designs. 1/ A fairly common consequence of such interference is the extension of a canal systems beyond its originally planned length or a change in its original alignment in order to benefit certain areas which local politicians are anxious to favour. Local political influences have also helped to intensify the difficulties of implementing the 'localisation' policies adopted in parts of South India: official permission to grow paddy has not been determined by soil factors alone but has also been influenced by local pressure groups. 2/

Most of the examples of planning deficiencies given here are taken from the Indian sub-continent, India especially, It should not however be assumed that they are confined to that part of the world. One reason why they have attracted particular attention in India is that the rapidity and scale of the nation's irrigation construction programme in the 1950s and 1960s, together with the increasing difficulty of the terrain to be developed, combined to bring out the problems associated with them in a particularly acute form. But to a greater or lesser degree similar problems occur elsewhere.

The tendency for engineers to dominate the planning and design process is greatest in those countries where the Irrigation or Public Works Department has historically been much more powerful and prestigious than the Agriculture Department, often antedating it by quite a long period (as in most of South and South East Asia). Elsewhere it has been less pronounced (as, e.g. in Taiwan, where the Japanese colonial tradition placed unusual emphasis on the development of improved agricultural techniques; or in most of sub-Saharan Africa, where large-scale irrigation is a relatively recent phenomenon and has tended to fall naturally within the responsibility of already well-established Ministries of Agriculture).

However, historical factors cannot be put forward as the only, or even the major, explanation for the widespread tendency to give disproportionate emphasis in planning and construction to major infrastructural works (dams, main canals) at the expense of detailed design issues which are crucial to the efficient operation of the system (control structures, measuring devices, well-designed watercourse outlets, watercourse layout, field

1/ Cf. Vaidyanathan's reference to "major changes in project scope and design after approval" (p. 4.6 above).

2/ For one example of canal extension and realignment after sanctioning (in the late 1940s), see History of the Lower Bhavani Project, Public Works Department, Madras, 1966, pp. 14-15, 165-169. On the politicisation of 'localisation' decisions, see R. Wade, op. cit.

drainage, land development). Nor is it simply a question of financial expediency, though detailed survey and design inevitably involve considerable added expense. The over-riding reason is a political one, and engineering dominance is only a symptom of it. To most governments the development of irrigation has obvious political appeal as a means of winning popular support. But there is also, understandably but regrettably, a common tendency to attach excessive importance to winning short-term acclaim through investments which are highly visible and spectacular. To attach equal importance to investments which are much less visible and essentially mundane (the 'nuts and bolts' which will enable the irrigation system to achieve successful long-term results) requires considerable political maturity and vision. These remarks, together with the earlier observations on the danger of local political interference in the planning process, underline the importance of the political dimension in decisions about new irrigation development. Given the high potential value of irrigation water, this should not be matter for surprise. Nor should it be surprising that political factors continue to be important once construction is completed and the project becomes operational.

III. PROJECT ORGANIZATION AND MANAGEMENT

5. The analytical framework

5.1 Defining spheres of responsibility

The central focus of this study is on project management. However, in addition to the 'non-management' factors already discussed, there are a number of important 'management' factors affecting project performance over which managers at the project level have only limited control. These factors largely determine the basic organizational and administrative framework within which project managers are expected to operate and the nature of the 'management tools' which they have at their disposal. They include:

- (a) The establishment of consistent and clearly-defined objectives for project management to pursue;
- (b) The provision of an organisational structure which is appropriate to the pursuit of project objectives;
- (c) The creation of a basic framework of management procedures, job descriptions, information and monitoring systems;
- (d) The formulation of policies on staff recruitment, promotion and salaries which will favour the attainment of project objectives;
- (e) The provision of adequate financial support for recurrent expenditure, either directly from government funds or from water charges levied on the beneficiaries (at rates to be determined by government), or from a combination of the two;
- (f) The provision of an effective legal framework in support of the attainment of project objectives (e.g. for the enforcement of water distribution rules or for the control of groundwater extraction).

These are all essential elements of what may be described as 'planning for management'. This should form a regular and prominent part of the project planning process, though - as the evidence from the field studies shows - it rarely does so: many of the aspects listed above are given only the most superficial consideration at the planning stage. Responsibility for establishing a satisfactory framework for project management clearly lies with senior policy makers and planners. It is also their responsibility to see that necessary revisions are made in response to changing circumstances over time.

The next clearly identifiable set of responsibilities belongs to the project managers. They are directly responsible for the performance of their subordinate staff; and they are also required to assist and supervise various activities at the watercourse and farm levels, even if (as in most cases) immediate responsibility for these activities has been delegated to the farmers themselves. Responsibility for project performance may therefore be usefully conceived as being divided between three distinct categories of people; policy-makers and planners; project managers and their staff; and farmers. In the case of the second and third categories, their capacity to perform well depends very significantly on the quality of performance achieved at the levels above them in the hierarchy of decision-making. Thus the actual and potential quality of management at project level (and at various levels within the project administration) can only be assessed with confidence once a clear picture has been established of the constraining or enabling character of the organisational and administrative framework. Similarly, assessment of the quality of farmers' management of watercourse and farm levels depends on a good understanding of the tasks of project officials and their supporting staff and of the effectiveness with which they have carried them out.

In any evaluation of management it is clearly important to try to be as accurate as possible in one's attribution of causes of strengths and weaknesses in management performance. Once again the principal reason for this is that only a correct diagnosis of causes is likely to produce appropriate and effective recommendations for remedial action. To give two examples which will be expanded upon later: if there are serious weaknesses in a project's organisational structure and opportunities for staff promotion which seeks to improve management performance through exclusive concentration on in-service technical training; and if main system water distribution is being carried out unsatisfactorily, it may be pointless to concentrate substantial resources on trying to encourage improved water distribution below the watercourses outlet (however poorly farmers may be performing the function at present). One of the most important objectives of project evaluation should be to try to clarify the precise causal relationships and to identify the correct priority and sequence of remedial action which they imply.

It is usually possible to make a rough provisional assessment of quality of the overall administrative framework within a fairly short period. The clarity and consistency of the objectives set for project management can be checked by a perusal of official documents (national and sectoral plans, annual project reports, etc.) and by interviews with higher-level planners and administrators. Broad answers to most questions about organisational structure can be obtained by reference to certain general principles and to the basic characteristics of the local context, without a great deal of field research. Availability of project manuals, job descriptions, procedures, etc. can be quickly established. Basic information on the policies governing the recruitment, promotion and salary structures of staff is fairly easily obtainable from project records; and the same applies to information on the quantity of the financial resources available and the nature of the

legal framework. Preliminary hypotheses can therefore often be developed about the character and probable effect of the overall framework on management performance without much detailed field investigation. However the division of responsibility for performance between policy-makers and planners on the one hand and project managers on the other is rarely a clear-cut one: for example, there is never a total absence of management procedures; the questions which usually need to be asked are whether they have been well designed and codified, and to what extent performance reflects their quality of design or the effectiveness with which project management has applied them. An accurate picture of the complex combination of contributory factors can therefore only be built up after a careful study of project records and detailed interviews with project staff at all levels, as well as with farmers.

As a result the next three chapters of this paper, like the corresponding section of the proposed method of evaluation, 1/ have been organized in such a way as to encourage the reader (or the evaluator) to keep a clear distinction in mind between two main spheres of responsibility for management performance - policy-making/planning and project management; but no attempt is made to isolate their respective influences until the following aspects of performance have been separately analyzed:

- (i) appropriateness of organisational structure (largely the planners' responsibility, though good managers can modify the effects of an unfavourable structure through committee work, procedural changes, etc.);
- (ii) the function of overall project management (partly the responsibility of the planners, partly that of the managers themselves; and
- (iii) the performance of the specialist activities which project management is responsible for supervising and coordinating.

Although there may also sometimes be difficulties in trying to isolate the influences of project officials and farmers at the watercourse and farm levels, the subject of organization and management at these levels is discussed separately in a later section of the paper. This is largely because in the projects studied there was a very distinct break in the management hierarchy between officials and farmers at the watercourse outlet; and also because the problems of stimulating the development of small groups of farmers at the village or watercourse level are substantially different from those of managing a large bureaucratic organization.

5.2 Assessing the management process

The quality of an organisation's performance can be seen as being partly a function of its structure (the way in which tasks and responsibilities are formally allocated among its members) and partly a function of its

1/ See Appendix A, Part III.

management process (the way in which decisions are actually made within the existing structure). To a large extent organisational structure can be analysed independently of the management process by means of techniques which depend more on theory than on detailed field research. Investigations designed to obtain an understanding of the management process are more intricate and time-consuming and in the four case studies they took up a large proportion of the total time spent in the field.

In this study the main emphasis has been placed on assessing the performance of certain specific activities which a number of agents combine to perform (overall project management, water allocation, system maintenance, agricultural extension, etc.) and then on identifying possible reasons for shortcomings. Many of these are to be found in the working conditions, capabilities and attitudes of the agents concerned. An alternative method of assessing the management process would be through an approach from the other end: starting with a detailed analysis of the conditions and characteristics of the agents belonging to different strata in the administrative hierarchy and the relationships within and between each stratum (e.g. senior Irrigation officials and subordinate staff; senior Agriculture officials and subordinate staff), and then going on to use the results of this analysis to explain the quality of the performance of various activities. The latter approach, used by Leonard in his Kenyan study, provides deeper insights into social relationships within the administration but it also requires more time. ^{1/} In practice, whichever is given the greater initial emphasis, both forms of analysis are obviously complementary and both are needed for a full understanding of management performance.

In an activity-led analysis of the management of irrigation schemes, a comprehensive evaluation would in theory require the management of each agency involved (e.g. Irrigation, Agriculture, and Cooperative Departments, as well as the farmers themselves) to be assessed with respect to performance in each of its major activities. However, while attempts were made in the case studies to obtain insights into a wide range of activities, it was clearly impractical to carry out detailed analysis on more than a few which were expected to be of key importance. For reasons already explained the main focus was on water allocation, but as much attention as possible was also paid to system maintenance, agricultural extension (water management extension in particular) and supervision of watercourse management, as well as essential supporting activities such as financial management, personnel management and monitoring.

In the case of each selected activity, actual performance was judged, where possible, against the stated, inferrable or hypothesised

^{1/} See D. Leonard, op. cit. Robert Wade has also used this approach to good effect in his study of canal system management in Andhra Pradesh (in material so far unpublished), but at the same time he has also looked very closely at the processes and procedures of one particular activity - water allocation.

objectives of the agency or agencies concerned. Investigations were made into the quality of the basic aids to management available to staff involved in performing that activity (manuals, job descriptions, maps, etc.); and particular attention was paid to the procedures according to which the activity (and its component parts of planning, implementation and monitoring) was supposed to be performed. 1/ Actual performance of the activity at various different levels of the administrative hierarchy was then observed and the accuracy of recorded data was checked in the field. Finally conclusions were drawn about the main reasons for high or low quality of performance.

As an aid to analysis of management performance, it has been found helpful to think of the possible reasons for performance as falling within three broad categories: resources, skills, and motivation. Shortcomings in each category imply very different kinds of remedy. Inadequate resources (which are normally thought of as consisting of finance, manpower and equipment, but could also be extended to include the other essential tools of management already referred to) obviously imply a need for an increase in those resources - although it does not of course necessarily follow that higher authorities will be in a position to supply them. Deficiencies in skill (which might be of various kinds - technical, management, communication) imply a need for an appropriate form of training. Poor motivation may be the consequence of a variety of causes, to which there corresponds a similarly wide range of possible remedies. It is often seen primarily as a problem of material incentives (salaries, promotion prospects). However there are usually many opportunities for substantially improving non-material incentives as well, for example by introducing more efficient methods of work programming which enhance job satisfaction or by raising the morale of junior staff through the reduction of authoritarian behaviour on the part of their seniors. As will be seen, well-planned management procedures can have a very important role to play here. 2/

1/ E.g. in the case of water allocation, questions were asked about the procedures for calculating the expected seasonal, monthly or 10-day patterns of supply and demand on which water scheduling was planned; the procedures for implementing or modifying the schedules, and the procedures for monitoring plan implementation.

2/ Staub and Green advocate the incorporation of the distinction between shortcomings in skills, motivation and resources into the internal monitoring of irrigation projects, arguing that project managers require an information system which will enable them to distinguish between the effects of each factor on performance and thereby help them to take appropriate remedial action (W.J. Staub and D.G. Green, "A performance Management Unit for Irrigation Agencies", in Proceedings of a Workshop on Implementing Public Irrigation Programmes, East-West Center, Hawaii, 1977, pp. 191 ff).

Finally, for those who are unfamiliar with the evaluation of management or other aspects of social behaviour, a few words may usefully be added about the ways in which methods of data collection and analysis for this purpose differ most markedly from those used in more conventional forms of evaluation. Perhaps the most important point to be stressed here is that the purpose of conducting interviews with staff and consulting their records is only partly to obtain information about facts (e.g. what are the objectives of Agency A? What are the procedures for Activity X?). Some of the information gathered may be of no value at all in terms of factual accuracy. It may nevertheless provide very important insights into attitudes, motives and technical and administrative capabilities within the project organization. For example, it can often be revealing to repeat the question "What are the procedures for Activity X?" to several different people involved in that activity, even when the interviewer already knows the correct answer. Similarly, records which can be seen to contain errors or falsifications may seem of little value to someone who would like to use them as a means of discovering 'what the factors are', but they can offer valuable evidence of the extent to which procedures are not being followed and of the effectiveness of the project's control and monitoring methods. Much of the most valuable information about management performance is thus obtained through indirect inference from the questions asked and the documents inspected.

The need for a tactful, oblique approach to information-gathering becomes particularly important when one is wishing to establish the reasons for divergences between precept and practice. For example, in a case where it has been found that water is being misallocated, is it simply a consequence of technical deficiencies (insufficient control structures, lack of measuring devices, etc.) or lack of resources (too few people required to cover too large an area with too little transport)? Or do the staff concerned lack the necessary skills to perform the activity well? Or is it that for reasons of poor morale (insufficient material or other incentives) they lack the motivation to perform the activity well? In this last case misallocation may be attributable either to negligence of prescribed procedures (because insufficient rewards are being offered from within the managing agency to encourage the achievement of desired objectives) or to their deliberate contravention (because there are substantially greater unofficial rewards to be obtained from the agency's clients for subverting the desired objective). Probing into this last area can be a delicate matter. However, such detective work is clearly necessary, since no evaluation can be considered satisfactorily completed until all probable reasons for poor performance have been thoroughly investigated.

6. Appropriateness of organizational structure

6.1 Influencing factors

The structure of an organization has already been defined as the pattern according to which tasks and responsibilities are formally allocated among its members. It is descriptive of the more static features of an organisation, whereas the management process refers to the more dynamic features of actual decision-making which occur within the structural framework. 1/ Organizational structure has both a horizontal and a vertical dimension. The horizontal dimension is concerned with the way in which the various functions or activities required for the achievement of an organization's objectives may best be differentiated (in accordance with the different specialist skills associated with each activity) and subsequently coordinated, with a view to producing a unit of effort among the organization's resulting sub-systems. The vertical dimension is concerned with the way in which roles and responsibilities are differentiated and coordinated between the occupants of positions at different levels of the hierarchy of each subsystem. 2/

As Peter Drucker has observed, "the best structure will not guarantee results and performance". (Much also depends on the fundamental character of the organization, its source of finance in particular, and on the quality of decisions produced by the management process. 3/) "But the wrong structure is a guarantee of non-performance. All it produces is friction and frustration. The wrong organisation puts the spotlight on the wrong issues, aggravates internal disputes, and makes a mountain out of trivia. It accents weaknesses and defects instead of strengths. The right organisational structure is thus a prerequisite of performance."4/

Given the importance of having the right or appropriate organisational structure, what are the criteria by which such a structure can be identified and recommended for adoption? One point which seems to be agreed by all present theorists in this field is that there is no single 'ideal' or 'universal' structure which is best for all organisations in all circumstances. Appropriateness of structure will vary in accordance with a number of factors which are specific to each organisation's objectives, functions

1/ See, e.g. F.E. Kast and J.E. Rosenzweig, Organization and Management: a Systems Approach, 1974, p. 207.

2/ *ibid.*, pp. 213 ff.

3/ The importance of an organization's source of finance as a determinant of its fundamental character, especially with regard to its accountability to its clients, is discussed in Section 7.3.

4/ P. Drucker, Management, Heinemann, 1974, p. 519.

and local context. 1/ Of the many factors which have been suggested as important determinants of appropriate structure as a result of comparative research in Western industrial contexts, the following seem to be among the most likely to have significance in the contexts of irrigated agriculture with which we are concerned:

- Size
- Technology
- Human capabilities
- Stability of decision-making environment
- Social culture
- Objectives, strategies and key activities.

Let us consider each briefly in turn.

Size. The fact that this study has been specifically focussed on 'large' rather than 'small' irrigation projects itself implies a recognition that the problems of organisation and management are likely to be markedly different at each end of the spectrum. Even within the 'large' category, however, there are very significant variations in size which have implications for organisational structure; these are discussed later. Handy comments that "size of organisation has always proved to be the single most important variable in influencing a choice of structure or of culture", 2/ and he concludes that the larger an organisation is, the more likely it is to be formalised in character and to develop specialised groups which need systematic coordination. In general, size will tend to push an organisation towards a predominantly 'bureaucratic' type of structure, in which procedures, rules and clear definitions of functions are necessarily important. 3/

1/ "Earlier management theory, in its search for universal formulae or cure-all remedies, did a great disservice in seeking to disseminate a common organizational culture. Fortunately organizations, unhearing or unheeding, were unaffected. More modern theories of organization are increasingly persuaded of the wisdom of the appropriate, of the match of people to systems, to task and environment, of interrelations between all four, of what has come to be called the systems approach to management theory" (C.B. Handy, Understanding Organizations, Penguin Books, 1976, pp. 176-177). Theories which are based on comparative analyses of organizations are also often termed contingency theories.

2/ The term 'culture' here refers to 'organizational culture' which may be roughly equated to 'management style': it is not to be confused with the culture of the surrounding society.

3/ C.B. Handy, op. cit., p. 187.

Technology. Studies such as those of Joan Woodward have demonstrated the importance of technology of production as a determinant of appropriate organisational form. 1/ Although the differences in the character of the technologies of canal delivery systems studied were not as marked as they would have been if a highly automated system had been included, certain differences in organisational structure could be seen to follow from variations in the 'mix' of skills required in each case. Choice of tubewell technology clearly has very important implications for organisation at the 'small group' level.

Human capabilities. Administrative capacity and skilled manpower are, to a greater or lesser degree, scarce resources in all developing countries. This factor is often the one which places the most severe and unavoidable limitations on the extent to which planning and management responsibilities can be profitably delegated to lower levels of the administrative hierarchy. The nature of the technical knowledge of staff in different specialist cadres (engineers and agriculturalists) also has important implications for horizontal structure on irrigation projects. More generally, Simon has observed that "since organizations are systems of behaviour designed to enable humans and their machines to accomplish goals, organizational form must be a joint function of human characteristics and the nature of the task environment. It must reflect the capabilities and limitations of the people and tools that are to carry out the tasks." 2/

Stability of decision-making environment. In some organisations, or parts of organisations, the need to keep abreast of rapid changes, whether in technology or market opportunities, is likely to favour the adoption of organisational forms which are adaptable and flexible. On the other hand, where the decision-making environment is relatively stable and many of the organisation's activities are routine and easily programmable, a more 'bureaucratic' form of organisation is likely to be appropriate. As Leonard has observed, much of the work which has to be carried out by

1/ Woodward classified a range of manufacturing firms into unit (or small batch), mass (or large batch), and process. She discovered that the length of the line of command, the span of control of the chief executive, the percentage of turnover devoted to wages and salaries, the ratio of managers to others, of graduates to non-graduates and indirect to direct labour, all increased as the technology involved moved along the line from unit to process. However, mass production was more formalised and mechanistic than the other two. She demonstrated that those organisations whose structures were in line with the norm for their technology were the most effective (Handy, op. cit., pp. 188-189; cf Kast and Rosenzweig, op. cit., pp. 189-190).

2/ H.A. Simon, "Decision Making and Organizational Design", in Organization Theory, ed. D.S. Pugh, p. 204. On the limitations imposed by administrative capacity as a scarce resource, see R. Chambers, Managing Rural Development, p. 152.

agencies concerned with agricultural development falls into the latter category.1/

Social culture. The surrounding social culture within which an organisation operates must inevitably have an effect on the precise form of organisation which is likely to produce the best results from its members, whatever the general pattern indicated by the combined influence of other factors. Numerous differences in ways of organising work have been observed in different countries at similar levels of economic development (e.g. USA, Britain, France, Japan), which are a reflection of each country's particular history and social characteristics; variations will also often be apparent between different regions of the same country. Even where the prevailing social norms might seem inimical to the promotion of intended objectives, it would be foolish to attempt the design of an organisation's structure without taking them into account.2/

Objectives, strategies and key activities. Drucker argues that these are the most fundamental factors on which all organisational choice should be based: less context-specific than the other variables listed, they are perfectly consistent with them and can be conceived as underlying or embracing them. Drucker sees the first step in the design of an appropriate structure as the identification of the activities which will need to be performed by the intended organisation; these he terms the organisation's 'building blocks'. The key activities are in turn determined by the objectives and strategy of the organisation; all other activities are of secondary importance. "Effective structure is the design which makes these key activities capable of functioning and of performance."3/

Drucker's more general formulations provide a particularly useful starting point for investigations into the appropriateness of horizontal relationships between specialist sub-systems, but several of the other factors appear to be most significant as criteria of analysis or choice in the context of vertical relationships within sub-systems. This reflects the preoccupation of most modern management theorists with questions of management styles and behaviour within organisations, particularly relationships between different levels of official management and staff. However, in the case of the irrigation projects studied it was clear that there were many problems concerned with the differentiation and coordination of specialist functions which possibly presented even more fundamental obstacles to the attainment of improved performance than weakness in their vertical structure. We shall therefore turn to the analysis of these problems first.

1/ See, e.g. Handy, op. cit., pp. 179-183; Kast and Rosenzweig, P. 213; Leonard, op. cit., p. 219.

2/ Cf. Leonard, op. cit., p. 17; Handy, op. cit., p. 176.

3/ Drucker, op. cit., p. 523.

6.2 Horizontal relationships: the differentiation and coordination of key activities

If we follow Drucker, our search for an appropriate horizontal, structure must start from a definition of an irrigation project's objectives. In the broadest terms, all irrigation projects may be assumed to have the same objective: the provision of water as an input to agriculture, in combination with other productive inputs, with a view to achieving an optimal balance between the goals of high productivity, equity and environmental stability, at least cost. In matters of detail, significant differences of objective can of course be found between different types of project and even between projects of the same type. Only very major differences have implications for horizontal structure, however.

The most obvious and important divergences of objective appear to be between (a) recently-established irrigated settlement schemes; (b) schemes (nearly always settlement schemes by origin) which have been established specifically for the purpose of producing high-value cash crops, often for export; and (c) schemes whose purpose is to supply irrigation water to already settled areas where farmers are allowed a relatively free choice as to the crops they cultivate.

The distinctive feature of new settlement schemes is that, in addition to the central activities of irrigation management, the project management also necessarily has direct responsibility for supervising the planning and implementation of new infrastructure (housing, roads) and social services (schools, health services). This applies to all new settlements, whether (as generally in Africa) they are set up predominantly for the purpose of intensive cash-crop production or whether (as generally in Asia - e.g. Rajasthan Canal; new Dry Zone settlement in Sri Lanka; new Outer Islands projects in Indonesia) freer choice of cropping is allowed under a less highly controlled pattern of agricultural management.

In schemes of the second type, because of the character of the principal crop or crops produced and their markets, governments see a natural advantage in making the commercial function of crop marketing one of the principal responsibilities of project management. The farmers' obligation to sell their produce through the project's single-channel marketing wing then makes it possible for the project to deduct a sufficient amount from the farmers' final payments to cover the cost of other services besides the central ones of water distribution and agricultural extension, e.g. credit, input supplies, in some cases even mechanised land preparation; and its direct control over these activities can be used to advantage in order to ensure greater timeliness of throughput as well as quantity and quality of production.

In the case of schemes of the third type (to which all four of the field studies belonged), there may often be a need for project management to participate in decisions concerning infrastructural development (particularly roads) in the early years of the scheme; but it should usually be possible for direct responsibility for planning and implementing in this field, as in social

services, to be left to the existing civil administration and the specialist departments concerned. The reasons for wishing to include marketing as one of the activities of project management are much less obvious than in the case of the predominately cash-crop schemes, since the establishment of single-channel control is extremely difficult in conditions of multiple-choice cropping, especially where a large proportion of production is food crops. In many areas with a long history of settled agriculture there may in any case be much less need to establish a new 'integrated' system of commercial services (marketing, credit, inputs) within the project itself simply because alternative institutions (whether in the public, private or cooperative sector) are already in existence.

This is not to say that project management should not concern itself at all with commercial services: ensuring the timely supply of other inputs besides water is a universally important function of irrigation management but it may often be most effectively performed through good coordination with another specialist agency rather than through direct control. The extent of direct management involvement in these fields should be determined by the effectiveness of existing commercial institutions. But in the absence of opportunities to establish control over a single-channel marketing system - which is the key to the 'integrated management' approach and the many administrative advantages it can provide - there are likely to be few benefits from trying to combine commercial and technical service activities within the same public sector organisation. The skills required for buying and selling are substantially different from those involved in the provision of services such as water supply and agricultural extension and there are obvious savings to government, especially in terms of scarce administrative manpower, if effective commercial institutions can be developed in the private or cooperative sectors. ^{1/} Moreover, there is a particularly strong argument for organizing commercial services round market centres rather than on the basis of irrigated command areas.

This suggests that we should be thinking in terms of four broad categories of activities, two of them central to irrigation schemes of all kinds and the other two optional depending on the particular nature of local objectives and contexts. These are:

- (a) Water supply service activities: water distribution, system maintenance, supervision of watercourse development, assessment and collection of water charges.
- (b) Agricultural production advisory service activities: general agricultural extension and water management extension (backed by agricultural research).
- (c) Commercial service activities: input supplies, credit, marketing.

^{1/} On the distinctive character of the 'commercial function' and the management skills associated with it, see G. Hunter (ed), Agricultural Development and the Rural Poor, pp. 83 ff.

- (d) Basic infrastructure and social service activities: housing, roads, schools, health services, etc.

With the focus on the first two central categories, the next step is to distinguish the key activities from those which can be regarded as secondary or ancillary. Given the principal objectives which have already been specified, the key activities would appear to be these:

- (i) Water distribution;
- (ii) Supervision of watercourse development (supervising farmers in their communal responsibilities for water course O & M and - where necessary - carrying out 'on-farm development' work);
- (iii) Agricultural extension (including water management extension); with the addition of;
- (iv) Overall project management.

The other activities are ancillary, though two of them are clearly of great importance: system maintenance, without which efficient water distribution is impossible; and the assessment and collection of water charges, which contributes to the revenue from which essential funds for operation and maintenance are obtained.

Water supply and extension: coordination or unified project management? The crucial question which arises with regard to irrigation schemes of the third type (already settled agriculture, with relatively free-choice cropping patterns) is whether the two central sets of activities - water supply and agricultural extension - are likely to be best organised by a single unitary organisation or by two separate organisations. As has already been argued, the objectives of all irrigation schemes require that these activities should always be closely coordinated. But what degree of coordination is desirable? The answer largely depends on two of the influencing factors listed in the previous Section: the size of the irrigated area; and the capabilities of the officials and staff who have been entrusted with performing the two activities concerned. 1/

The question of size will be discussed later; for the time being let us assume that we are concerned only with the organisation of large irrigation schemes (however 'large' is to be defined). On such schemes it will be argued that there are very powerful grounds for advocating a unified project management structure wherever:

1/ See pp 70 - 72.

- (a) the officials charged with responsibility for water distribution are not 'agriculture-oriented' in their training and outlook;
- and/or (b) the agricultural extension service is weak, both in terms of resources and specialised skills (particularly with regard to field-level water management);
- and/or (c) the average level of farmers' management techniques, particularly their techniques of water management, is low (often a function of (b)).

Where none of these conditions apply - i.e. where water distribution officials have been trained in such a way that they are agriculture-oriented, where agricultural extension services are strong, and where farmers' techniques of farm and water management are well developed - the case for a unified management structure is much weaker. Indeed, there are likely to be savings in administrative costs if responsibility for the water distribution and agricultural extension functions is divided between two organisations, with the necessary coordination being effected through periodic meetings, correspondence, etc. Only in Area Four did this latter set of conditions apply: for this reason the division of responsibilities between Irrigation Project Authority and Farmers' Associations is judged appropriate in that context. But in the three other countries, water distribution is in the hands of civil engineers who have had little or no training in agricultural matters; and extension services are generally weak. Farmers' management capabilities range from low in Area Two, to rather high in Area Three. In Areas One and Two conditions, a particularly strong argument can be advanced for unified project management. In Area Three, the need for much closer collaboration between civil engineers and agriculturalists is very evident, but the case for unification is weakened once questions of scale are taken into account. 1/

Reference has already been made earlier in this report to deficiencies in the planning and designing of irrigation projects which are attributable to the disproportionately large degree of planning responsibility given in many countries to civil engineers and to the relative ineffectiveness of their agricultural research institutions. 2/ The same imbalance between civil engineers and agriculturalists can be found in the organisations used in these countries to operate irrigation projects after construction has been completed. And the historical reasons for the imbalance are the same in both cases. In many countries of Asia (particularly those previously under British administration - but also including, e.g., Indonesia, Thailand) Departments of Irrigation or Public Works were created long before there were any Departments of Agriculture; and partly for this reason and also

1/ See p 83.

2/ P 57.

because they were revenue-generating departments, they built up much more power, prestige and influence over the years than Agriculture. These departments were headed by civil engineers (originally by military engineers in India); there was no tradition of agricultural or field engineering - training in these disciplines has begun to be developed only very recently. In this respect, at least, most sub-Saharan African countries have benefited from being late-comers to large-scale irrigation. The natural pattern there has been for irrigation to be developed within an already established Agriculture Department and to be planned and operated by a single-command-based agency headed by agriculturalists. 1/

In the S. and S.E. Asian countries, scope for collaboration between Irrigation and Agriculture has been further weakened as a result of their being organized on a different territorial basis - Irrigation on the basis of canal command areas, Agriculture in accordance with the boundaries of the civil administration. The least coordinated organisational structure encountered in the field was in Area One, where there were four agencies responsible for various aspects of the management of irrigated agriculture (canals, tubewells, drainage, agricultural extension) each with a different area of jurisdiction.

Chief weaknesses of the traditional S. and S.E. Asian line department approach to irrigation management may be summarised as follows:

- (a) an absence of common (agricultural) objectives within the water distribution and extension agencies;
- (b) a tendency among the engineers to regard water distribution as a routine activity, requiring an understanding of water supply but not water demand - an activity of secondary importance to system repair and maintenance;
- (c) poorly motivated agricultural extension staff, owing to the inadequacy of their resources and their low status vis-a-vis the engineers;
- (d) an absence within the extension service of any cadre with specialist experience in field-level water management; and
- (e) a failure to monitor project performance effectively - partly because certain key data which need to be combined in order to monitor performance (e.g. crop areas and crop yields) are

1/ As, e.g. the National Irrigation Board in Kenya, Report No. 1, pp. 8-9; or the recently established River Basin Authorities in Nigeria, Proceedings of the Commonwealth Workshop on Irrigation Management, op. cit., pp. 35, 39.

collected by different agencies with different areas of jurisdiction. 1/

In such circumstances, the following corresponding advantages are potentially obtainable through the combination of the water distribution and extension agencies into a single organization:

- (a) the development of a single clearly-defined set of objectives;
- (b) an obligation on the part of the engineers with responsibility for water distribution to collaborate more closely with the agriculturalists and to devote greater attention to water demand in addition to water supply factors; 2/
- (c) an automatic strengthening of the relative influence and status of the agriculturalists, leading to an improvement in morale and effectiveness;
- (d) an obligation among the agriculturalists to increase their understanding of engineering matters and to develop specialist expertise in water management extension; and
- (e) a capacity to monitor project performance effectively. 3/

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- 1/ Especially since Agriculture (which is responsible for crop yield data) usually includes rainfed as well as irrigated land within its area of jurisdiction. This created problems for evaluation of project performance in Areas One, Three and Four. In Area Two provision was made later for a unified project monitoring unit, but the results of its first surveys were not available at the time the field study was carried out.
 - 2/ In the long-term, as is argued below (pp 84 - 85), what is needed is the development of an entirely new cadre of water distribution specialists. In the meantime, bringing the engineers into a unitary organisation can be one important element in a set of measures designed to make them more agriculture-oriented.
 - 3/ Area Four, the division of responsibility between Project Authorities and Farmers Associations presents no difficulties with regard to items (a)-(d) because of the agricultural orientation of irrigation staff and the strength of the extension services. The different territorial coverage of the Project Authorities and Farmers' Associations does however still create problems for monitoring project performance. These problems could be overcome without major structural changes, through the introduction of modifications in present procedures for data collection and analysis. And despite their different territorial coverage at HQ level, liaison between Project Authorities and farmers Associations could be further strengthened if at the local level farmer extension groups were to be formed on a watercourse basis.

Some of these potential benefits seem to be appearing in India where Command Area Development (CAD) Authorities have been established. It should be emphasized here, since there is some ambiguity about the objectives of CAD, that we regard the radical reorganisation which is a necessary feature of CAD in its most comprehensive form as its most important single characteristic. In other words, it should not be regarded, as some have chosen to regard it, merely as a temporary institution for spearheading a time-bound technical programme of 'on-farm development'. It is much more than that: it provides the permanent organizational framework which needs to be eventually adopted for the management of all large scale irrigation schemes in India. CAD in this form has not yet been accepted in many States, possibly because there is some genuine misunderstanding about its objectives but also because it is regarded with suspicion by some Irrigation Departments as implying changes which would entail a significant loss of influence and status on their part. However, an increasing number of administrators and independent commentators are coming to see the merits of its widespread adoption. 1/

The need to work towards the adoption of a more unified and interdisciplinary approach to irrigation management is also coming to be increasingly recognised in several other countries of Asia, notably Malaysia, the Philippines and (more recently) Indonesia. Steps to redress the traditional imbalance between engineers and agriculturalists have been taken in Malaysia through the creation of unified authorities for two of the largest irrigation projects (Muda and Kemubu) and in the Philippines through the recruitment of substantial agricultural expertise into the country's National Irrigation Administration. The Public Works Department (DPC) in Indonesia, historically an exclusively civil engineering organisation, has also recently begun to recruit its own agricultural personnel.

In countries where the traditional patterns of organisation, and the pattern of education and training associated with them are so different from the pattern advocated here, proposals for its adoption will inevitably meet with strong initial resistance from many quarters, particularly Irrigation and Public Works Departments, which will (rightly) see it as an attempt

1/ For evidence of resistance in many Indian States to the adoption of the more radical and far-reaching implications of CAD and a common tendency to misinterpret or distort its original objectives by laying primary, and sometimes exclusive, emphasis on 'on-farm development' construction work, see K. K. Singh, "Alternative Organizational Strategies for Command Area Development", Proceedings of the Commonwealth Workshop on Irrigation Management, Hyderabad, op. cit., esp. pp. 216-217. In many States where CAD organisations have been set up the Irrigation Departments have not been incorporated and continue to operate independently - a total negation of CAD's real objectives (see, e.g., s. Hashim Ali, op. cit., p. 180 and passim on Andra Pradesh; and Niranjana Pant on Bihar, in Some aspects of irrigation administration - a case study of Kosi Project, A.N.S. Institute of Social Studies, Patna, 1979).

to alter the present balance of power. It is recognised that such potential far-reaching structural changes cannot - and should not - be made overnight. In most cases a substantial planning period will be needed after the initial decision to institute such changes in order to ensure that they can be satisfactorily implemented. During this time when a realistically phased programme of implementation is being drawn up, many less radical methods for improving coordination between engineers and agriculturalists can profitably be introduced as interim measures - e.g. through the establishment of committees and work groups, and various kinds of procedural reform. In our view, however, such measures are unlikely to be a sufficient long-term answer to the fundamental problems of inter-agency coordination we have observed in Asia. In the conditions we have described the long-term objective must be full-scale reorganization.

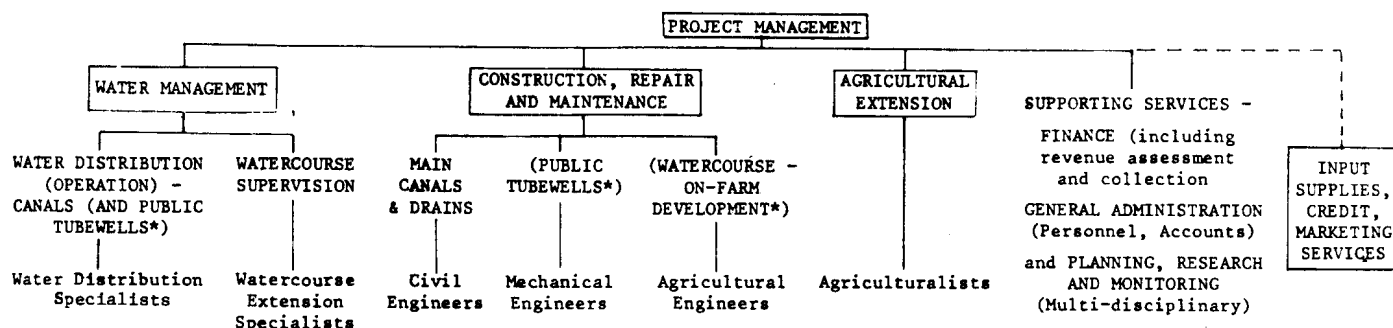
In many countries, the comprehensive adoption of a unified organisational structure for all large-scale irrigation projects would inevitably be a protracted exercise. Among the most important problems likely to arise during the transformation process (which would need to be anticipated as far as possible during the initial planning period) are the suspicion of the Irrigation Departments, already mentioned; the need, in the early stages at least, to second departmental staff to the new unitary organisation, with the result that seconded staff will have divided loyalties between their parent department and the project to which they have been temporarily posted; and the need to find suitable senior administrators to manage such projects, with sufficient knowledge and authority to be capable of coordinating the work of the two principal cadres concerned effectively. This last point recognises the greater administrative difficulties (and administrative costs) associated with the management of unified projects as opposed to single line departments. Nevertheless, we are confident that with determination and good planning all these difficulties can be surmounted and that they will be far outweighed by the eventual advantages of a unified organisational structure.

Favoured form of unified structure. In those conditions where a unified structure is deemed most appropriate, the most favoured pattern of horizontal coordination is that outlined in Table 6.1 (a). Organisation of Area Four Irrigation Project Authorities (Table 6.1. (b)) is similar with the obvious difference that in the latter case agricultural extension is performed by a different organisation with additional responsibilities for the provision of commercial services. Area Two organisation (Table 6.1 [c]) includes the same range of activities, but they are allocated substantially differently. 1/

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- 1/ In the case of new settlement schemes and predominantly cash crop schemes, the same pattern of organisation as shown in Table 6.1. (a) is recommended for the central set of agricultural and water management activities, but the structure would also need to include other relevant activities in addition. Minor modifications may also be needed elsewhere, depending on local circumstances. E.g., in the case of Area Two, with its unusually severe problems of erosion, there seems to be a strong case for including sections concerned with soil conservation and forestry within the CAD organization.

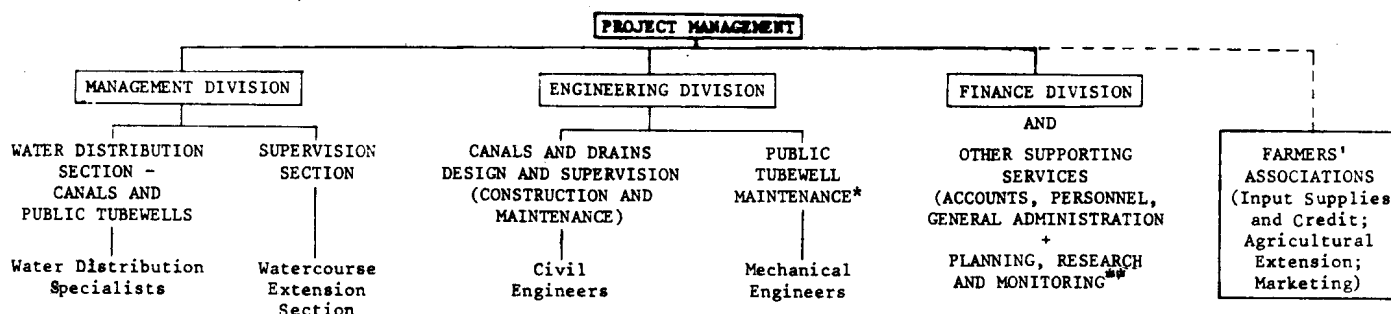
TABLE 6.1 Unified Project Organisation: Horizontal Structure

(a) Preferred Pattern of Differentiation and Coordination of Central Activities



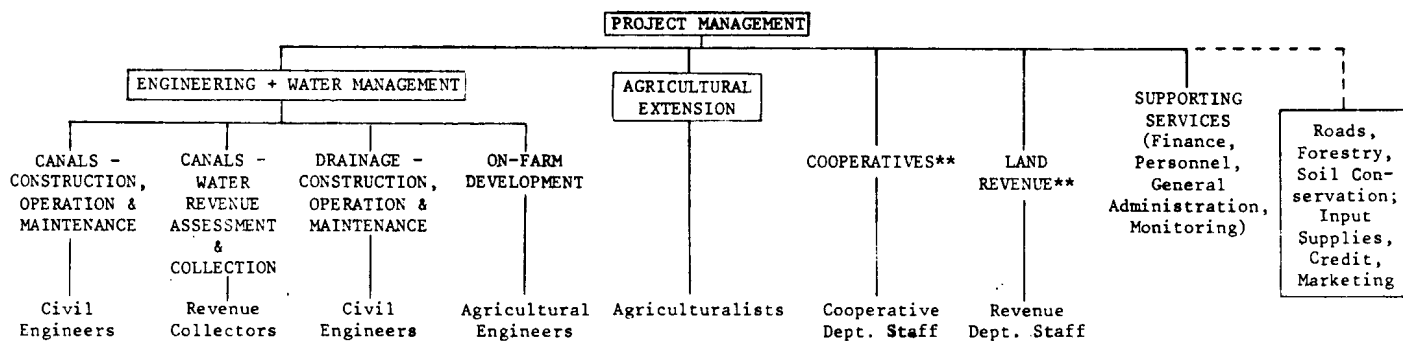
* Where relevant.

(b) Organisation of Activities, Irrigation Associations, Area Four



*This section in fact falls under the Management Division, but its activities are quite distinct from the other two. **Planning, research and monitoring is carried out by a small group working directly under the Chairman.

(c) Organisation of Activities, Area Two



** Activities directly under the control of Project Authority but of relatively little importance--- though the Cooperative staff helps with coordination of input supplies.

———— Direct responsibility - - - - - Coordination with other agencies

The most distinctive features of the proposed pattern of horizontal organization are:

(a) A specialised section with responsibilities for the planning, implementation and monitoring of water distribution on the main delivery system; to be staffed by a cadre of water distribution specialists and quite distinct from the construction, repair and maintenance sections (to be staffed by civil engineers for main canals and drainage; by mechanical engineers for public tubewells, if any; and by agricultural engineers for major 'on-farm development' work, if any).

(a) A separate section, closely associated with the water distribution section, with specific responsibilities for the supervision of watercourse affairs - particularly with regard to extension work on the operation and maintenance of watercourse channels.

(b) A multi-disciplinary planning, research and monitoring unit working closely with the project management.

The case for a separate cadre of water distribution specialists is made later on in this section of the report. The need for an additional cadre for supervising watercourse affairs and for a planning and monitoring unit is discussed in Chapter 8, Sections 4 and 5.

Meanwhile two caveats need to be made in connection with the introduction of the organisational changes proposed. The first is that, in the course of seeking to strengthen the influence of agriculturalists within the unified organization, care should be taken to avoid doing so through measures which would entail a reduction in emphasis on agricultural development work in all other areas. It is a possible danger that the interdisciplinary agency set up for the development of major irrigated areas could turn into an elite organisation and the Agriculture Department be relegated to second-class status, with responsibilities confined to 'residual' activities in the 'marginal' areas of minor irrigation and rainfed agriculture. This would clearly be undesirable in terms of regional equity.

The other caveat applies to area-based agricultural development programmes of all kinds. It has already been argued that there are only a limited number of key activities and essential supporting activities, all directly linked to the agricultural production process, which need to be included under the immediate authority of the command area project management. Other activities which may be of considerable but more indirect interest to the project management (e.g. the development of basic infrastructure and social services) are likely to be best dealt with by liaison through the district administration with the departments concerned. However, it is important to ensure that, when newly-created area-based organisations take over responsibility for the central agricultural development activities, the relative importance of the district administration's work in other fields is not thereby diminished and the effectiveness of its programmes is not impaired.

This point can be illustrated by an example from Chambal, where a hiatus appeared to have been created in the local government system as a result of the decision to convert all Village Level Workers (VLW), previously multi-purpose extension agents working under the local government's Block Development Officer (BDO), into full-time agricultural extension agents employed by the authority. In the absence of new field staff to work under the BDO, it was unclear how the social services previously channelled through the VLW (health, education, etc.) were now supposed to be reaching the villages. ^{1/} The creation of particular anomalies like these must always be guarded against and, in general, careful planning is required to ensure that the right overall balance is maintained between the provision of agricultural and other services.

Medium-sized projects. It must be re-emphasized at this point that the whole of the foregoing argument has been concerned exclusively with large irrigation schemes. But, as has already been noted, the size of the irrigated command area has important implications for horizontal organizational structure. At the far end of the size spectrum, the adoption of a highly integrated 'project' structure of this kind clearly does not apply: small schemes, in which the farmers themselves may often be expected to play a large part in management, are probably best supervised through a process of inter-departmental coordination at the local district level (or its equivalent), unless a large number of them are sufficiently densely concentrated within a particular area to be grouped under a single 'project' management. The organisation and management of small projects is discussed separately in a later section of the paper. ^{1/} The area of greatest uncertainty concerns medium-sized projects which may not be sufficiently large to justify the high overhead costs entailed by separate unified management structures of their own; or conditions such as those in Java (which are typical of much of South-East Asia) where there are numerous medium-sized or relatively small, discontinuous irrigation commands interspersed with unirrigated land. In the latter case the choice appears to rest between greatly strengthened coordination of the existing Departments of Irrigation and Agriculture at the district level, including the establishment of common services in certain fields (e.g. for the collection and analysis of statistics); and the more radical alternative of an area-based pattern of administration in which the units of management would be defined not on the basis of irrigation commands but on the basis of complete watershed and catchment areas.

If such an approach could be adopted - and it might well require still greater structural transformations than the creation of irrigation command organisations - it would have numerous advantages: it would allow the establishment of unified interdisciplinary area agencies; it would normally require agriculturalists to be in overall administrative control; it would encourage equitable treatment of rainfed and irrigated areas; and

^{1/} Chapter 12.

it would make it possible to manage the land and water resources of a particular catchment area as an integrated whole - a matter of particular importance where (as in much of South-East Asia) encroachment by cultivators on higher hill slopes may be causing erosion. 1/

Separate water distribution section. Only Area Four of all the countries visited has so far recognised that water distribution is a specialised skilled activity requiring its own cadre of specialist staff. The section responsible for main system water distribution is headed by graduates whose basic training has been in agricultural or irrigation engineering; and their supporting staff is made up largely of people with technical high school backgrounds who have acquired a detailed knowledge of their job through long experience in the field and in-service training. Elsewhere water distribution (operation) has been combined with maintenance as a function to be carried out by civil engineers, usually with separate sections differentiated on the following pattern:

- (a) canal operation and maintenance;
- (b) public tubewell operation and maintenance (if any); and
- (c) surface drainage operation and maintenance.

The major weakness in this pattern (apart from the absurdity of splitting responsibility for canal and tubewell operation) is that there is no logical reason why the activity of water distribution should be entrusted to civil engineers. Though their training may fit them well for construction, design and maintenance work, the activity of water distribution requires considerable knowledge of agricultural factors (crop-soil-water relationships) and an understanding of farming practices and farmers' problems, none of which has been included in their formal education. 2/ Moreover, there is often little opportunity for them to learn much about these aspects of water distribution on the job, especially when, as often happens, their careers require them to

1/ Arguments in favour of area-based administration can of course be extended to contexts in which any scarce communal natural resource (not necessarily irrigation water) needs to be systematically managed (e.g. soil and water management in erosion-prone rainfed areas; grazing and water management in extensive pastoral areas; forestry, grazing, soil and water management in higher watershed areas). The potential advantages of area organizations (as well as the difficulties of establishing them) increase with the number of different specialist disciplines or Departments that require close coordination.

2/ "The syllabus for civil engineering in many Universities is a generalist course dealing with structures. There is no specialised course after the basic degree course for specialisation in irrigation ... There is no special course on canal operation". (S. Hashim Ali, op. cit., p. 190).

move in and out of O & M work from design and construction work; in the case of Public Works Departments some of the latter work may have no connection with irrigation at all. 1/

These weaknesses are clearly not the fault of the particular civil engineers concerned, many of whom would be the first to admit that they are not specialists in this field. Once again they reflect a failure to adapt from a historical tradition in which the need for detailed knowledge of agricultural factors was much less critical than now, either because the canal systems of that time were deliberately designed to supply water as a means of preventing drought rather than as a means of maximising crop production (as in North India), or because water was then relatively abundant and operational subtleties were unnecessary (as in many of the higher rainfall rice-growing areas of South-East Asia, South India, and Sri Lanka).

For various reasons, the need for reform in the structure and procedures of water distribution has been slower to catch the attention of administrators than the more general need to strengthen coordination between engineers and agriculturalists. However, a growing number of researchers who have studied irrigation management practices in detail have been coming to the conclusion that what is ultimately required is the development of a separate cadre of water distribution specialists. 2/ In most countries such a development is bound to be a long-term objective, since it would require major changes in university curricula as well as in the career structures of graduated engineers. The immediate priority would appear to be the encouragement of greater specialisation within Irrigation Departments (and irrigation wings of command area organisations) by sharpening the distinction between design and construction engineers on the one hand and operation and maintenance engineers on the other; and by providing intensive in-service and on-the-job training to the latter group in order to upgrade their operational capabilities. 3/

One argument that might be made against the separation of responsibility for the operation and maintenance functions is that it would leave

1/ Manuals for operational procedures are often inadequate, if not absent altogether. In an individual engineer's career, operational work may represent a very small proportion of the total. Robert Wade found that in Andhra Pradesh the Executive Engineer in charge of a major canal system had had only 1-1/2 years' operational experience (many years previously) before being posted to his job. Eight Assistant Engineers had had 140 years of service between them, but only eleven years of canal operation (unpublished paper).

2/ E.g., G. Levine and T. Wickham, "Some critical issues in irrigation planning for S.E. Asia", in K.W. Easter and L.R. Martin (eds), Water Resources Problems in Developing Countries, Economic Development Center Bulletin No. 3, University of Wisconsin, 1977; also S. Hashim Ali, op. cit., and Robert Wade (unpublished paper).

3/ This subject is discussed further in Sections 8.1 and 9.2.

the civil engineers (in charge of canal and drainage maintenance) and mechanical engineers (in charge of tubewell maintenance) with work which was insufficiently interesting to provide them with the necessary amount of job satisfaction and incentive. But this would only be true if (as in all the cases studied except Area Four) their responsibilities were confined strictly to maintenance work and were not extended to include a substantial amount of local design and construction work. One of the very impressive features of projects in Area Four is that the physical rehabilitation and upgrading of the irrigation system is not seen as something to be undertaken by an external agency after a long interval of nothing but (often inadequate) routine maintenance: it is seen as a continuous function of the Project Authority itself. 1/ But for such a pattern to be adopted elsewhere would entail willingness on the part of the government agencies concerned to delegate more responsibility for design and construction work to management at the project level, together with the increased provision of recurrent finance that this would entail.

6.3 Vertical relationships: the shape of the hierarchy

The vertical dimension of an organisation's structure is concerned with the shape of the hierarchy of each of its sub-systems and the location of responsibilities at different levels within it. At one end of the spectrum are organisations in which responsibilities are highly centralised, or concentrated towards the top of the hierarchy; at the other end are those in which they are highly decentralised, or dispersed widely throughout the hierarchy. 2/ In the case of agricultural projects or programmes, it may be clearest if two different aspects of vertical structure are considered separately: first, the division of responsibilities between the official project organisation and the farmers; and secondly, the division of responsibilities between different categories of employee within the official

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- 1/ In the Sudan, too, maintenance engineers have had extensive responsibilities for planning and executing additional capital improvement works (communication from C. Swan, Sir A. Gibb and Partners).
- 2/ It is taken as axiomatic that almost any large organisation, and certainly the kind with which we are concerned, must be hierarchical in structure. Simon suggests two reasons why "almost any system of sufficient complexity would have to have the rooms-within-rooms structure that we observe in actual human organisations": "1. Among possible systems of a given size or complexity, hierarchical systems, composed of sub-systems, are the most likely to appear through evolutionary processes 2. Among systems of a given size and complexity, hierarchical systems require much less information transmission among their parts than do other types of systems The reasons for hierarchy go far beyond the need for unity of command or other considerations relating to authority" (H. A. Simon, "Decision Making and Organizational Design", in D.S. Pugh (ed), Organization Theory, pp. 202-203.

organization. However, before either of these aspects is considered in detail, we need to establish the criteria by which a particular vertical structure is to be judged appropriate or inappropriate.

Appropriateness of vertical structure. The first point to be reemphasised (since it often seems to be forgotten by advocates of this or that theory of management organisation) is that there are no a priori reasons for supposing that a single pattern of centralisation or decentralisation of responsibility is necessarily 'the best' in all circumstances. It all depends on what the particular circumstances are (the nature and objectives of the organisation, the economic and social environment, etc.).

In this connection, we would strongly support Leonard in his rejection of arguments that the promotion of agricultural development in developing countries is most likely to be achieved through organisations which are relatively 'organic' (flexible, free-form) in character rather than through ones which are more 'mechanistic' or bureaucratic (with clear-cut lines of authority). There are several factors which point strongly towards the need for a more bureaucratic type of structure in this context. The one which applies most generally to all kinds of agricultural programmes is the relatively stable character of much of the decision-making environment: many of the tasks of management and staff can be organised within a fairly high structured framework of rules and procedures. 1/ This applies with still greater force in the context of irrigation, where much of the work of operation and maintenance is better for being routinized. The fact that management skills are scarce in many developing countries also tends to be a powerful factor in favour of a more bureaucratic structure. In the case of large irrigation schemes, the influences of two further factors combine to operate in the same general direction: their size and the very character of the water distribution process (the need for a controlling, rationing, arbitrating agency; and the inevitable dependence of many lower-level decisions on those taken higher up the system).

These are very broad and general observations, however, and still allow a wide range of organisational choice. The degree of concentration or dispersal of responsibility which is appropriate to an irrigation organisation's objectives varies considerably from one case to another, for reasons explained below. It should also be stressed that we are concerned at this stage of the analysis exclusively with questions relating to the shape or structure of an organisation; questions about the behaviour and attitudes of people within that organisation are a separate issue. In stating that a bureaucratic form of organisation is likely to be the most appropriate for large irrigation schemes, we are not thereby advocating a specific style of administrative behaviour - certainly not behaviour of the 'authoritarian' kind which is commonly attributed to 'mechanistic' organisations by their

1/ As Leonard points out, the arguments of those who favour a more organic structure for agencies concerned with development are based on a non sequitur: "It is false logic to argue that because development agencies are designed to create change, they are working in changing conditions" (op. cit., p. 219).

critics. It is quite wrong to assume that authoritarian behaviour is a necessary consequence of bureaucratic structure, just as it is quite wrong to make the converse assumption that a 'democratic' or participative structure necessarily begets democratic or participative behaviour. 1/ It is no doubt true that the greater the concentration of power in a few hands at the top of an administrative hierarchy, the greater the likelihood of an authoritarian style of management - particularly where the hierarchy is highly stratified and there is little scope for upward mobility from one rank to another. But that is not a good reason for criticising all forms of bureaucratic organisation indiscriminately. As Leonard points out, environments can be found in which "organizations may have settled into informal patterns even more authoritarian, narrow and rigid than a planned and formally established mechanistic structure would be"; and cases have been observed "where formal procedures lead to a lessening of authoritarianism rather than to an increase". 2/

6.3.1 Location of responsibilities: officials and farmers

On irrigation schemes there are two quite separate kinds of reason why it may be appropriate to allocate responsibility between officials and farmers in a particular way. These need to be distinguished if they are not to be a source of confusion.

The first relates to the farmers' 'management capacity', both at the farm and local group levels. 3/ Here one would expect it to be appropriate for the official agency to assume direct responsibility for a relatively large number of functions in cases where farmers' management capacity was low, and to delegate increasing amounts of responsibility to farmers as their agricultural experience and capabilities for group action grew. Such a pattern of evolution would be desirable for a number of reasons, the two most obvious being: (a) administrative convenience; the more functions that can be delegated for the farmers themselves to manage, the lower the cost to government and the greater the body of scarce administrative manpower available for release to uses in other areas; and (b) the stimulation of increased farmers' participation in the decision-making processes which affect their own economic and social development. By this criterion, a pattern of management control which is highly concentrated in official hands would be judged

1/ As the history of rural cooperatives in many developing countries has shown. See, e.g. G. Hunter and J. Jiggins, "Farmer and Community Groups", in ODI, Stimulating Rural Development, 1976, pp. 33 ff.

2/ Leonard, op. cit., pp. 219-220.

3/ For the sake of simplicity, length of experience of irrigated agriculture will be taken here as an indicator of farm-level management capacity, and propensity to cooperate as an indicator of group-level management capacity. This skates over the complexity of the interaction of the many factors involved. These are discussed more fully in Chapters 10 and 11. The purpose here is only to indicate very broadly the sort of criteria by which one aspect of vertical structure should be analysed.

inappropriate where farmers have been engaged in irrigated agriculture for some time and should have been given an opportunity to develop a capacity for group action, either naturally or through training. Conversely, a very decentralised pattern would be inappropriate where farmers' capacity for self-management (at the farm level) or group management (at the village or water-course level) is low.

The second set of factors, which can confuse the issue, are technical ones. There are a number of technical reasons why it may be appropriate for the official agency responsible for the overall management of an irrigation scheme to impose restrictions on farmers' choice of cropping patterns, irrespective of the farmers' management capacities. For example:

- (a) shortage of water may entail restrictions on the proportion of a total command areas permitted to cultivate crops with high water requirements, in the interests of maximising productivity and equity (e.g. rice or sugarcane);
- (b) soil characteristics (and a need to prevent high rates of seepage and/or waterlogging) may determine which crops are permissible in different areas (e.g. rice and 'irrigated dry' crops in 'localization' areas of South India); 1/
- (c) other agronomic considerations may lead to an insistence that farmers cultivate according to a prescribed large-block crop rotation system (e.g. maintenance of soil fertility in the Sudan; or efficiency of pest control on cotton in Egypt).

It is usually fairly easy to determine the conditions under which 'interventionist' policies are desirable on technical grounds. Judgement of farmers' management capacity and of the extent to which responsibilities should be devolved to them is somewhat more difficult. However the basic criteria for assessing appropriateness of organisational structure in this context can be simply illustrated by reference to two strongly contrasting cases of centralised and decentralised management. At the highly centralised end of the spectrum come settlement schemes such as Mwea in Kenya, where the project management had full control of all the following items:

- (a) land tenure (land owned by the State; farmers' tenancies annually renewable and subject to termination if farmers' performance is deemed unsatisfactory);
- (b) choice of crop (monocrop rice only, which is sold through a single marketing channel controlled by the management);
- (c) timing of cultivation operations (official management organises mechanised land preparation according to pre-planned schedules; irrigations to each field are organised by project staff, not the farmers);
- (d) enforcement of irrigation rules.

1/ See pp 57 - 58 above.

Towards the other end of the spectrum comes Taiwan, where a technical factor (water scarcity) has led to the imposition of strict limitations in many areas on farmers' choices of cropping pattern. Nevertheless, farmers' representatives (the leaders of the Small Groups at the 150 ha level) are given very substantial responsibilities in other respects: for example, with regard to operation and maintenance within the watercourse command; local settlement of internal disputes between sharers of the same watercourse; collection of membership fees (water charges); and voting rights concerning the level at which membership fees are to be charged.

In the very early years of the development of a newly-established irrigated settlement scheme, there are particularly strong grounds for arguing that farmers' cultivation and irrigation practices should be closely supervised, since some of them may have had no previous experience of agriculture, let alone irrigated agriculture. This does not necessarily mean that it is always desirable or politically feasible for such an unusual degree of centralised control to be imposed as in Mwea. ^{1/} Close supervision will also be needed where irrigation has been newly introduced to already cultivated areas, though here many of the mechanisms used to strengthen management control on schemes of the Mwea type will certainly not be feasible. However, such management structures, in which the role of the supervising officials is very dominant, must be capable of adaptation over time.

In Taiwan, where farmers' management skills are now of a high order, an evolutionary pattern of institutional development has been followed for over 50 years - from close supervision, control and discipline externally imposed on farmers at the initial stages, leading to increasing self-control and self-discipline by farmers' groups. Institutional form, in terms of allocation of responsibilities between officials and farmers, may therefore have come close to being 'appropriate' at all stages of Taiwan's economic and social development. The most common danger in the case of projects where the mechanisms for management control are particularly powerful in the initial stages (e.g. high degree of insecurity of land tenure, obligation to grow cash crops for sale through a single marketing channel) is that their institutions will fail to develop over time, with consequent social and economic stagnation. Insecurity of tenure tends to become a factor which is particularly inhibiting to change of any kind, since farmers have no long-term interest in investing in their own land. A system commonly used on post-land reform projects whereby farmers are allowed to purchase their land over (say) a 30-year period could provide a similar degree of management control in the initial stages but

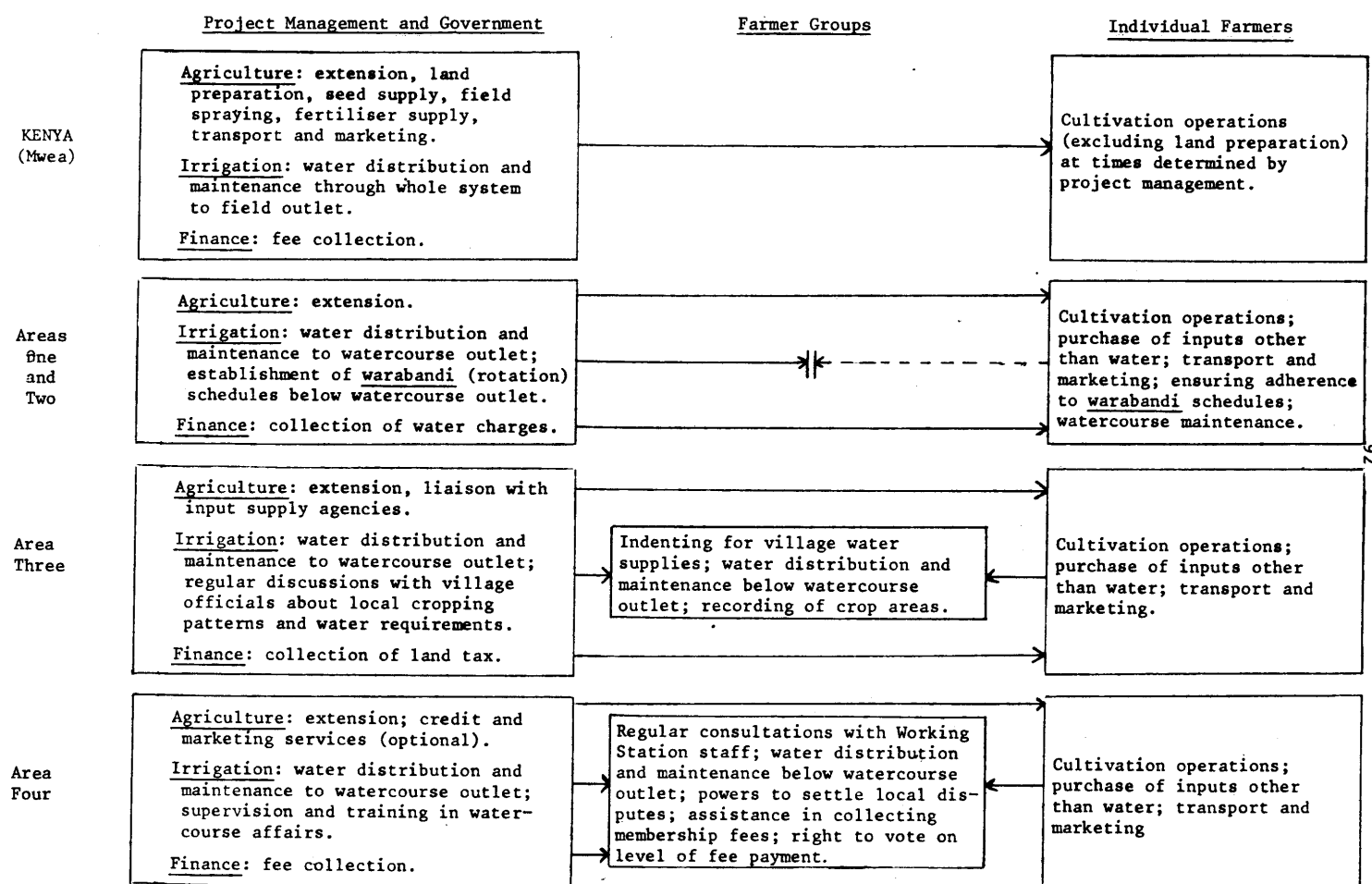
^{1/} There are powerful economic and financial arguments in favour of a project management's exercising a large degree of influence over the production processes in the early years of an irrigation scheme (where possible) in order to produce rapid returns which will help to justify the high capital costs of construction. The experience of Mwea in Kenya has shown that its kind of highly-controlled management system is capable of stimulating high levels of production in a short period.

would have the additional advantage of allowing farmers the opportunity to assume increasing responsibility for various decisions at the farm and community levels. A common verdict on a project like Mwea might therefore be that its structure was in many ways appropriate initially, but that it was in danger of ceasing to be so with the passage of time.

At first sight, Taiwan might seem to provide a less obvious anti-thesis to the highly controlled management system of the Mwea type than the relatively loosely controlled or 'laissez faire' system of administration found in North India and Pakistan, where project management imposes no restrictions on farmers' choices of production patterns apart from those which follow naturally from the availability of water and on obligation to observe the irrigation rules. However, this is an illusion created by the technical factors which make it necessary for project management to control cropping patterns in Taiwan but happen to be absent in North India and Pakistan. If technical factors are excluded from the picture, the way in which responsibilities are divided between officials and farmers in North India will be seen to fall some way outside the path of historical progression from high supervision/low delegation which has been argued to be generally desirable. The traditional Indian pattern of management (which is not confined to the northern systems, but extends to Central and Southern India, where conditions call for cropping pattern control) may be broadly characterised as low supervision/low delegation. As can be seen from the schematic representation of different management patterns shown in Table 6.2, there is a conspicuous gap in the Area One and Two patterns with regard to responsibilities for operation and maintenance at the watercourse level: Irrigation Departments have only very limited responsibilities below the watercourse outlet and, until very recently, no attempt had been made to stimulate the formation of watercourse groups which might be capable of taking on some of the communal responsibilities currently borne by the Small groups in Area Four or the village organizations in Area Three.

It would be too sweeping a generalisation to dismiss the Indian approach as universally inappropriate. During the British colonial period when the older Indian systems were built, there was something of an ideological belief in the virtues of non-interference by government officials below the watercourse outlet, which was connected with the object of minimising opportunities for corruption. Given the main objectives of the systems (maximum protection against famine at minimum cost) and the limited supplies of skilled managerial manpower available at the time, the approach could be seen as logical and justifiable. This is no longer the case, however, now that the objective of promoting agricultural development has become paramount and much more skilled manpower is available for the

TABLE 6.2 Generalized Patterns of Responsibility Distribution: A Comparison Between Selected Projects



purpose. ^{1/} As with some of the older settlement schemes, we have a case here of an organisational structure which has outlived its original purpose and failed to develop with changing circumstances. Indeed the tradition of 'non-intervention below the watercourse' has become so ingrained in many Indian States that even on the newer central and southern projects, where firm control over cropping patterns is demanded for technical reasons, the authorities have been very slow to recognise the need for radical changes in past practices. In most of North India and Pakistan the initial requirement is for closer official supervision, followed by greater delegation of responsibilities to farmer groups once the capacity for communal activity has been developed substantially beyond its present generally low level.

6.3.2 Location of responsibilities within the official organisation

Within each sub-system of the official organisation the appropriateness of the distribution of responsibilities between different categories of staff will again largely depend on two sets of factors. The first relates to the nature of the activity or activities which a particular section of the organisation is expected to carry out and the mix of skills entailed. The second may be generally termed 'administrative capacity' but relates more specifically to the availability of skills of various kinds (e.g. management, technical, 'communication') at different levels of the official hierarchy.

The ways in which the character of different activities affects the pattern of vertical organisation required for them can be illustrated by several examples:

- (a) In the case of any kind of work concerned with farmer training and extension, there is a need (as has just been indicated) for large numbers of junior field staff with skills in communication, though their level of technical knowledge does not have to be high; a relatively small number of higher-level specialists will, however, be needed to provide the necessary back-up of technical knowledge.
- (b) The activity of water distribution will also generally require a similarly patterned mix of skills, though it will

^{1/} In some parts of North India and Pakistan, it could be argued that water distribution within the watercourse has been performed quite well in the absence of formal or informal water users' groups, because water scarcity has put heavy pressure on all individuals to adhere to the official warabandi (rotation) schedules. There may be some truth in this (though it does not apply uniformly throughout the region), but even so there are general problems of watercourse maintenance which could be more easily tackled through group action; and in a part of the world where the natural level of social cohesion is low, the creation of functional watercourse groups would have very far-reaching implications if they could be encouraged to provide the basis for a much wider range of group activities in the future (Report No. 7, pp. 18-20, 82).

also vary in accordance with the technical complexity of the particular distribution method concerned: for example, the system used in Area Three requires a relatively high degree of computing skill at all levels and of communication skills at the lower levels; whereas the proportional distribution system used on the canals of Areas One and Two makes less heavy demands on both skills. In addition, close management control is required on all systems to prevent misallocation of water.

- (c) The maintenance of civil works can normally be done by a large body of relatively unskilled labour, directed and supervised by a small number of senior staff with the appropriate technical skills; ability to communicate with farmers is not necessarily important. More sophisticated canal systems may call for a somewhat different distribution of manpower and skills. Where there is a lot of mechanical maintenance to be done, as with public tubewell, there will be a greater need for qualified technicians at the lower and middle levels of management.
- (d) Certain activities, such as engineering design or planning, research and monitoring work, may require a substantial number of trained specialists, with a fairly small supporting staff of technicians (e.g. draftsmen, field enumerators).

By examining the nature of each activity in the particular context of each irrigation project it is therefore possible to reach a broad conclusion as to the general shape an irrigation organisation should have with regard to the proportion of staff members falling into different skill categories. How much responsibility can usefully and profitably be delegated within that structure from more senior to more junior staff will, however, depend on the level of skills actually attained by the staff in each category. It may be assumed that wherever management skills are a scarce resource there will be advantages to be gained from delegating responsibilities as far as possible, since this will help to reduce the work load of senior staff and to upgrade the capabilities of their subordinates through on-the-job training. There are also likely to be particular advantages in the case of activities whose effective performance depends to a large extent on the feedback of detailed local information from farmers, as in extension or water distribution work. Nevertheless the level of education and experience of junior staff must inevitably place limits on the amount of delegation which is possible and these limits will vary from one situation to another. In the case of Area Four, where living standards and educational levels are substantially higher than in the other countries visited, one would expect it to be feasible for more responsibility to be delegated further down the organisation than elsewhere. One would also expect that with the development of each project over time (as with the division of responsibilities between officials and farmers) it would be possible as well as desirable for senior staff: junior staff

relationships to progress from a pattern of more supervision/less delegation to one of less supervision/more delegation. 1/

In addition to these two sets of factors which, taken together, indicate how responsibility is likely to be best distributed within an organisation, there is a third factor which also affects its vertical structure. This is the size of the geographical area to be managed. Where the project area is small and compact (as, e.g., in the case of the Mwea project - c.5,000 ha.) a simple 'functional' structure will usually be appropriate - i.e. the chief executive is supported by a single set of functional deputies, each with a single line of command which covers the whole project area. But where the area is widely extended long lines of communication between senior and junior staff can be reduced if a 'geographical' structure is adopted: in this case all field or 'line' functions are coordinated in regional offices subordinate to the headquarters office. If effective delegation is made to the regional level, such a structure should not only improve contact between senior and junior staff, but should also help to promote better horizontal coordination at levels below project headquarters. Vertical and horizontal relationships are likely to be further strengthened if field staff at each level below the regional offices are located at the same place within the particular areas for which they are responsible. 2/

From the foregoing discussion it will be apparent that it is somewhat more difficult to reach a firm conclusion about appropriateness of organisational form in the vertical dimension than in the horizontal, since there are more local contingencies (physical, technical, social, economic variables) to be taken into account in the case of each irrigation project. However, the process by which assessments were made in each of the field study areas will be illustrated as briefly as possible. In the interests of simplicity, reference is made only to the central activities of water distribution, system maintenance, agricultural extension and supervision of watercourse affairs. A full evaluation would require other activities to be considered as well. 3/

1/ This would be consistent with the findings of research carried out in Western industrial enterprises, which has shown that appropriate structures and relationships between senior staff and their work force vary according to the latter's 'maturity' (i.e. level of education, willingness and ability to assume responsibility). "Immature, untrained workers need a structured organisation with more individual attention, personal interaction and supervision to develop their talents"; but as their maturity increases, the organisation can and should become more loosely controlled and flexible in character (P. Hersey and K. H. Blanchard, Management of Organizational Behaviour, Prentice Hall, 1972, p. 147).

2/ For a diagrammatic illustration of the difference between functional and geographic organisational structures, see Appendix B.

3/ For further details, see also Table 3.1.

(A) Area One

Required structure: (i) Distribution of skills. Water distribution: canals alone: technically simple but some feedback on local variations in demand desirable; canals-cum-tubewells: technically complex, requiring sophisticated planning and good two-way communications between senior executives and field staff; a need in all cases for close supervision of field staff against misallocation. Maintenance: canals, technically simple; tubewells, technically complex, requiring more skilled field personnel than canal maintenance and quick access by middle management to spare parts. Agricultural extension: moderate to poor farm management practices and large areas to be covered; large numbers of locally resident field staff required. Watercourse supervision: watercourses large and difficult to maintain; substantial field extension staff required. (ii) Distribution of responsibilities. Junior staff not highly educated or accustomed to assuming much responsibility. Need for structured organisation with limited delegation of responsibilities and close supervision and training of Junior staff, both skilled and unskilled. (iii) Scale. Extremely large command area indicates need for 'geographical' structure with regional offices.

Actual structure. Highly stratified organisation, with salary differential of 6:1 between senior project officials and skilled (matriculated) field staff; staff in each stratum selected on the basis of educational qualifications; very limited scope for upward mobility from lower to higher strata. In Irrigation Department, very high proportion of unskilled field staff. Area covered by junior qualified water distribution official (Junior Engineer - diploma-holder) 12,800 ha/50 canal km. Area covered by junior maintenance man - unskilled) 5.6 canal km. Agricultural field assistant: farmer ratio 1:1000-1500 (4200-6300 ha). No watercourse supervision staff. Many regional or areas offices physically located in headquarters town and therefore very long lines of communication to and from the field; most middle management and some junior field staff not resident in own area of work. Decision-making highly centralised: e.g. nearly all water distribution decisions taken by Executive Engineers, disputes about water charges referred to Superintending Engineer, very little financial authority delegated below Executive Engineer level.

Assessment. Within the Irrigation Department the distribution of skills may be appropriate for the activity of canal maintenance but there is an absence of junior field staff with the necessary skills and training for water distribution and watercourse supervision; the provision of sufficiently skilled staff for tubewell maintenance may also have been underestimated. Agricultural field assistants are matriculates with some specialist training but their numbers are inadequate and they are not closely supervised. The general nature of senior staff: junior staff relationships can be characterised as low delegation/low supervision. Though there are good reasons for delegating responsibilities to only a limited extent, the rules specifying responsibility levels could profitably be relaxed more than at present (e.g. to speed up purchases of minor spare parts for tubewell maintenance).

Inadequacy of supervision and training of junior staff may be partly attributable to weaknesses in the management process, but structural weaknesses - particularly the scarcity of genuine regional offices - are also likely to have contributed to poor supervision and poor communications generally. One would also expect that such a rigidly stratified organisational structure, which is an inheritance from the British colonial period, would create problems of motivation among middle-and lower-level staff, whose aspirations are being increasingly raised through the spread of education over time. 1/

(B) Area Two

Required structure: (i) Distribution of skills. Water distribution: need to control extent and location of high water-consuming crops (rice, sugarcane) implies adoption of technically complex distribution methods; need to combat very pronounced head-reach bias implies particularly close supervision and support of junior staff against pressures to misallocate. Maintenance: apart from major rehabilitation work (which makes heavy demands on engineers' design and construction skills), routine maintenance is technically fairly simple but the physical difficulties (heavy soils, weed infestation, etc.) demand a large work-force. Agricultural extension: poor farm management practices and large areas to be covered; large numbers of locally resident field staff required. Watercourse supervision: immediate need for 'on-farm development' design and construction teams; substantial field extension staff required subsequently. (ii) Distribution of responsibilities: Similar to Area One. (iii) Scale. Large command area and very poor road communications indicate need for 'geographical' structure with regional offices.

Actual structure. Irrigation staff structure very similar to Area One but much better agricultural extension coverage. Field assistant: farmer ratio 1:500 (1600 ha). Regional offices located in headquarters town; most middle management resident at headquarters town, not in own area of work. Despite coordination at headquarters level, offices of irrigation and agriculture staff at intermediate and lower levels often located at different places. Decisions on operation and maintenance highly centralised, as in Area One: Executive Engineers have a particularly heavy work load.

Assessment. As in Area One, there is insufficient provision for trained junior field staff for water distribution (the complexities of which have been underestimated) and watercourse supervision. Numbers of maintenance staff may also be inadequate. Within the recently reformed agricultural extension wing, field staff appear almost adequate in numbers; they are closely supervised and provided with training on-the job. By contrast, relationships within the irrigation wing suffer from the same kinds of weaknesses as in Area One for similar reasons.

1/ Cf. p 88 above. Leonard comments on the similar retention of a colonial 'hub-and-wheel pattern of authority' in the administration of agricultural extension staff in Kenya, "although the conditions which first made the pattern rational no longer exist" (Leonard, op. cit., pp. 198-200).

(C) Area Three

Required structure: (i) Distribution of skills. Water distribution: technically complex; most junior field staff have to be in regular contact with farmers' representatives to assess actual water demand and must be capable of calculating differential patterns of water delivery; this implies particularly close supervision by more senior staff, to check against technical errors as well as against pressures to misallocate. Maintenance: technically simple. Agricultural extension: relatively good farm management practices and densely concentrated farming population; field staff; farmer ratio need not be as high as in Areas One and Two. Watercourse supervision communal activity among farmers unusually high; fewer extension staff needed than in Areas One and Two. (ii) Distribution of responsibilities. Less pronounced differences in educational levels between senior and junior staff than in Areas One or Two. Somewhat greater delegation of responsibilities may therefore be desirable, though there is particular need for close supervision of junior staff engaged in water distribution. (iii) Scale. Relatively small total command area; on the other hand, relative complexity of irrigation system, including numerous interdependent small commands, and lack of homogeneity of conditions within project areas indicate the need for regional offices capable of accumulating and acting upon detailed local knowledge.

Actual structure. Somewhat less stratified organisation than in Areas One and Two (salary differential of 3.7:1 between senior project officials and matriculate field staff); shortage of graduates in the past has encouraged some upward mobility of staff with more modest educational qualifications from lower to higher strata, but pattern is likely to change with increasing recruitment of graduates. Matriculate field staff used for water distribution; less skilled staff for maintenance. Area covered by junior qualified water distribution official 700 ha/4.4 canal km. Agricultural field assistant: farmer ratio 1:3200 (600-1000 ha). No watercourse supervision staff. Regional offices at sub-district level (5500 ha) with decentralised locations; sub-district officers and junior staff resident near area of work. Decision-making with regard to water distribution markedly decentralized.

Assessment. On the irrigation side skills and resources appear to be adequate for maintenance (major work is done by outside contractors); but skills in water distribution need to be strengthened at all levels of the organisation; too much responsibility is being delegated to junior field staff and their activities should be more closely monitored and supervised. A new cadre is required for watercourse supervision. Agricultural extension staff numbers are inadequate and the range of skills needs to be extended. Field office structure is appropriate, encouraging close contact between staff of different levels and between junior staff and farmers' representatives.

(d) Area Four

Requirement structure: (i) Distribution of skills. Water distribution: technically complex on the supply side because of need to combine numerous different water sources but demand calculations simplified by controlled pattern of crop rotation; usual need for supervision of field staff against misallocation. Maintenance: canals, technically simple; lining reduces labour requirements, though sedimentation high in some areas; tube-wells, technically complex, requiring relatively skilled field personnel. Agricultural extension: good farm management practices and densely concentrated farming population; need for high field staff: farmer ratio not so pressing as elsewhere. Watercourse supervision: farmers well organised; relatively few extension staff needed. (ii) Distribution of responsibilities. Junior staff well educated. Considerable scope for delegation of responsibilities to lower levels, though water distribution, as always, requires close supervision. (iii) Scale. Total command area not large by Indian standards but, as in Area Three, large number of different water sources and diversity of conditions within project area indicate the need for regional offices.

Actual structure. Although the educational qualifications of staff vary quite widely, this is not a major barrier to upward mobility from lower to higher positions within the administrative hierarchy. Salary differentials of only 1.6:1 between senior project officials and skilled field staff; very little use of unskilled labour (maintenance is done by outside contractors). Area covered by junior water distribution official 350 ha/7.5 canal km. Watercourse supervision carried out by water distribution field staff, under direction of specialist unit. Agricultural field assistant: farmer ratio 1:300. Four regional offices (Management Offices) at 15,000-20,000 ha level; and 43 area offices (Working Stations) at 1500 ha level; staff at all levels resident at or near area of work. Considerable responsibility delegated to Management Offices and Working Stations. Major decisions on water scheduling, maintenance programme and budgeting taken only after consultation with these lower-level field offices. Minor decisions left to field offices. But all decisions subsequently monitorable by headquarters.

Assessment. Skills and resources appear adequate for all activities (given the high level of farmers' competence in watercourse management, a separate field cadre for watercourse supervision is not required). Balance of delegation and supervision appears well judged; very detailed local knowledge would be needed to assess whether still more delegation and flexibility could profitably be introduced. Field office structure is highly beneficial, encouraging closer vertical and horizontal relations between staff and ensuring regular contact between officials and farmers.

Although the method of analysis and assessment is summarised somewhat crudely here, these examples bring out clearly the great importance of a project's structure, vertical as well as horizontal, as an enhancing or constraining influence on the effectiveness of its management process. Serious structural weaknesses create problems for management and staff which can only be surmounted through exceptional talent and initiative. An appropriate structure, on the other hand, is positively conducive to good management.

As with horizontal structure, some of the major weaknesses in vertical structure are unlikely to be remediable in the very short-term. Where there are significant shortfalls in staff numbers and/or skills, the necessary training program will take some time to institute and produce an effect. Questions of salary structures and promotion policies are likely to be particularly intractable. It would rarely be feasible or appropriate for changes to be introduced unilaterally in the case of irrigation projects alone; major decisions at the centre, with far-reaching effects throughout all public sector organizations, would need to be made. And decentralizing the location of the offices of middle management and field staff is seldom an easy task in many areas, where rural population densities are relatively low, villages and rural towns are small, and most amenities are concentrated in the district capitals. ^{1/} Conditions for a decentralized management structure are much more favourable in densely populated rural areas with numerous settlements, good road networks and a wider dispersal of amenities, as in Area Four and most parts of Area Three.

This should not be taken to mean that in projects with unfavourable structures there can be no hope of achieving any significant short-term improvements in management performance. Though the major impediments can only be fully removed through policy changes of a more radical nature, there is nearly always considerable scope for bringing about rapid improvements in senior:junior staff relationships (in terms of a more appropriate balance of delegation and supervision) by means of comparatively modest reforms in management procedures and job specifications. Such reforms are unlikely to arouse much controversy and they can be quite quickly and easily introduced, provided sufficient time and manpower is made available for the detailed research on which they need to be based. The potential for using procedural reform as a means of enhancing management performance will be further illustrated in the chapters that follow.

6.4 The superstructure: organization at the provincial and national levels

Discussion in this chapter has so far been focussed exclusively on organizational structure at the project level and below, largely because that is the level of organisation and management with which this study is most concerned. For the purposes of detailed analysis there are certain advantages in confining the range of discussion in this way, since it is at the project level that executive decisions are taken which directly influence the production process; and as a result the 'project' (whatever its precise organisational form) is the unit most closely analogous to the kind of enterprise to which organisation theorists have given most attention. On the other hand public service enterprises such as irrigation schemes are inevitably dependent to a greater or lesser degree on related organisations at a higher administrative level for financial and other support. It is therefore somewhat artificial and misleading to look at project level

^{1/} According to staff, one of the great disincentives to living and working in the rural villages of Area One was the absence of good schooling in the rural areas.

organisation in isolation from the broader context of organisation at the provincial and/or national levels. A brief review of this broader context will allow some of the issues already discussed to be viewed from a new perspective. And in particular it will help to bring out the extent to which strengths and weaknesses in project level organisation can be reinforced or counteracted by the character and structure of higher level organisations.

Let us consider horizontal structure first. In the case of Area One the administration of irrigated agriculture at the provincial and national levels is structured on the same pattern as at the project level and it therefore helps to reinforce rather than counter tendencies at the project level. In the provinces there are two separate Departments of Irrigation and Agriculture, while at the national level there is an Agriculture Ministry and a separate parastatal agency, which is responsible on its water side for all major irrigation designs and construction work, especially in the field of groundwater development. Interdepartmental coordination at the provincial level is infrequent and poor. The parastatal agency is a powerful and prestigious organisation and, unlike any of the others mentioned, has the virtue of being inter-disciplinary in character in that it includes some agriculturalists and economists in addition to its central core of engineers. On the other hand it has virtually no operational functions (except in pilot research areas) and the sharp division of responsibilities between design and construction (parastatal) and operation and maintenance (Irrigation Departments) has had generally undesirable consequences. Not only has the parastatal agency, with its more abundant resources, attracted some of the Irrigation Departments' best staff away from O & M work, which is seen as essentially maintenance-oriented and mundane, but its planners have no access to field experience and get little feedback about real field problems through the Irrigation Departments. In addition some friction is caused (in the study area at least) as a result of overlaps in the technical research work done by the parastatal agency's monitoring organisation and the provincial Irrigation Department's Land Reclamation Organization.

In Area Three there are separate departments for agriculture and irrigation at the central and provincial levels, as in Area One, the latter coming under a Public Works Department (PWD). The inclusion of irrigation under public works is indicative of the traditional conception of it since colonial times as an activity essentially concerned with design and construction. Until recently therefore the structure at these levels has tended to reinforce the difficulties of coordination between irrigation and agriculture at the project level. However the government has lately been seeking ways of coordinating the activities of Agriculture and the PWD more closely, for example, through the establishment of coordinating committees at central, provincial and district levels. 1/ Steps have also been taken within the

1/ The coordinating programme is primarily concerned with the development and dissemination of new rice varieties and the supply of fertiliser and credit, but it is also concerned with the promotion of improved water management. It is supervised by Agriculture but the PWD is represented on the Committees at all three levels.

Water Resources Directorate of the PWD to convert it from a purely engineering agency into one much more concerned with the operational aspects of irrigation. This has been reflected in various ways, including the establishment of pilot centres for the joint training of irrigation and agricultural field staff and the recruitment of an increasing number of agricultural specialists into the headquarters offices of the PWD. There also appears to be more mobility of engineering personnel between design and construction work and operation work than in Area One.

In Area Two improved coordination has been achieved at the central government level since the decision in 1974 to transfer responsibility for irrigation, previously under a separate Ministry, to the Ministry of Food and Agriculture. However the powers of the centre are limited to advising the States on policy and providing supplementary finance for certain programmes. At the State level, where the major agricultural policy decisions are taken, there continue to be separate Ministries of Irrigation and Agriculture. Where unified Area Development Authorities have been established at the project level (usually as a result of initiatives by central government and substantial financial support from the same source) some of the potential benefits of better coordination between engineers and agriculturalists have not unnaturally tended to be somewhat undermined by the dyarchy at State level. In Area Two an Area Development Department has been set up within the Agriculture Ministry, but at the time of the field study the Irrigation Ministry still had a direct interest in more than half the finance and staff of the project. And the long-term loyalty of staff seconded to the project continued to be divided between two different organisations. A still less satisfactory organisational pattern has been developed in another area, which was the first to establish a separate Area Development Department with its own secretariat and staff. On the face of it that would appear to be a move likely to promote better coordination at the project level. However, despite the efforts of the Area Development Secretary to achieve this, he has been hampered by the continued existence of Departments of Irrigation and Agriculture at the State level and the fact that Area Development Department's responsibilities are largely confined to 'on-farm development' work, with Irrigation retaining sole responsibility for water distribution and maintenance as well as design and construction. The result is a tripartite division of functions at both State and project levels.

Reasons have already been given why it is appropriate that in Area Four responsibilities for irrigation and agriculture should be divided between two agencies at the project level. But whatever may be lost through the absence of closer coordination at this level are strongly compensated for by the very high degree of coordination achieved in the principal planning organisation at the national level. This includes nine sections, each responsible for various aspects of agricultural development. One of these is concerned with Irrigation and Engineering but other sections whose work has immediate relevance to irrigated agriculture are Plant Industry, Rural Economics, Rural Credit, and Farmers' Services. There is also good coordination at the provincial level between the Departments of Agriculture and Reconstruction, of which the latter includes a Provincial Water Conservancy

Agency (PWCA). A small illustration of this is the existence of a joint committee between the PWCA and two bureaux in the Agriculture Ministry which has responsibility for dealing with problems of watershed management.

If we turn to look at vertical relationships between organisations at the project and provincial/central levels, we shall see that in general these tend to show the same tendencies towards more or less centralisation as are to be found within each project level organisation. This can be illustrated by reference to one indicator: the amount of financial responsibility delegated to project level management. In both Area One and Area Three, very little responsibility appears to be delegated from the provincial level. Although Superintending Engineers in Area One and Section Engineers in Area Three are required to prepare and submit budgets, the amount of finance they receive is essentially determined by higher-level government bodies in accordance with predetermined 'yardsticks'. In the Area Three case, only a limited amount of the money spent on maintenance work is actually held at the Section level at all, most of it being retained by the Provincial office for direct payment to contractors. ^{1/} The Area two case offers something of a paradox in that, although a very senior official was appointed as Area Commissioner of the project, he was given remarkably little budgetary discretion; and the engineers' recurrent budgets are determined on the same basis as in Area One. The paradox can be explained in terms of an unresolved conflict between the new Area Development approach favoured by the central government, which implies greater devolution of responsibilities to the project level as well as improved interdepartmental coordination, and the old departmental pattern of administration still in force at the State level, one of whose traditional characteristics has been centralised financial control.

Only in Area Four are very substantial responsibilities delegated to project management - in this case the management of the Project Authorities. This is largely because the Project Authorities, in contrast to the project level organisations in the other three countries visited, depend for much of their revenue directly on farmers' fees. Decisions about desired levels of expenditure (and desired levels of fee assessment) can therefore be taken within the Project Authorities themselves. Insofar as they are dependent on supplementary government finance for some of their capital expenditure, they are also necessarily bound to confer with higher level authorities about their overall budget requirements and allocations. Their relations with these authorities do however appear to be less unequal and one-sided than in the other study areas, with some scope being provided for genuine bargaining and negotiations between the two parties.

^{1/} The Province-Section relationship in Area Three partly reflects the relatively low rank and experience of the Section Engineer as compared with the Superintending Engineer in Areas One and Two. A study of relations between the Provincial Office and the District Engineer in Area Three provides a fairer comparison.

The criteria for appropriateness of organisational structure are the same at the provincial/central levels as at the project level. For policy and planning purposes, close horizontal coordination between Agriculture and Irrigation is clearly desirable. Only Area Four has achieved this, though efforts are being made at the highest levels both in Areas Two and Three to reform and modify long and powerful separatist departmental traditions. Vertically, the amount of responsibility to be delegated should be commensurate with management capacity at the project level. This criterion appears to have been satisfied in Area Four; but in Areas One and Two, too little responsibility seems to be given to senior field officials, who are usually highly qualified within their own disciplines and have extremely large areas under their charge. The case of Area Three may be somewhat different since the country is at present less well endowed with qualified and experienced 'middle management' personnel.

From the cases included in this study there would seem to be a broad tendency for more coordination to go together with more delegation of responsibility; and conversely for more departmental separatism to go together with more centralisation of responsibility. This is not altogether surprising. Where the need has been perceived for a unified organisation at the project level, it automatically follows that highly capable senior managers must be provided to direct and coordinate its numerous activities; and the enlargement of the management function at this level logically calls for a more decentralised pattern of decision-making. On the other hand, where the need for close inter-department coordination is not recognised, there is correspondingly less pressure on any of the departments concerned to modify their natural or traditional preference for centralised decision-making: the official at the project level is conceived not as the manager of an enterprise with a certain degree of autonomy but simply as an executive administrator who occupies one point in a long unbroken line of command from the centre.

7. The project management function and its performance

7.1 The Scope for project management: external limitations

When we move on from the analysis of organisational structure to the analysis of the management process, a logical starting point would seem to be the central directing and coordinating activity of project management. This presents no conceptual difficulties when we are concerned with an organisation like the Authority in Area Two, where the direction of all the key activities and essential supporting activities is the responsibility of a single body of management; or the Project Authority in Area Four, whose management enjoys a considerable degree of financial autonomy and is also required to direct a wide range of activities (even though agricultural extension is not included among them). However, there are obvious problems in defining what is meant by 'project' management in cases such as those of Area One and Area Three where responsibilities for overall management within the study areas concerned are divided between two or more agencies and it is unclear where, if anywhere, the primacy of responsibility lies. Does it lie with the senior Irrigation Department official at the command area level or its equivalent? With the senior Agriculture Department official at the District level? Or with some higher-level generalist coordinator at the District level or above? In the case of Area Three, it could be argued that overall authority lies with the District administrator, since he heads an interdepartmental Irrigation Committee which meets four times a year to discuss major policy issues. However, such a person can hardly be conceived as a 'project manager' on the strength of chairing four meetings a year - a minute part of his total duties. The same applies even more strongly to District administrators in Areas One and Two, who usually concern themselves even less with the details of irrigation management.

In fact, in conditions like these, where there is no horizontally unified management structure and each of the major executive agencies has a different area of jurisdiction, it is a contradiction in terms to talk about 'project management' in the strict sense. Nevertheless, for the purposes of comparative analysis it is necessary to retain some concept of management 'at the project level' (i.e. the level where executive decisions are taken which directly influence the production process). ^{1/} And for those purposes the best approximation to an assessment of the performance of the overall management function is an assessment of the management performance of the most senior executive officials in each of the leading agencies concerned. In the field studies, the main focus was on management within Irrigation Departments, largely because of shortage of time and a special interest in water distribution. But a full evaluation would require similar assessments to be made within Agriculture Departments and other agencies considered to have important management responsibilities at the project level.

Where there is no project structure, one of the inevitable consequences is that the range of activities which senior officials have to direct

^{1/} Cf. p 100.

and coordinate is relatively specialised and limited. There are two other ways in which the capacity of senior officials to act as 'managers' in the true sense of the word may be further diminished. The first is through a limitation in the powers delegated to them to exercise control over the recruitment, promotion or salaries of their subordinate staff, or to raise revenue directly from their clients. The second is through a failure on the part of government to provide them with the other necessary 'management tools' which have already been referred to, namely:

- consistent and clearly-defined overall objectives
- the basic framework of a management system (procedures, job descriptions, information systems)
- adequate resources (recurrent finance, staffing, equipment)
- an effective legal framework. 1/

Where there are significant limitations in all the three respects mentioned here, there are good grounds for concluding the senior officials at the project level are scarcely in a position to act as managers at all. They are not expected, nor indeed are they able, to take major initiatives of their own with regard to local programming and planning. They can only be relatively passive 'administrators', with briefs that require them to be, at best, reliable executors of policies and programmes determined for them at a higher level. 2/

Substantial limitation over project managers' powers - particularly with regard to staffing and finance - is a common feature of public service enterprises everywhere. Many senior managers in Western enterprises are not free to recruit or promote staff, set salary levels, raise finance or purchase beyond certain set limits. However, they do have a right to participate in these decision-making processes and are accountable for implementing what

1/ Cf. p 63.

2/ The terms 'management' and 'administration' are similarly contrasted by Belshaw: "The word 'management' refers to the process of decision-taking affecting an institution's achievement of its specified objectives.... The emphasis is on purposive achievement in conditions of change and uncertainty.... The achievement orientation of management necessitates deliberate planning activities. This may be compared with the merely pragmatic approach of dealing with circumstances as they arise, which frequently characterises the system maintenance or survival behaviour associated with administrative approaches." (D.G.R. Belshaw, "Improving management procedures for agricultural development", op.cit., pp. 414-415.)

has been decided. In all the study areas except Area Four, project managers not only have virtually no freedom of action in these fields, but even their scope for participation in major decisions is severely limited. Staff are appointed and transferred by higher departmental authorities; rules about promotion and salary scales, which reward academic qualifications and long service rather than field experience and performance, are rigidly applied; and, although project officials are responsible for raising revenue from water users (at rates determined by the government), none of it is retained locally and they are wholly dependent on government for all recurrent finance. 1/

In Area Four the powers and accountability of senior project officials are limited to some degree but much less than in the other three cases. Project Authority Chairmen may appoint their own staff on assuming office (subject to approval by higher authorities). Considerable importance is attached to field experience and performance in a remarkably open and flexible promotion system. Decisions are reached through a well-articulated process of participation and accountability which extends to the lowest levels of the organisation. And, although salary scales are fixed externally, bonuses can be issued to staff who have performed well if revenue exceeds expenditure. The main key to the greater autonomy of the managers of these projects is the source of their finance. A large proportion comes directly from members' fees and precisely how much the project can raise from this source depends a great deal on the efficiency and resourcefulness of its own staff. The significance of this factor is discussed further in the final section of this chapter. Although it would be quite unrealistic to expect many other countries to switch to a similar pattern of administration, at least in the short term, in view of the radical attitudinal and institutional changes required, there are nevertheless possible ways of trying to apply the lessons of Area Four experience adaptively elsewhere; some of these are also explored.

The central section of the chapter is, however, devoted to a review of the performance of the overall management function in the four study areas, in which the limitations of the managers' powers in each case are accepted as given and the main focus of attention is on the adequacy of their management systems. The question of how well overall objectives have been defined is also considered, since this is a closely associated issue. Reference is also

1/ It is interesting in this connection to note that A. T. Mosher, in his booklet Serving Agriculture as an Administrator (A.D.C., New York, 1975), includes among the "essential tasks" of the administrator several over which senior officials at project level usually have no influence: e.g. assigning tasks to subordinate employees in accordance with their aptitudes; deciding who is to authorise which expenditures; selecting and promoting employees. He adds, however, that these tasks "vary greatly in how free an administrator is to deal with them within his own organisation" and he counsels him "not to become too frustrated with those that are beyond his control" (p. 33). Advice that is easier to give than apply, perhaps.

made to the adequacy of resources and the effectiveness of the legal framework, but detailed discussion of these issues is left to a later stage. This is because the definition of what is adequate in terms of resources depends to a significant extent on the quality of the management system and other factors, including the legal framework. And legal issues are easiest discussed in the specific context of the management of water distribution. 1/

7.2 Assessment of project management performance

A confident and authoritative assessment of the performance of the project management function in each of the case study areas would require much more detailed evaluations than we were able to carry out. The object here is simply to illustrate the kind of criteria by which assessment can be made, to present indicators of quality of performance in particular cases and to suggest probable reasons for successes and shortcomings. These fairly broad assessments are supported by more detailed analyses of the performance of specialist activities in the next chapter.

The function of the manager has been described as "getting things done through other people." His chief tasks may be summarised as:

- setting objectives
- directing the (annual) planning and budgeting processes
- directing the detailed programming of work (work scheduling)
- supervising the execution of the agreed programme
- monitoring project performance against objectives and staff performance against agreed work targets (and using the results as the basis for the next round of planning and programming). 2/

1/ The legal aspects of water distribution are discussed more fully in Section 8.1, and the adequacy of resources in Section 9.4.

2/ The management cycle follows the same pattern as the planning cycle and is best regarded as part of it. The steps in the full planning cycle have been listed by Belshaw as: Plan formulation (identification of alternatives - design - appraisal - selection) - Plan implementation (budgeting - programming - monitoring - adjusting) - Plan evaluation (data collection - data processing - policy analyses) - Plan reformulation. Belshaw stresses the need to regard planning and management as a continuous process, with management an essential part of planning and planning an essential part of management. He rejects the common failure to do so (both by planners and the administrators) as "seriously counter-productive, both for practice and the policy sciences" (D.G.R. Belshaw, op.cit., pp. 418, 420).

It was observed in the course of the field studies that certain weaknesses in the performance of these tasks tended to recur. Many of these have also been noted elsewhere. Actual performance in each study area will therefore be assessed with reference to these common weaknesses. The main object of the assessment will be to judge the extent to which the level of performance achieved is determined by the quality of the management system (combined with other important factors outside the control of senior project level officials) rather than by the personal characteristics of the officials themselves. The common weaknesses selected for scrutiny are:

- (a) Confused objectives.
- (b) Absence of a systematic, participative approach to budgeting and work programming (common consequences in the latter case including uneven and sometimes impossible workload allocations; and unclear divisions of responsibility).
- (c) 'Departmentalism': i.e. lack of consultation between specialist units in the planning and execution of work programmes.
- (d) Authoritarian behaviour towards subordinates in the execution of the work programme; 1/ and
- (e) Inadequacies in the monitoring of project and staff performance (particularly the absence of appropriate criteria for assessment; and poorly designed systems for the feedback, quality control and analysis of information from the field). 2/

1/ There is a large body of evidence from studies of management in Western enterprises that authoritarian behaviour towards subordinate staff tends to be counter-productive. Leonard emphasises, however, that the important factor here is not authoritarianism in some absolute sense, but what the subordinate regards as being authoritarian. Leonard found that in Kenya junior extension staff tended to respond well to their seniors if their attitudes towards them were less authoritarian than they expected, though these might still be regarded as fairly authoritarian attitudes by US standards (op.cit., pp. 86-94).

2/ Compare the list of principal weaknesses identified by Chambers and Belshaw in their studies of rural management at the District level in East Africa, which their Programming and Implementation Management (PIM) system was designed to counteract: (i) authoritarian management; (ii) wasteful meetings, (iii) excessive reports, (iv) departmentalism, (v) top-down targetry (i.e. lower level staff take no part in setting their own work targets), (vi) inadequate resources (e.g. housing, transport, funds for petrol etc), and (vii) ineffective work programming (R. Chambers, Managing Rural Development, pp. 37-38). We have treated inadequate resources as a separate constraint, though of course one of the advantages of a good management system is that it helps to identify the preise extent of this constraint. We have little evidence of 'wasteful meetings'. Otherwise the lists are very similar.

(A) Area One

Objectives: Clear objectives had been laid down in official manuals for the management of the Canal Groups but they were old and in need of revision, both in the light of new developments in agricultural technology and of the introduction of tubewells into the canal command in the 1960s. No clear objectives had been specified for the operation of tubewells, with the result that priorities were often seen by Tubewell Group staff to lie with the tubewells' drainage function (lowering the watertable) and with their maintenance rather than with the function of water distribution.

Budgeting/programming: On the canal side, budgeting and programming of maintenance work was carried out in considerable detail, with some delegation of responsibilities (largely to the Executive and Assistant Engineer levels) for the calculation of estimates and the keeping of accounts. Canal operations were relatively straightforward and routine and could mostly be done in accordance with rules specified in the manuals. The need for detailed planning and programming only arose in fresh groundwater areas, where the provisions for planning the conjunctive use of canals and tubewells were extremely inadequate. In contrast to another project in the country, there appeared to be no programme of regular workshop servicing of tubewells, though routine field tests were carried out monthly; procedures for getting even minor mechanical repairs done were inflexible and time-consuming. The programming of the work of agricultural extension staff also compared very unfavourably with the above-mentioned project, where detailed procedures had been established (and set down in an Operational Manual) on lines similar to the Benor Training and Visit system. 1/

Even where fairly detailed budgeting and programming was carried out in accordance with established procedures or guidelines, there appeared to be little consultation with junior staff. There was also a tendency for senior staff - especially at the Executive Engineer level - to have to carry excessively large work loads.

Departmentalism: The fragmentation of responsibilities between different agencies, even within the Irrigation Department, has already been commented on. There was no significant contact, for planning or any other purposes, between Irrigation and Agriculture; nor were there any signs of a desire for closer contact. Relations between senior staff in the different Irrigation Groups were much more cordial but the procedures which would have been required to ensure a collaborative approach where it was most required (canal and tubewell water distribution) were absent.

Management style: The attitudes of senior officials towards their subordinates was judged to be fairly authoritarian, though not unusually so

1/ Agricultural Extension, The Training and Visit System, D. Benor and J.Q. Harrison, World Bank, May 1977.

in comparison with normal local practice. Visits by senior officials to the field for purposes of consultation and/or supervision appeared to be limited, no doubt partly because of inadequate transport and low petrol allowances.

Monitoring and information systems: (a) Project performance.

On the canal side, detailed procedures had been established for collecting and recording information on actual patterns of water distribution and on cropping intensities; but, although a large volume of potentially useful information was collected, there was little attempt to analyse it systematically for the purposes of measuring performance against targets - largely because there was no requirement from higher authorities to do so. Maintenance work and expenditure were, however, quite closely monitored. On the tubewell side, the quality of data on project performance was much more unreliable particularly with regard to water distribution. The main emphasis in the monitoring of tubewells was in any case on their technical aspects (watertable levels, water quality, pump characteristics); the sort of questions which would have been needed for an accurate assessment of water distribution patterns and their effect on productivity and equity were not asked.

(b) Staff performance. Control and supervision of junior staff were notably poor in the Tubewell Group, where major deficiencies in operation and maintenance were attributable to opportunism or carelessness on the part of tubewell operators. Information on the performance of each operator could have been collected through the monthly inspections made of their records, but the inspections were not used primarily for this purpose. If they had had more detailed evidence (coupled with clearer objectives and carefully devised procedures), senior officials would have been in a better position to exercise more effective management control. As it was, with only a generalized knowledge of poor performance and the reasons for it, they were ill-equipped to discipline the fairly strongly unionised operators. This contributed to the generally low level of morale within the Tubewell Group.

Assessment. Management performance was conspicuously poor in those agencies which lacked detailed procedures. When planners had devoted time and care to the preparation of operational manuals performance was conspicuously better than where there were no manuals at all although senior officials in all cases had similar professional qualifications and capabilities. Inadequacy of resources (finance, maintenance equipment, transport) was also an important factor, affecting the performance of all agencies in the Area One study area adversely, the Tubewell Group in particular. Legal sanctions against mis-appropriation of water also needed to be strengthened. Other weaknesses were of secondary importance. Although their formal training had given them access only to technical skills, senior Irrigation Department officials had also had considerable opportunity to acquire certain relevant management skills in the field (the Department being concerned exclusively with O & M work and not with major design and construction) there was no doubt scope for the acquisition of further management skills through formal training, but this could only be expected to have a significant impact where a sound management system was already in situ. In the absence of changes in established policies with regard to salaries and promotion, the best opportunities for improving the motivation of senior officials also lay in the strengthening of the management system.

(B) Area Two:

Objectives: Although written manuals had not been prepared, clear overall objectives had been established with regard to most aspects of the new development programme, as a result of regular discussions with State Government and World Bank officials. There was, however, an unresolved ambiguity about the long-term objectives with regard to water distribution: whether water should be allocated proportionally throughout the command area, leaving it to farmers to make a free choice of cropping patterns, or differentially, in accordance with differently designated crop zones.

Budgeting/programming: The major reconstruction and rehabilitation programme was budgeted and programmed in detail. Careful planning and programming were also conspicuous features of the 'on-farm development' (ofd) and agricultural extension programmes, the latter being based on the Benor Training and Visit principles. Procedures used for water distribution were crude, however, and senior irrigation officials, who were also heavily engaged in design and construction work, had little time in which to consider possible improvements.

Most major decisions with regard to budgeting and programming appeared to be taken without consultation with junior staff; though considerable care was taken to ensure that the workloads of junior agricultural extension staff were realistic and manageable. As in Area One, most senior staff had very heavy workloads; this was particularly so in the case of the Executive Engineers in charge of the three main Canal Groups, who had to deal with numerous disputes about misappropriation of water in addition to their construction and routine O & M responsibilities.

Departmentalism: The unified structure automatically helped to bring officials from different departments and disciplines in closer contact; and certain activities, particularly the planning of the ofd programme, demanded the collaboration of many different groups (agricultural extensionists, land and water revenue officials, cooperative officials, loan officers and agricultural engineers). The Area Development Commissioner also insisted that members of the irrigation and cooperative sections attend all fortnightly training and debriefing meetings for extension staff in order to deal with questions about water supplies and other input requirements.

Management style: The attitudes of senior irrigation officials towards their subordinates was often fairly authoritarian, but possibly somewhat less so than in a typical non-Area Development context. On the agricultural extension side, junior staff were provided with an unusual amount of paternalist support, with the Project Director (Extension) attending many of their training meetings in the field, often accompanied by the Commissioner himself.

Monitoring and information systems: (a) Project performance. In order to satisfy the investors, the technical and financial aspects of the large World Bank-assisted capital works programme were being monitored systematically and in detail. A new internal evaluation unit was also established

for the purpose of charting the progress of the project in terms of increased agricultural output, with particular emphasis being paid to the impact of the agricultural extension and of programmes. In addition, the Extension wing was attempting to monitor its own performance by comparing changes in production levels over time, as well as the results of its own 'contact' and 'follower' farmers on the one hand and 'non-follower' farmers on the other. No system had yet been introduced for monitoring water distribution, however, even though abundant and detailed information was being collected (on canal discharges and cropping intensities) which could have been used for the purpose. The canal engineers could be excused for neglecting this aspect of their work because of shortage of time, but it was unclear why the evaluation unit was not required to pay more attention to the monitoring of water distribution patterns and their effects on production. 1/

(b) Staff performance. Only the Extension wing had a formal control and feedback system which enabled senior officials to make regular objective assessments of the performance of junior field staff (by reference to their field diaries and through discussions at debriefing sessions). Management control in the other wings was less systematised, but the pressure imposed on the Irrigation and on farm development (ofd) wings by their time-bound construction programmes ensured that senior officials spent much of their time in the field. They were therefore in close touch with their subordinates and able to make fairly frequent first-hand assessments of their performance.

Assessment. At the time of the field study the ofd and drainage programmes had barely started and canal construction work had not yet reached a stage at which a controlled and systematic approach to water distribution was possible. It was therefore too early, except in the case of the agricultural extension programme, to attempt a judgement of the quality of management by its results in terms of increased production. It was nevertheless possible to judge the adequacy of the management framework and the caliber of senior officials by careful analysis of the manner in which the various programmes were being implemented. Because of its technical complexities, this was by far the most difficult of all the four study areas to manage. Our judgement was that, although the general calibre of senior officials was very high, both in terms of managerial and technical skills and of motivation, the progress achieved would have been impossible without an organisational structure which was well adapted to the tasks required and some very systematic preliminary planning which (despite a failure to give due priority to water distribution) set clear objectives and work targets. 2/ Moreover, in the area of most

1/ Some detailed analysis has now been undertaken by an external agency, however.

2/ The reason why the skills of senior officials were unusually high was no doubt that they had been carefully selected for a difficult and very important project. Many of them were also well motivated because success in this project was likely to be noticed and could therefore be expected to help their future career prospects. Some senior officials also had special salary increments as a result of their attachment to the project.

conspicuous success - agricultural extension - very little would probably have been achieved if traditional and inefficient extension methods had not been replaced by a new carefully planned management system; the degree of success was greatly enhanced by the dedication of the Project Manager (Extension) and the personal support of the Commissioner, as well as significant additions to staff numbers, but these factors were nevertheless secondary to the existence of the system itself. Many of the canal engineers were also highly intelligent, hard-working and strongly motivated; but much less progress was possible with regard to the improvement of water distribution, partly because of technical difficulties, ineffective legislation and inadequate resources (manpower and recurrent finance in particular), but also because no master plan for cropping and water distribution had been prepared and there was therefore no firm basis on which to develop a detailed management system. This weakness was perceived by some of the canal engineers, but since it proceeded from an imbalance in the overall plan it would have been impossible for the project management to make the necessary strategic adjustments on its own without external concurrence and assistance. It is still not too late for such adjustments to be made.

(c) Area Three

Objectives: In the absence of any written statements of objectives for the project, there was considerable confusion among irrigation field staff as to whether priority should be given in the dry season to the cultivation of 'irrigated dry' crops or rice. In the interests of productivity and equity, senior irrigation officials at central and provincial government levels strongly favoured the former; but uncertainty was created at the project level by directives from other government departments stressing the importance of increasing rice production.

Budgeting/programming: In the irrigation section office most of the budgeting appeared to be of a fairly routine nature, with many major decisions about the maintenance programme being taken at higher levels (Division and Province). For water distribution, however, there were very detailed and elaborate procedures based on formulae developed during the Dutch colonial period, designed to produce a pattern of allocation which was highly responsive to local variations in demand. There were doubts concerning some of the technical assumptions about water requirements on which these formulae were based, but it was also clear that there were shortcomings in the ways in which they were being applied in practice. Water distribution in the dry season was markedly inequitable both among different canal systems within the project area and among different watercourses. In the case of the agricultural extension programme, evidence of uneven coverage between villages suggested an absence of systematic programming.

The method of water distribution required frequent consultation between senior and junior staff. Substantial responsibilities were delegated to the latter - possibly more than they had the technical skills to manage. The complexity of the planning, implementation and monitoring of water distribution of all levels of the canal network was such that both senior officials and subordinate staff were likely to have heavy workloads if they carried out all their tasks in accordance with requirements.

Departmentalism: There was little formal contact between irrigation and agricultural extension officials at the project level except at quarterly meetings chaired by the District administration. All the initiatives to promote closer cooperation between the staff of the two departments (e.g. the joint programmes of junior irrigation and agricultural field staff in pilot areas) came from the central and provincial levels, not from the project/district level.

Management style: The attitudes of senior irrigation officials towards their subordinates were not markedly authoritarian, reflecting a typical local preference for behaviour which is likely to promote consensus and avoid discord.

Monitoring and information systems: (a) Project performance. Extremely detailed information on actual patterns of water distribution was reported back from junior field staff up the line to the section engineer. However, one of the weaknesses of the system as a means of monitoring project performance was that, partly because of the confusion about overall objectives, the criteria by which quality of performance could have been judged were not clearly specified. Much of the information gathered, instead of being scrutinised analytically as a tool of management, was merely compiled and aggregated (often with substantial inaccuracies) for inclusion in routine reports on past performance.

(b) Staff performance. The same information also provided senior officials with an excellent opportunity to exercise close control over the activities of junior staff. However, despite clear evidence of anomalies in the pattern of water distribution and/or mistakes in computation, there was little evidence that action was being taken to remedy these faults.

Assessment. Senior officials at the project level were hampered by unclear advice from above as to what their broad objectives should be. The procedures for planning, implementing and monitoring water distribution could also be criticised on points of detail. Nevertheless, an inherently attractive - but undeniably complex - management system was in existence. The failure of senior project officials to employ this system satisfactorily was ascribable, at least in part, to lack of sufficient management skill; to what extent there was also lack of motivation to apply the prescribed procedures was unclear. Resources of finance, staff and equipment appeared adequate; legal powers to prosecute for the misappropriation of water appeared limited.

(D) Area Four

Objectives: The Project Authority's own broad objectives - increasing agricultural production through a minimisation of water losses and an equitable pattern of water distribution - were clear and unambiguous and appeared to be well understood by field staff. There was some doubt as to whether the right priorities were being given to rice and 'irrigated dry' crops, but decisions on this issue were largely determined by higher-level government authorities (through their policies with regard to the designation of cropping patterns and support prices), and not by the Authority itself.

Budgeting/programming: In the preparation of the annual budget various alternative allocations of expenditure were considered before the final decision was reached by the Chairman in consultation with his divisional heads. The budgeting process also involved the participation of junior staff; for example, the maintenance budget was built up through the submission of plans from the 43 Working Stations which were passed upwards, after checking and processing by the Management Offices, to the Authority's headquarters.

Very detailed procedures had also been developed for the planning, implementation and monitoring of water distribution; the initial plans were again based on calculations prepared by each Working Station. Programmes for the supervision and training of farmers' Small Groups and for fee assessment and collection were also carefully planned in accordance with agreed time-tables, with responsibilities at each level of the organisation clearly defined. There were numerous manuals detailing how each major activity was to be performed.

Departmentalism: Although contact with the Farmers' Associations (responsible for agricultural extension, input supplies and marketing services) was infrequent, the Authority's procedures ensured that there was close internal collaboration between the main specialist divisions, especially Management (water distribution), Engineering (construction and maintenance) and Finance. For example, all divisions were required to argue their case as to how the annual budget should be allocated among different categories of expenditure (new construction, maintenance, staff salaries, Small Group activities, research etc.).

Management style: Despite the strongly hierarchical shape of the project organisation (Headquarters - Management Offices - Working Stations - Small Groups), there was a marked absence of stratification among staff by rank or social status. This was a reflection of the relatively egalitarian character of the local society in general and also of the unusual opportunities offered within the Authority for upward mobility of junior staff on the basis of experience and in-service training; as a result many of the most senior officials had the same kinds of educational and social background as their subordinates. This was in sharp contrast to the other case study areas.

Monitoring and information systems: (a) Project performance. Very detailed information was gathered on various aspects of project performance, particularly revenue and expenditure, levels of fee collection and water distribution patterns. It was felt, however, that better measurements of productivity and equity could have been achieved if more accurate estimates had been made of crop yields as well as cropped areas. The main reason for the Authority's failure to measure levels of crop production more closely was that this would have entailed duplication of the work of other data-collecting agencies; but since their data related to Township Council areas, not to Project areas, accurate assessment of Project Authority performance was impossible. The lack of information within the Authority about the number of characteristics of private wells in the area also appeared to be a weakness.

(b) Staff performance. The detailed information collected on the performance of particular activities (water distribution, maintenance, fee collection, etc.) also provided a good basis for management control over junior staff. Reports on the performance of each member of staff are also studied annually by a Review Committee, headed by the General Manager.

Assessment. Apart from a few relatively minor weaknesses which were remediable without great difficulty, the project had an excellent management system. Its basic framework was very similar to those in use in other projects in the country and owed its character to careful higher-level planning; but it had also been adapted in points of detail to the particular requirements of the project area and even of small localities within it. The planning as well as the execution of most activities required the involvement of junior staff; and the detail of the procedures, particularly for water distribution, ensured that junior staff were able to carry out fairly complex and responsible tasks, providing them automatically with training in the field, in addition to any further in-service training they were able to receive outside the project. This in turn contributed to the ability of some junior water distribution staff, even if they lacked high academic qualifications, to rise to positions of considerable responsibility within the organisation and perform their tasks more than competently. Apart from the management system, other unusual advantages already referred to contributed significantly to the high levels of management performance achieved - particularly the Project Authority's flexible policies with regard to promotion and the degree of financial autonomy which stemmed from its substantial dependence on membership fees (and allowed it, among other things, to reward its staff with bonuses for good performance). The management system was nevertheless of key importance, not only encouraging timeliness and efficiency in the performance of tasks but also enhancing the skill and job satisfaction of Project staff at all levels. Strong legal powers helped to reinforce its effectiveness.

In view of the large number of other variables which inevitably have some influence on the performance of the overall management function (such as organisational structure, financial and manpower resources, material incentives, legal framework), there are obviously difficulties in trying to isolate the degree of influence specifically attributable to the quality of a management system. However, this review strongly suggests that it is a very significant factor indeed. The point is most strikingly illustrated by experience in Pakistan and India, where agencies with well-designed management systems could be seen to be performing markedly better than other agencies without them, even though they had very similar characteristics in most other respects. It also seems clear that in all the study areas, with the possible exception of Area Three, the quality of the management system has been much more significant in explaining the level of performance achieved than the personal characteristics of the managers themselves.

The other point which is brought out strongly in the review is that in all the study areas except Area Four present management systems are far from satisfactory and there is great scope and need for procedural reform. In one subproject case, there can hardly be said to be a management system at

all; and there is a real danger here that the virtual absence of properly planned operating procedures and effective methods of management control will lead to further serious declines in performance and morale unless strong counter-measures are taken quickly. 1/

7.3 Problems of incentive in public service institutions

One of the great advantages and attractions of procedural reform is that, compared with many other remedial measures which may also seem highly desirable, it is fairly uncontroversial and offers the possibility of significant improvements in performance within a relatively short period of time. 2/ Much more controversy surrounds the subject of material incentives, though it is clearly one which has a very important bearing on the quality of management performance. As we have seen, senior officials at the project level in all the study areas except Area Four have little or no influence over the salaries or promotion prospects of their subordinate staff. Moreover, they themselves are subject to the same inflexible rules. The point has already been made that significant changes of government policy in this field will generally be extremely difficult to achieve. 3/ This does not mean that continuous efforts should not be made to seek possible ways of introducing change, particularly through the development of more flexible policies with regard to the promotion of staff from one recruitment category or stratum to another, in conjunction with better facilities for in-service training. But it does add further force to the arguments in favour of giving very high priority to procedural reform in view of its capacity, even in the absence of greater material incentives, to induce substantial improvements in performance, thereby automatically increasing job satisfaction and motivation at all levels of the organisation.

Meanwhile, there is one other line of thought concerning the improvement of incentives and motivation which may be worth pursuing further. It was argued earlier that the main factor which accounted for the relative autonomy of the managers in Area Four and their ability to reward staff with bonuses for performance was the source of finance. Instead of being fully dependent on government funds for their recurrent budgets the Project Authorities have to rely heavily on the fees they receive from their members. The most important consequence of this is that the project management and staff are made accountable to their clients and are put under pressure to provide them with good service. If they do not, fees will be more difficult to recover, total revenue will decline and cuts may have to be made in staff numbers and salaries. On the other hand, if they provide good service, fee recoveries are likely to be high (since the farmer members recognise that high levels of payment will increase the likelihood of good service in the future)

1/ For more on the importance of procedures in the particular context of water distribution, see Section 8.1.

2/ Cf. R. Chambers, Managing Rural Development, p. 27. This point is elaborated further in Chapter 9.

3/ Cf. p 100.

and management will be able to reward itself and staff members with bonuses as well as having additional funds for reinvestment. This series of self-sustaining links (client satisfaction - higher fee payment - higher rewards to staff - good service - client satisfaction) was still more powerful before the temporary suspension of the Project Representative Committees in 1975, when members were able to vote through their representatives how high their membership fees should be. But even now there is still a strong sense among project staff that they are accountable to their clients; and the farmers in turn are conscious that service is likely to decline if the returns from fees are not maintained at a high level. Farmers also show particular interest in supporting high fees if they can be assured that a substantial proportion will be ploughed back for reinvestment in their own immediate localities. 1/

By contrast, in the other study areas there is no direct link between the level of performance a project organisation achieves and its financial rewards. The amount of funds it receives from government is determined first by the total availability of funds for recurrent expenditure within the irrigation and agriculture sectors and then by reference to 'yardsticks' which reflect the government's view as to the relative need of different projects. 2/ The quality of its performance, either in terms of increased agricultural production or in its recovery of revenue through water charges or other forms of taxation, is largely immaterial; indeed, consistently bad performance may sometimes oblige government to increase its financial support. Such a system removes any incentive for farmers to pay their water charges, since the proceeds go to general revenue and have no direct effect on the level of local reinvestment; and there is similarly no incentive to management and staff to improve their service to farmers in the expectation that this will lead to an increase in their finances. Further side-effects are likely to include a hardening of farmers' opposition to any attempts to raise water charges; a reluctance on their part to pay water charges and other taxes, even at the very low rates usually prevailing; and a consequent need for tax-collecting staff to be correspondingly more coercive in their relations with farmers.

These conclusions are in line with Drucker's explanation for the frequently poor performances of public service institutions in comparison with competitive commercial business enterprises. He argues that the crucial difference between the two types of organization is not that the latter are necessarily more 'businesslike' (i.e. in their control of costs), are led by better managers or have more tangible objectives; the difference lies in the

1/ One Small Group leader in Area Four questioned in an interview about the present level of fees (on which an upper limit has been imposed by government), said that they were too low and should be raised - an unthinkable reaction in any of the other study areas.

2/ The yardstick for each project is based on formulae which usually take some account of its relative 'difficulty' (e.g. with regard to soils, numbers of structures, etc.).

way the service institution is paid. Businesses, other than monopolies, are paid for satisfying the customer; satisfaction of the customer therefore becomes the basis for assuring good performance and results. On the other hand, service institutions, which are usually monopolies, are paid out of a budget allocation: "revenues are allocated from a general revenue stream which is not tied to what they are doing but is obtained by tax, levy or tribute". And as a result they tend to become misdirected in their objectives; performance and results are no longer measured by reference to the criterion of customer satisfaction; instead the main concern is to satisfy government and to find ways of persuading it to increase its budget. 1/

Accepting the budget payment may often be necessary or desirable, Drucker goes on to consider how these unproductive tendencies could be most effectively counteracted. His first point is to underline the extreme importance of providing service institutions with powerful management systems which will direct them towards the achievement of their intended objectives and help resist their common tendencies to be deflected elsewhere. But his principal conclusion is that an element of competitiveness should be introduced among service institutions, either through the direct encouragement of the operation of market forces within the public sector or through the establishment of performance standards against which competing institutions can be differentially rewarded by government.

Drucker emphasises that this recommendation is made not on the grounds that there is intrinsic virtue in free enterprise but because there is abundant evidence that such an approach tends to produce better performance and results within the public sector, both in socialist and mixed economies. The principles of 'socialist competition', advocated by the Marxist economist Oskar Lange in the 1930s, in which public ownership of the means of production is combined with the operation of competitive and autonomous businesses under their own managements, have been successfully applied in Yugoslavia. In practice, too, considerable competition has been encouraged among communes in China as a result of a policy of low agricultural taxation; this has given each commune additional incentive to increase output with a view to increasing the amount of finance available for local reinvestment and disbursement among its members. Despite their very different political ideologies, some of the management principles being applied in China and Taiwan appear strikingly similar. What has been recognised in all these cases is that the introduction of an element of competition allows resources to be allocated on the basis of performance and results and that this in turn stimulates accountability and further improvements in performance: "being paid for performance and results directs towards performance and results." 2/

1/ P. Drucker, Management, pp. 131-146.

2/ Drucker, op. cit., pp. 148ff. On China's agricultural taxation policies, see e.g. P. Schran, "The organization of agricultural development in the Chinese People's Republic", in Hunter et al (eds), Policy and Practice in Rural Development, p. 90.

There is little doubt that the performance of many irrigation project organisations could be significantly improved if ways could be found of introducing some degree of competitiveness in place of the present inflexible methods of budget allocation. Even very modest changes in current practice could be helpful; and indeed it would be unrealistic in most cases to try to aim initially at anything more. Several possibilities might be considered, perhaps on an experimental basis in the first instance. All would involve the need to establish easily measurable indicators of performance against which financial increments could be earned; these might be based on levels of production and/or equity of water distribution or on levels of recovery of water charges. The government could then provide each project with an annual payment consisting of two elements; a flat-rate grant, which would take into account the particular characteristics and needs of the project area concerned, and a variable bonus whose level would depend on the project's performance in the previous year. Alternatively, each project might be allowed to retain a certain percentage of the revenue it had raised in accordance with its performance, to which the flat-rate grant could be added. Some of the bonus could be earmarked for reinvestment, some for local increments in staff salaries.

Apart from the anticipated attraction which such a strategy would have for project managers, staff and farmers, government should also stand to benefit greatly from increases in revenue if (as might be expected) project managements began to lobby for higher water charges and farmers themselves began to perceive that such a policy could have its advantages. If such a coincidence of interest could be achieved, major opportunities might be opened up for overcoming another of the chronic problems of irrigation management - scarcity of funds for recurrent investment.

Another consequence of such a policy is that it would provide a climate in which farmers would be inclined to take a greater interest in the way that project finance was being spent. For example, their motivation could be expected to increase in favour of forming representative bodies at the project level which would have responsibilities for discussing expenditure plans with the official management, monitoring the results and thereby introducing greater accountability. Under present policies, attempts to create 'participative' institutions for such a purpose would be much less likely to meet with genuine enthusiasm because the farmers, recognising that they had made no direct contribution to what was being spent, would feel that they had nothing of their own at stake.

8. The Performance of Specialized Activities

8.1 Water Distribution

Wherever water is scarce in relation to farmers' demand for it, the most important of all the functions of irrigation project management is to ensure that it is efficiently and fairly distributed. It is only if the main water distribution system is well operated that many other important management objectives can be satisfactorily realized (such as 'on-farm management' work, improved watercourse and farm-level water management, the introduction of higher water charges); and it is only then that high returns can be obtained from agricultural extension advice and the increased application of their complementary inputs. However, the poor quality of water distribution in most developing countries and the dimensions of the management reforms required to remedy it have tended to be consistently underestimated, if not ignored, by both developing country governments and external aid agencies.

Abundant evidence has been amassed in recent studies of irrigation management performance in different parts of the Third World which shows that serious deficiencies in water distribution practices are widespread. Further reference is made to this evidence at the end of the Section. It is fully supported by conclusions made in the field study areas, which are presented below. It was apparent in all cases except Area Four that a substantial proportion of the overall inefficiency of water use could be attributed to shortcomings in main system management. It was also clear that management reforms would be capable of generating major benefits not only in terms of increased productivity but also of increased equity, both between locations and in favor of the poorer farmers. In accordance with a familiar pattern frequently observed elsewhere, head-reach farmers were being allowed to take far more than their proportional share of available water on the canal systems of Areas Two and Three, leaving tail-reach farmers with insufficient and unpredictable supplies. And in the Area One major irregularities occurred in the operation of tubewells, from which large farmers (and the tubewell operators) appeared to be the principal beneficiaries.^{1/} It has already been argued that wherever water supplies to the tail of a main canal system are scarce and uncertain, the principal losers will also be the poorer, smaller farmers.^{2/}

There are two main dimensions to the management of water distribution, each with a distinctly different set of problems and potential remedies associated with it. The first dimension is essentially technical and is concerned with the quality of the water distribution methods used and their capacity to meet the objective of securing the best possible match between expected supply and demand. The second is social and political, and concerns the capacity and will of irrigation officials to ration water equitably and resist pressures from often influential farmers to misallocate it. Good water distribution thus requires not only a high order of technical

^{1/} cf. Section 3.2.

^{2/} See Section 2.1.

skill but also a management system which will make it rational for irrigation officials to deny extra water to the more powerful and better located, despite the unpopularity and loss of 'unofficial income' this will almost inevitably entail. Another essential requirement for good water distribution, both in its technical and socio-political dimensions, is a well-designed two-way information system between irrigation officials and farmers.

The following discussion is divided into three parts: a review of performance from the technical perspective (with some introductory comments on technical design); a review of performance from the social and political perspective; and a conclusion assessment of the potential for improving current performance, together with an outline of the kind of remedial action needed to realize this potential.

Planning and Design for Water Distribution. Reference has already been made to the vital importance of good planning and design of irrigation systems as a prerequisite to their good management. The first basic requirements for good water distribution are (a) that the planners should select distribution techniques for use on the irrigation project concerned which will be appropriate to the expected cropping patterns within the command area; and (b) that the irrigation system should be designed in such a way that these techniques can be applied without undue difficulty. Too often these requirements are not fulfilled. It appears to be in only rare cases that planners have given really detailed thought to alternative techniques of distribution before deciding on the basic design of the irrigation system;^{1/} and there is strong evidence to suggest that in Area Two the original design of the canal system was based on assumptions that water would be distributed according to techniques which were entirely inappropriate to the requirements of future cropping patterns.^{2/} Moreover, even in cases where the selected distribution techniques are more appropriate than in Area Two, there are not uncommonly defects in system design which make it difficult, sometimes impossible, to implement them satisfactorily. The absence of adequate measuring devices is a frequent defect - it was found in Area Three - but one that is fairly easily remediable. Much more serious are the kinds of defects found on systems such as those already referred to in Andhra Pradesh: mistakes in the design of canal capacities and, in particular, insufficient control structures to make it possible to allocate water in accordance with the intended plan.^{3/}

^{1/} See, e.g. G. Levine, "Management Components in Irrigation System Design and Operation", Agricultural Administration, 4.1, p. 43.

^{2/} See p 54 fn1.

^{3/} Pp 58 - 59.

No attempt will be made here to enter detailed argument about the virtues of different techniques of water distribution under different local conditions, since it is a subject of great technical complexity. One thing that seems clear, however, is that it requires much more detailed field research, the object of which should be to develop an optimal method for each homogeneous agro-climatic region. At present there appears to be a strong tendency for planners to adhere rather uncritically to old traditions and formulae without considering the possibility of developing better alternatives. This has led in India to the illogicality of each State applying the same formulae throughout its land area irrespective of agro-climatic variations; so that a formula which is appropriate to one area can get applied in another where it is entirely inappropriate, and conversely different formulae can be applied in different parts of the same agro-climatic area simply because they belong to two different States. Another example of variations in distribution methods which may owe more to tradition than logic can be found in Indonesia, where the differential pasten system is used almost exclusively in East Java, whereas in most parts of Central Java a simple proportional system is used. In Area One there was a failure to explore the possibilities of introducing much greater flexibility into water distribution methods following the installation of public tubewells; instead, a rigid pattern of scheduling was adopted whose choice may have been strongly influenced by the irrigation engineers' long habit of operating very inflexible canal systems. Even in Area Four, there seemed to be grounds for suggesting that the time might have come for considering the introduction of somewhat greater flexibility into otherwise excellently planned water distribution methods, in order to encourage greater responsiveness to observed local variations in actual water use.

The question as to what standard of irrigation design may be considered 'adequate' for the purpose of subsequent management is another one which cannot be discussed at length here, though it is clearly extremely important that it should always be asked before the final design decisions are taken in any new project. As always, adequacy is a relative concept, varying according to the circumstances of each particular case. Minimum requirements in all cases would presumably include measuring devices down to the last control structure; sufficient control structures and watercourse channels to ensure that targeted levels of efficiency in water distribution can be achieved; and adequate canal capacities. But there may be very substantial differences between the levels of control which are feasible or acceptable under different conditions.

For example, on the Muda project in Malaysia, where the micro-topography is relatively flat, it was consciously decided on cost-benefit grounds that in the initial years of the project, when water supplies were abundant in relation to demand, no tertiary canalization would be installed and that water would be conveyed from the secondary canals in a crude field-to-field manner over a distance of about 1 mile. It was considered that the additional investment required for 'on-farm development' could profitably be delayed until such time as increases in farmers' management

capacities and cropping intensities made better water control essential.^{1/} These technical standards, though adequate in Muda, were clearly inadequate in the much more uneven micro-topography and difficult soils of Area Two and other projects like it. Nevertheless, the same principles could have been applied there; and this would have entailed the provision of substantially more structures and channels in order to achieve the same minimum acceptable level of water distribution efficiency as in Muda.

The principles employed in Muda - a graduated approach to technical improvement, with good management being used as a substitute for investment in technology wherever possible - are essentially the same as those which have been followed in area Four over a long period of time. Though the present level of technology in Area Four is substantially more capital-intensive and sophisticated than that to be found on most developing country systems (with its control structures down to the 50 ha level and its very high percentage of canal lining), the process of change has been a gradually incremental one. The main determinants of the pace of change have been the increasing scarcity of water supplies in relation to demand and increasing costs of labor.

The technical dimension: procedures, skills and resources. Water distribution, like all the other principal activities of management, contains three sequential sub-activities: planning, implementation and monitoring. The kinds of procedures, skills and resources needed to perform them vary somewhat from project to project, depending on its design characteristics and the methods of distribution being used. These distinctive features are discussed later but the following points apply generally on any irrigation system.

Planning: Detailed information is needed both about expected water availability and expected water demand within the forthcoming crop season. Important sources of information on the supply side include rainfall and river flow records, together with records of reservoir levels and watertable levels where these apply, both past and present. For the calculations of expected demand, data are required on expected cropping patterns and cropping calendars, backed by as detailed empirically-based information as possible about different levels of crop water requirements under different soil conditions. On the basis of the data available from both sides a plan can then be prepared with the object of harmonizing the patterns of supply and demand as closely as possible. This should be made known to farmers before the new season starts.

The skills required for the collection and analysis of supply information are essentially those of the hydrologist. Accurate measuring facilities and reliable field staff are also needed; the latter imply the need for effective monitoring and control as well as the provision of appropriate training. The maintenance of historical records in a form which can be easily analyzed is important. There is no need for any

^{1/} See, e.g. "The Muda Irrigation Project", Case study paper to Commonwealth Workshop on Irrigation Management, Hyderabad, October 1978.

agricultural knowledge nor for any communication with farmers or other members of the general public. The skills required on the demand side are substantially different, however. The best source of information on farmers' cropping intentions are interviews (through field staff) with farmers themselves, though records of past decisions can also be helpful. The reliability of the formulae with regard to crop water requirements depends on the quality of prior research carried out by agronomists and soil scientists. Well-designed forms and procedures are of great assistance throughout the planning process. The proposed plan should be discussed with agriculturalists and farmers' representatives and, after agreement, be communicated to farmers throughout the project area.^{1/}

Implementation: Officials require continuing information (through the same channels as during the planning stage) about actual patterns of supply and demand throughout the crop season, so that necessary adjustments can be made. Accurate measuring facilities and a reliable system of communication between headquarters, section offices and field staff are essential. Implications for changes in operating procedures as a result of variations in supply levels (e.g. with regard to frequency of canal rotation) should be specified in detail in operational manuals and should be clearly understood by operating staff at all levels. Farmers should be regularly informed about actual discharges, the deviation from planned levels, and the reasons for the deviation; further research is required into the kinds of information system likely to be most reliable and effective for this purpose. ^{2/} Pressures from farmers on field staff to misallocate water should be firmly resisted and cases of misappropriation should be reported and investigated immediately.

Monitoring: In addition to daily reports of gauge readings from field staff, weekly or ten-daily reports need to be compiled on water supply patterns so that senior officials can see how closely instructions have been followed. Periodic reports on cropping patterns and intensities are also required, particularly with a view to checking on equity of water distribution. Inaccuracies or falsifications in field staff's records are best guarded against by random spot checks by their superiors and an effective information system to farmers which enables them to do their own

^{1/} For more on the role of farmers in planning water distribution, see Section 10.1.

^{2/} Possible techniques include the use of boards at the head of each watercourse outlet on which planned and actual discharge levels can be recorded, as in Area Three, and simple measuring devices at the watercourse outlet which can easily be interpreted by farmers. Ideally, however, farmers require a method of discovering what supplies are going to other parts of the project area (particularly upstream of their own outlet) so that they can check on the accuracy of information given them by officials. Such information is at present much easier for farmers to obtain on small systems than large ones.

monitoring. At the end of each crop season, senior officials should monitor overall project performance against objectives: a data collection system is therefore required which will provide them with accurate information about levels of crop production in different parts of the irrigated area as well as patterns of water distribution, environmental factors (waterlogging, salinity, etc.) and cost. In areas where substantial use is being made of groundwater through private wells, the extent of farmers' dependence on this water, as opposed to that supplied by the project, should be known.

The most important points which emerge from this general review of the technical dimensions of water distribution appear to be these:

- (a) Most aspects of the decision-making process are amenable to a high degree of routinization. Most eventualities can be foreseen and detailed procedures can therefore be developed to help officials and staff to deal with them.
- (b) The computation required for good planning, implementation and monitoring is detailed and often complex. This can clearly be greatly assisted by simple and relevant data-collection systems (with well-designed records and forms) and methods of analysis.
- (c) Senior officials need to have an understanding of agricultural production processes as well as skills in the fields of engineering and hydrology. The reliability of their estimates of crop water requirements also depends crucially on the quality of the formulae developed for them by higher-level planners - and this depends in turn on the extent to which the formulae are based on detailed agricultural research work.
- (d) A carefully-designed two-way information system is required which will enable farmers (i) to supply main system operators with necessary information about local variations in demand; (ii) to receive regular predictions about the quantity and timing of water deliveries; (iii) to monitor the pattern of actual supplies; and (iv) to address formal complaints to officials about perceived shortcomings.

Before assessing the actual performance of water distribution in the study areas, a few additional points need to be made about the particular implications for management which follow from certain differences in basic design and methods of distribution. These seem to be the most important:

1. Basic design

- (a) With or without storage. On systems supplied by major reservoirs there is clearly much greater scope for flexibility of operation

than on those which are dependent only on run-of-the-river supplies. The range of possible permutations in the pattern of supply and demand is also correspondingly increased, and this in turn increases the complexity and responsibility of the senior distribution officials' task (as well as that of higher level planners).

(b) With and without groundwater. Groundwater again allows much greater flexibility of operation. Where well operation is in the hands of the government agency, the conjunctive use of canal and groundwater calls for sophisticated overall planning, together with day-to-day procedures which allow for maximum permissible flexibility in well operation in response to local variations in demand. Where the wells are privately owned, the canal agency must be well informed about their patterns of operation, both in order to adjust its own plans and operations accordingly and also in order to be able to assess the quality of its own performance accurately.

2. Distribution methods. 1/

(c) Proportional/differential. There are considerable differences in the management requirements of systems where water is supposed to be distributed on the basis of strict proportionality, with the choice of cropping left entirely to the farmer and systems with a differential pattern of distribution - i.e. one in which different areas require different supply patterns as a result of controls imposed on farmers' cropping choices.^{2/} Planning and operation are relatively straightforward in the case of proportional distribution; in particular, fewer trained field staff are required. With differential distribution, there are (or should be) many more control structures to operate; and where the object of cropping control is - as so often - to prevent farmers in certain areas from growing popular but highly water-demanding crops (rice, sugarcane), the need for intensive supervision over farmers and field staff against misallocation is likely to be increased.

(d) Responsiveness/unresponsiveness to local variations in demand. Professional systems are not intended to be highly responsive to local variations in demand, and many, such as those in N. India and Pakistan, lack the necessary control structures to permit much responsiveness. Even so, under good management some flexibility may often be possible (and reasonably detailed knowledge of planned and actual crop requirements is still needed in order to vary supplies in accordance with different stages of crop maturity). Many differential systems also operate proportionally within each differentiated crop zone (e.g. Taiwan, or the South Indian 'localization' system). Others, however, are specifically designed to respond to local variations in demand:

1/ In all the study areas, provision was made for the rotation of water supplies within the main canal distribution system (among distributaries, minors, etc.)

2/ Cf. p 88.

e.g. the group indenting pasten system in East Java, or the methods of individual indenting used in certain parts of India - Maharashtra, Madhya Pradesh, West Bengal.^{1/} In these cases much more detailed and frequent assessments of planned and actual cropping patterns need to be obtained by field staff in consultation with farmers. There is also a danger that, unless very closely supervised, such methods will lead to markedly inequitable distribution, both in favor of better placed locations and larger farmers.

A further very important factor affecting the complexity of the water distribution officials' task is of course the rainfall pattern. The more abundant, frequent and/or unpredictable the pattern of rainfall within a particular area, the greater the need for operational skills and good information systems. This factor combines with several others to indicate a requirement for substantially higher levels of 'management intensity' in semi-humid areas than in semi-arid ones.

Detailed assessments of the performance of the water distribution function will not be given here, but an attempt will however be made to weigh up the apparent relative importance of procedures, skills and resources as influences on the quality of performance in each case, with the focus still largely on the technical aspect of water distribution.

Area One. Procedures: For canal operation, there were detailed written procedures; demand factors played little or no part in planning and implementation, the method of distribution being one of strict proportionality; obligation to communicate with farmers was confined to advance notification about canal closures and rotation dates but this was not always provided; and there were procedures for monitoring cropping intensities as indicators of productivity and equity, but again these were not always applied or followed up. Only crude unwritten guidelines were available for operating tubewells in conjunction with canals. These encouraged very inflexible distribution schedules, with little correspondence to actual variations in seasonal demand; there were no formal procedures for discussing operational matters with farmers. Skills: Senior officials of the Irrigation Department (mostly civil engineers, with some mechanical engineers on the tubewell side) had traditionally little need to concern themselves with demand questions in connection with canal operation; but with the advent of tubewell irrigation, their lack of formal training in agricultural matters became a much more serious limitation. There was a marked preference among most engineers on both the canal and tubewells sides for maintenance work rather than water distribution. Junior staff on the canal side (below the level of Junior Engineer) were unskilled and had only maintenance responsibilities; on the tubewell side, however, the tubewell operators (among the most junior staff members) had substantial operational responsibilities for which they were inadequately trained. Resources: Manpower for canal operation appeared adequate. Under conditions of good management, it would probably have been adequate for tubewell operation too, though there was a need for a full-time

^{1/} R. Wade, "Water accounting in irrigation projects: a technique from Maharashtra", Economic and Political Weekly, 11 (35), August 28, 1976.

unit for planning and programming conjunctive water use. But under prevailing conditions of tubewell operation and maintenance (poor maintenance being a significant cause of poor operation) insufficient transport, for supervisory purposes, and insufficient maintenance equipment could both be regarded as significant constraints.

Area Two. Procedures. The procedures for canal operation assumed a wide homogeneity of cropping pattern throughout the command area; in Area Two, cropping pattern and intensities diverged widely between localities but there was no provision in the procedures for adjusting supplies to these variations in demand (although they were identifiable from revenue officials' records). Assumptions about crop water requirements were not based on research carried out under local soil conditions. Information to and from farmers was conveyed through ad hoc fortnightly discussions between irrigation and agricultural staff. Skills: Senior officials of the Irrigation Department were civil engineers, some of them with more experience of managing canals than others. Those who showed most skill in handling the numerous problems that arose had developed a personal interest in water distribution and were committed to the project's success; but they had had no specialist training in the subject and their style tended to be improvisatory rather than systematic. Resources. Manpower was almost certainly inadequate, because of the heavy demands being made on the time of senior officials and operating staff by design and construction work.

Area Three. Procedures. The system of distribution required very detailed information to be collected on both supply and demand aspects. For the latter purposes, junior staff were expected to meet farmers' representatives every ten days to estimate actual cropping patterns within each watercourse command and allocate available supplies accordingly. However, two weaknesses noted were that (a) crop area figures were only rough estimates and were capable of manipulation and (b) some of the assumptions about water requirements on which the system were based appeared suspect. In certain pilot areas boards had been set up at watercourse outlets to record planned and actual discharges, but only a few were being regularly filled by operating staff. Skills: Some Section Engineers have engineering diplomas, but the majority have only secondary high-school diplomas; while most sub-section heads have only lower secondary or primary education. There is thus a shortage of trained technical personnel. Most senior staff have, however, had long field experience, many of them being promoted from the ranks. Analysis of records suggested that junior field staff did not always understand the complex procedures and computations they were required to perform. Resources: Manpower numbers were sufficient. Transport was not a major problem because of the short distances to be covered.

Area Four. Procedures. Detailed procedures for planning, implementation and monitoring were in use, involving regular discussions with farmers' representatives (Small Group leaders). Crop water requirement formulae were based on detailed field experiments previously carried out by agricultural research organizations; water rotation intervals were also based on the results of national experiments, which were adapted to local circumstances. Skills: The majority of field staff and senior officials have

had Vocational Middle School educations. Most officials have worked their way up from the ranks; many come from farming backgrounds and hence have a good rapport with farmers. Most of their practical and technical knowledge has been acquired by learning on the job and through regular in-service training. The Chief Engineer (in charge of maintenance as well as operation) is an Agricultural Engineer. Resources: Manpower numbers were considered by senior project officials to be sufficient. Transport was not a problem because of the short distances to be covered.

Four important points emerge from this review:

- (a) Operating procedures. In two of the areas studied (Area One for the purposes of conjunctive use of surface and groundwater; and Area Two) very little thought had been given by planners to the design of appropriate operating procedures and there were consequently major opportunities for improvement. In Area Three, there were technical flaws in a theoretically attractive water distribution method which required investigation; it was also questionable whether, with the present management skills available, the potential advantages of the system (a high degree of responsiveness to local demand) were not being outweighed by its disadvantages in practice (the need for complex computation and close supervision of staff to minimize inequitable distribution). In the case of the Area One canals, detailed procedures had been in existence for a long time but some were only perfunctorily applied.
- (b) Farmers' information systems. Despite the limited scope for flexibility of operation in Area Two and Area One (non-tubewell areas) more frequent feedback of information on local variations in demand would have been feasible and probably valuable; it was certainly required in Area One. In Area Three, where there was a need for particularly frequent feedback, the necessary procedures for it existed but the quality of the information collected was often suspect. Similarly there was little attempt to provide farmers with regular information about expected supplies in Areas One or Two; in Area Three information was both needed and provided much more frequently and efforts were being made to introduce a system which might have helped farmers to monitor flows to their own watercourses. In none of the project areas, however, including Area Four, was there any formal means whereby farmers on one watercourse could easily learn about supply patterns elsewhere on the main delivery system.
- (c) Skills. In the system which was by far the best operated (Area Four) the officials responsible for directing field operations were not civil engineering graduates but technical high school diplomates with long field experience, an understanding of agricultural matters and substantial on-the-job and in-service training. The excellent distribution procedures, whose development had depended heavily on high quality agricultural research, not only reduced the need for people with high academic qualifications but also provided the basic framework for staff training.

- (d) Resources. Staff members were judged to be adequate in Areas Three and Four and almost certainly inadequate in Area Two. There were some doubts about optimal staff requirements in Area One because present operating procedures are clearly unsatisfactory and it is uncertain what additional resources, if any (apart from a planning unit), might be needed to run a new system satisfactorily.^{1/}

The social and political dimension: motivation, legal back-up and accountability. The crude importance of the social and political aspects of water distribution has already been underlined. The essential problem is as follows. Where water is a scarce, and therefore highly valued, resource it must be rationed. As a result, farmers are likely to exert strong pressure on irrigation staff to let them have more water than they are entitled to. If staff comply, a pattern will develop of excessive extraction of water at the head, with only meager supplies reaching the tail. Resistance to pressure will make staff unpopular, and involve them in additional work, but compliance often brings substantial financial rewards from the farmers concerned. It follows that an unusually powerful combination of measures is required to make irrigation field staff and their superiors strongly motivated to resist pressure - the motivation of agricultural extension staff, for example, is a relatively easy matter.^{2/} At least three elements seem to be needed for the purpose: (i) a management system within the official irrigation organization which will reward individual members if they perform in the social interest and penalize them if they do not; (ii) legislation which enables quick punishment to be given to those farmers who steal water; and (iii) as a counterweight against possible abuses of power by officials and a reinforcement of their internal management system, measures which will oblige them to be accountable to their clients, particularly to the most vulnerable of them - the tail-enders and small farmers: one means of promoting accountability might be through the formation of a farmers' organization with a watchdog, monitoring role, in which tail-enders and/or small farmers would be strongly represented.

A fuller list of the requirements for an effective water management system would emphasize all the following points:

- (a) there should be clear rules about water allocation and rationing, which are based on sound assumptions about cropping patterns and crop water requirements;
- (b) these rules should be fully understood, both by farmers and by officials and field staff;
- (c) the physical design of the distribution systems should be such that the rules are capable of implementation;

^{1/} This point is discussed further in Section 9.4.

^{2/} See Section 8.3.

- (d) staff should be motivated to apply the rules; partly through an internal system of rewards and sanctions, partly through external pressure from farmers to be accountable to them; and
- (e) there should be effective legislation for the punishment of farmers who break the rules which both they and the irrigation staff are required to adhere to.

There are two important points to note here about sequence. First, if rules and procedures about water distribution are not codified in detail, the chances that they will be understood and complied with are much reduced; moreover if there are significant deficiencies in the system design (e.g. difficult access to water in the absence of properly designed watercourse channels or insufficient control structures), discipline and control may be very difficult to establish. Adequate system design and clear procedures are thus essential preconditions for good management, and hence staff motivation and morale. Hence, officials and staff will be in a very weak position to invoke the threat of legislation and the punishment of water stealing unless they themselves have applied the irrigation rules impartially. In other words, a precondition for the effective use of legal sanctions is good motivation; and this in turn is dependent on a good management system and an obligation to be accountable.

The degree of water scarcity is of course a major influence on the amount of pressure likely to be exerted by farmers on irrigation staff and vice versa.^{1/} There is also a likelihood of greater pressure where the method of water distribution requires the area of certain popular crops (rice, sugarcane) to be restricted. A third extremely important factor is the social structure of the farming community. In areas where there are large landlords who are often people of considerable local political influence (members of legislatures, etc.), it is particularly difficult for junior field staff, with their very low salaries and status, to resist pressures to misallocate. Even if they do resist, with support from senior officials, further pressure may well be exerted on the officials. Robert Wade reports from Andhra that one of the most common weapons used against senior officials who show signs of being uncompliant is the threat of having them transferred.^{2/}

^{1/} Robert Wade found in his studies that on a system where it was estimated that irrigation officials' unofficial earnings were roughly equal to their official salaries, water-scarce villages in the tail reaches were much better organized for the purpose of lobbying officials for water than those in the head reaches; and the bribes they were required to pay were also correspondingly higher. ("The Social Response to Irrigation: An Indian Case Study". Journal of Development Studies, 16, 1, October 1979 pp. 3-26).

^{2/} "In transfer decisions... 'politics' intrudes heavily. A politician ... has a good chance of getting a non-compliant engineer transferred if he wishes to, or so the engineers think. The threat of transfer is one of the strongest weapons of compliance in the hands of politicians... For most engineers their political vulnerability is a potent source of job dissatisfaction". (R. Wade, unpublished paper).

It takes considerable courage on the part of an irrigation official to stand up to such threats, especially if he is unlikely to obtain any tangible reward for doing so, and it should not be too surprising that many prefer to opt for a quiet life by agreeing to the demands made on them and making 'special arrangements'.

Let us now consider, in the case of each of the four field study areas, what the degree of pressure on irrigation staff was; how effectively equipped they were to resist these pressures; how well they performed in practice; and what implications these experiences have for general policy.

Area One

Degree of pressure: (a) Water scarcity: Substantial; greatest in non-tubewell areas, but demand to increase cropping intensities or to adopt crops with higher water requirements strong in all areas. (b) Cropping restrictions: none. (c) Social structure: Highly skewed; larger farmers' chief targets likely to be tubewell operators (in charge of the most flexible source of water supply); canal operators, except at distributary or minor heads, had less scope for manipulation.

Capacity to resist pressure: (a) Design factors: no major weaknesses, except for failure to enlarge watercourse capacities (but this was universal and affected all tubewell areas equally); watercourse outlets from canals (APMs) difficult to tamper with. (b) Procedures: clearly prescribed for canals; badly designed and not specified in detail for tubewells; absence of good information and control system for tubewells. (c) Motivation: for junior staff, low salaries and no promotion prospects; for senior officials, satisfactory salaries but few regards specifically related to good performance; poor management control system for tubewells. (d) Legislation: in existence, but prosecutions required lengthy litigation through the courts. (e) Accountability: No formal farmers' representation.

Performance assessment: Canals appeared to be operated well, despite greater water scarcity in non-tubewell areas; contributory reasons appeared to be precise and well-understood procedures and an inflexible but well-executed design which was not easily manipulated. Tubewells were operated poorly; heavy pressure was being placed on tubewell operators because of their great power to influence the pattern of supplies from a very flexible local source. The management control system was poorly designed but even simple monitoring of operators' performance was not being done properly. Sanctions against operators' poor performance were limited, partly because of strength of operators' union and absence of small farmers' representative body. Scope for material reward for good performance: nil. Suggestions that bribes to operators were being 'passed up the line' - a symptom of low morale. In the absence of effective resistance to pressure groups, little moral authority for prosecuting against stealing offences.

Area Two

Degree of pressure: (a) Water scarcity: In an overall sense, probably not great. But weaknesses in design (especially lack of proper watercourse layouts) led to official agreement in early years of the project to allow 'unofficial' outlets, mainly in the head-reaches, in order to make more land irrigable; as a result excessive supplies were going to head-reach areas and the tail areas were nearly always short. (b) Cropping restrictions: none. (c) Social structure: highly skewed; tendency for local politicians and influentials to lobby Commissioner and senior irrigation officials for more water to their areas.

Capacity to resist pressure: (a) Design factors: weaknesses in design were numerous (lack of proper watercourse layouts; crude pipe outlets unable to provide proportional flows to each watercourse; insufficient control structures). Illegal outlets were in the process of being removed and the installation of APMs was planned. (b) Procedures: the problem of over-outletting in the head-reaches led to engineers having to adopt ad hoc procedures for trying to ensure sufficient supplies to the tail (running canals above design capacity, etc.). (c) Motivation: for junior staff, low salaries and no promotion prospects; for senior officials satisfactory salaries and possibly some rewards for good performance in view of project's special status; management control largely ad hoc, through periodic field visits. (d) Legislation: in existence, but prosecutions required lengthy litigation through courts. (e) Accountability: Embryonic water users' groups at watercourse level, but no formal representation at project level.

Performance assessment: In the circumstances, canals may have been operated almost as well as they could have been (i.e. in political terms; on purely technical grounds operational methods could be more easily criticized). The major problems stemmed from deficiencies in design and past decisions that 'illegal' outlets should be permitted. There was evidence under the new regime of official resistance to local political pressures, which was greatly assisted by the support of a high-ranking Commissioner. Despite the complexities of the legal system, numerous cases were being pursued against farmers who had committed offences of water stealing - an unlikely situation if officials and staff had been dealing with farmers in a compliant manner.

Area Three

Degree of pressure: (a) Water scarcity: very great in dry season. (b) Cropping restrictions: full water allocations for rice limited to 'permitted' areas only. (c) Social structure: only moderately skewed but village heads often exert considerable local influence.

Capacity to resist pressure: (a) Design factors: no major weaknesses. (b) Procedures: prescribed in great detail. (c) Motivation: for junior staff, low salaries and few promotion prospects; for senior staff, satisfactory salaries and moderate promotion prospects; detailed information available for effective management control. (d) Legislation:

in existence, but rarely, if ever, applied (for reasons not fully ascertained). (e) Accountability: Powerful local organizations at village level but no formal representation at project level.

Performance assessment: There were very great inequalities between high and lower commands, and in lower commands between different villages. Some of the obvious imperfections in the execution of the system was attributable to inadequate technical skill on the part of field staff and officials, but it was also clear that, particularly in the lower water-scarce areas, motivation was lacking to resist pressures from particular villages for additional water. Potentially powerful monitoring and control procedures were not being effectively applied suggesting that not only junior staff were benefiting from compliance. However, the unusual character of the system - its responsiveness to variations in local demand - means that the distinction between legitimate demand and illegitimate pressure may often be a difficult one to draw, especially for a junior field man. If senior officials are to be able to guide their staff clearly on this point, they need a clear understanding of the project objectives - with regard to priorities for rice and other crops, productivity v. equity, etc.; in fact objectives were ambiguous because of lack of consensus at higher levels of the administration.

Area Four

Degree of pressure: (a) Water scarcity: very substantial, especially in dry season. (b) Cropping restrictions: restrictions on rice, sugarcane, to specified areas. (c) Social structure: relatively egalitarian.

Capacity to resist pressure: (a) Design factors: no major weaknesses. (b) Procedures: prescribed in great detail. (c) Motivation: rewards in form of bonuses and better promotion prospects, for staff at all levels; also penalties in form of reduced promotion prospects and, in extreme cases, dismissal. Good management control system. (d) Legislation: The Project Authority had powers to exact quick punishment against water theft. (e) Accountability: Since suspension of Project Authority Representative Committees in 1975, no formal farmer representation at project level; but well-informed Small Groups at watercourse level and an inbuilt inducement to accountability through the dependence of Project staff for their jobs and salaries on the level of farmers' fee payments.^{1/}

Performance assessment: Water scarcity and cropping restrictions were both factors likely to create strong pressures on staff but absence of large landowners reduced problems of political pressures. The linking of rewards and penalties to performance levels and farmers' payments gave staff strong incentives to perform well. The management control system provided a further check. Farmers' inclination to be cooperative was strengthened by their frequent contact and communication with staff, who were often in a position to provide useful advice as well as to act as

^{1/} See Section 7.3.

‘policemen’. This inclination was further reinforced by the rigour with which penalties for water stealing had been exacted in earlier years; as a result the present level of water stealing offences was relatively low.

In at least two of the field areas studied (Areas One and Three) it was clear from internal evidence - inequitable distribution patterns, poorly kept and monitored operating records, evasive replies from operators under questioning, comments from farmers and independent observers - that the failure of staff to resist local pressures was a very significant influence on poor performance; and in Area Two, it had been a major factor before the introduction of the rehabilitation programme. It should be noted, however, that the combination of factors contributing to this failure was not the same in the two former cases as in Area Two. In neither of the former cases were there any technical deficiencies which made the staff's tasks exceptionally difficult: it was simply that motivation to resist pressures was weak. Area Two, on the other hand, belonged to that category of projects which contained all the necessary ingredients for disaster. The social context is one in which strong political pressures are likely to be applied; but the facilities available to operating staff to resist them are exceptionally weak: there are major deficiencies of design, making physical control of water supplies very difficult. There are no detailed operating procedures, and the penal powers of irrigation officials are minimal, in addition to the usual absence (outside Area Four) of significant material incentives.

Wade has described the predictable results of such a situation in Andhra, where the need to enforce differential cropping patterns (without adequate physical controls to do so) represents an additional pressure on the operating agency. Officials and staff at all levels are under pressure to misallocate and to ignore the rules about ‘localization’ of crops. Because of the difficulty of enforcing rules and in the absence of incentives to do otherwise, senior officials opt for the easy solution, acquiesce in rule-breaking and take their share of ‘unofficial’ revenue. They therefore have no moral authority to punish junior staff or offending farmers and the morale of the organization as a whole disintegrates. Reports from the field which could serve as sources of useful data and provide a basis for management control are full of inaccurate information and are in any case largely disregarded. There is a low level of trust between senior officials and junior staff and behavior throughout the organization is authoritarian and arbitrary.^{1/}

In cases such as this, it is clear that there is a need not only for comprehensive management reforms but also for certain basic improvements in the physical infrastructure. In the absence of the latter, major improvements in performance can undoubtedly be achieved - in the short term. This is evident from Area Two, where post-Development Authority experience has demonstrated the extent to which high-level commitment can raise the quality of water distribution practices despite continuing imperfections in the

^{1/} Robert Wade, unpublished paper.

technical facilities. Wade has also described a case in Andhra where, even within the technical limitations of the systems concerned, the exceptional determination of two senior officials to enforce the 'localization' of rice and 'irrigated dry' crops led in a single year to major reductions in the areas of unauthorized rice cultivation (c.4000 ha); this allowed three times the area lost to rice to be used for irrigated dry crop cultivation (c.4500 ha single-cropped and 4000 ha double-cropped), with tail reaches benefiting most, and water-logging in almost 2000 ha in the head-reaches was eliminated.^{1/} But despite these remarkable examples it must be concluded that in general a sustained long-term improvement under such conditions requires a two-pronged attack on both management practices and system design. By contrast, in cases such as those observed in Areas One and Three, the solution lies exclusively in management reform.

Conclusions. Although the projects selected for study are probably among the best examples of their type within each of the countries concerned, there are clearly major opportunities for improvement in water distribution methods and practices in all cases apart from Area Four, both through the introduction of better distribution techniques and through policies which will motivate staff to perform well. The internal evidence collected in each of the study areas amply confirms the conclusions reached by other researchers about the present alarmingly inefficient and inequitable nature of water distribution management in many developing countries; illustrations can be cited from Ecuador (27% overall irrigation efficiency) through Iran (11-15% efficiency) to India (Punjab/Haryana, Bihar, Andhra), Sri Lanka, Bangladesh, Thailand, Indonesia and the Philippines.^{2/} Attempts have also been made

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- ^{1/} R. Wade, "Water Supply as an Instrument of Agricultural Policy" Economic and Political Weekly, 13 (12), March 25, 1978.
- ^{2/} See, e.g. R. Zabala, "Chimborazo irrigation district, Ecuador", paper to ODI workshop on irrigation management, Canterbury, 1976; G. Levine, "Management components in irrigation system design and operation", op. cit., p. 42 (on Dez project, Iran); R. Reidinger, "Institutional rationing of canal water in North India", Economic Development and Cultural Change (23, 1) October 1974; A.K. Sinha, op. cit., (Haryana); N. Pant, Some aspects of irrigation administration - a case study of Kosi project (Bihar), 1979; R. Wade; S. Hashim Ali; and S.K.S. Hussain and N. Seetamaraiah, op. cit. (Andhra); J. Harriss and R. Chambers in B. Farmer, ed., Green Revolution?, Macmillan, 1977; and K. Shanmugarajah and S.C. Atukorale (see below) (Sri Lanka); M.F. Ali, "Performance of Ganges-Kobadak project (Bangladesh)", paper to ODI workshop 1976; T. Motooka, Agricultural Development in Thailand, Vol. III, Center of South Asian Studies, Kyoto, n.d.; Satya Wacana University, Salatiga, "A Research on Water Management at the Farm Level: an Indonesian Case Study", 1975; and A. Valera and T. Wickham, (see below) (Philippines).

in the course of this study's field investigations to weigh up the relative importance of different influences on performance in each case (design factors, skills, motivation, etc.) with the object of identifying the principal ingredients likely to be required in any future improvement program. What it has not been possible to do in this study (or indeed in the case of any other similarly brief pieces of investigative research), is to make any confident quantitative estimates of the extent to which deficient management may be contributing to poor performance or of the potential benefits (and costs) of management reform programmes. Such estimates are virtually impossible on the basis of 2-3 week 'identification' studies of the kind undertaken for this project, especially where so much of the essential data (e.g. on water losses) is absent, incomplete or suspect. The only ways of obtaining convincing quantitative evidence about the potential of management reform are through 'action research' (testing and measuring the results of experimental reform programs in the field) or through the careful monitoring of actual management interventions. Ideally both require fairly long-term research inputs (1-2 years).

It is symptomatic of the general neglect of water distribution problems that so little research of this kind has so far been attempted. We know of only one well-documented piece of action research, undertaken by members of the International Rice Research Institute in the Philippines. This produced some startling results. In their experiment, on a canal-irrigated command area of 5700 ha, the researchers found that quite modest changes in water distribution procedures, combined with minor technical improvements were associated with a 97% increase in rice production on the systems overall, and a 149% increase in the tail section of the system, over a two-year period. Before the intervention there had been a familiar pattern of over-irrigation at the head, with insufficient supplies remaining for the tail; official control over water appropriations had been minimal and there was widespread uncertainty among all farmers about the likely timing and quantity of water supplies. The experiment was carried out without the introduction of any technical improvements. In another more recent pilot project undertaken by IRRI, intervention in the management process led to a 70% increase in overall production in the space of one year (1977-1978).^{1/}

To this evidence can be added the observations made on the occasion of two pieces of management intervention, one in Sri Lanka, the other in Andhra Pradesh. In the Sri Lanka case the introduction of strict management procedures on a tank irrigating about 5000 ha enabled a level of rice production to be reached which was about 50% higher than would have been possible under

^{1/} For the earlier experiment, see A. Valera and T. Wickham, "Management of Traditional and Improved Irrigation Systems: Some Findings from the Philippines", FAO Farm Management Notes, 5 January 1978. Information on the latter experiment provided by R. Chambers.

normal operating conditions.^{1/} The results of the intervention in Andhra have been described above.^{2/} In neither case was monitoring as accurate as in the controlled experiment in the Philippines, but the results in every case followed the same pattern: very large increases in production in the tail reaches as a result of adequate and predictable supplies; and substantial overall increases in production.

A very important point to note about the Philippines experiment was that, although head-reach farmers were obliged to take less water than before, these results were achieved without any detriment to their own levels of production: indeed their production rose by 23% over the two-year period, partly no doubt because yields had been suffering in previous years from over-watering and were later benefited by the reduced but more predictable water supply pattern. The point is important because it means that if similar results are widely achievable elsewhere, resistance from head-reach farmers to management reform will be much less difficult to overcome than in a 'zero-sum' situation - i.e. where it is possible to benefit tail-enders only at the cost of some loss of production at the head. It seems probable that the same pattern was achieved in the Sri Lanka case; in Andhra, some head-reach farmers were required to abandon rice production and replace a single rice crop with one or two 'irrigated dry' crops - a process which undoubtedly aroused strong resistance, at least initially, and required a correspondingly determined administrative effort to overcome it.

It should be noted that in all these cases where we have some quantitative evidence of the benefits of management reform, rice was a predominant crop. It can be hypothesized that in all-rice commands in semi-humid areas, as in the Philippines and Sri Lanka, the 'zero-sum' problem is generally likely to be easier to overcome than on large, low-intensity commands in semi-arid areas such as North India and Pakistan. In commands where head-reach farmers are obtaining 100% intensities of rice cultivation per season, their over-irrigation in aggregate will often be considerable (especially since over-watering reduces weed growth and hence labor costs). However, on semi-arid low-intensity commands even head-reach farmers may be unable to reach 100% seasonal cropping intensities and may be under-watering each unit of land they succeed in irrigating. In such cases the transfer of water from head to tail areas could meet with very strong resistance from the head - and perhaps even to overall losses in production - unless compensation could be offered through substantial increases in overall system conveyance efficiency and improvements in other complimentary services, particularly agricultural and water management extension. We have good reason to believe from our own studies in Pakistan that a significant proportion of the very

^{1/} K. Shanmugarajah and S.C. Atukorale, "Rajengane Scheme - Lessons from the 1976 Yala Cultivation", Case Study paper to Commonwealth Workshop on Irrigation Management, Hyderabad, India, October 1978.

^{2/} P 137.

large water losses recorded by the Colorado State University (CSU) team at the watercourse and field levels were attributable to poor main system water distribution. Unfortunately the CSU studies were confined to observations below the watercourse head and the benefits and costs of management reform would only be possible to gauge accurately through a new all-system programme of action research.

It is not clear from either the Philippines or the Sri Lanka cases what the real administrative costs of intervention there were. In the Philippines, the number of additional staff required to direct and enforce the new distribution procedures appears not to have been large, but the fact that the experiment was conducted with the authority of an international research agency behind it no doubt contributed significantly to the willingness of the irrigation officials to cooperate; without that special authority, a substantially larger input of administrative resources might have been required to achieve the same results. In the case of the Sri Lanka tank, a single Resident Engineer was supplemented (at a time of critical water shortage) by a senior Manager and a team of four Technical Assistants; this is clearly an exceptionally large increment for a command area of 5,000 ha and would be impossible to replicate over a wide area.

The task which the administrators in Andhra set themselves was particularly difficult, since they were attempting to reinforce the 'localization' of rice and 'irrigated dry' crops according to an original plan (which had been flouted by farmers growing unauthorized rice, mainly in the head reaches), as well as to develop and enforce procedures designed to get water distributed as equitably as possible between head and tail reaches. Wade observes that they were able to achieve considerable success with respect to both these objectives largely through the more effective use of "the existing machinery of canal administration". In amplifying this observation, he notes that no new procedures were created for regular reporting on the state of crops, no formal channels for inter-departmental coordination were set up, and there was no formal involvement of tail-end farmers in the decision-making process: "as usual, the whole operation was done by the bureaucratic apparatus" of the Irrigation Department. While these points are true, it should nevertheless be noted that the exercise did involve some additional administrative costs other than devising and enforcing new water distribution procedures and management control systems: Wade reports that the Irrigation Department engaged a large number of laborers as temporary water-guards (to the extent that the number of water-guards was approximately doubled in tail reaches); and it sought the help of Andhra's newly-established CAD department to give water management advice to farmers unfamiliar with the cultivation of 'irrigated dry' crops. It should also be noted, as Wade himself observes, that in other comparable situations most senior officials "are not likely to be as committed as the ones in this case". It was an exceptional case, and the administrative inputs

for a similar success elsewhere would almost certainly need to be significantly greater.^{1/}

At the end of an evaluation of the performance of main system water distribution, the kind of remedies to be prescribed would depend on the nature of the principal weakness identified. They might include changes in organizational structure, procedural reform, increases in personnel, technical and/or management training, changes in the material incentives offered to staff, and the development of water users' organizations. But whatever the combination of measures prescribed in broad terms, a necessary first step in most cases would be to set up an action research program. This would have two main objectives: to identify through detailed monitoring the most effective, least-cost package of management reforms required in social and physical conditions similar to those of the pilot area; and to provide a visible and convincing demonstration to government and farmers of the potential for improved performance through better management. In all the countries visited except Area Four, action research programs are needed to generate the kind of information required for accurate prescription; their demonstration effect would be invaluable; and they could also have an additional function as management training centers.

Two of the management problems likely to be most difficult to solve in the course of these programs are (i) improving services to tail-enders without antagonizing those at the head; and (ii) compensating irrigation staff for the loss of 'unofficial' revenue. As has already been pointed out, the provision of incentives to junior irrigation staff to perform well is likely to pose special difficulties, particularly where the scope for changes in salary structures is very limited. The best possibilities probably lie in improved training, combined with better promotion prospects; and in measures designed to raise the status of staff. Cases have been observed in industry where staff have been given the incentive to perform unpopular jobs well as a result of receiving recognition from management that their jobs are important. This recognition may take the form of better working conditions, special uniforms, etc., and has the effect of enhancing the standing of the staff concerned within the community. If coupled with training and strong support from their superiors, such measures could bring about significant improvements in staff morale, at low cost.

8.2 System Maintenance

The maintenance of irrigation systems is an ancillary activity whose performance is essential to a high quality of water distribution. Maintenance and repair work may be divided into three categories:

- (i) Routine or preventive maintenance, which is intended to keep the system in such a condition that it can be operated in accordance with the original design specifications. Costs are provided for under a regular annual budget.

^{1/} See Wade, op. cit.

- (ii) Emergency maintenance, in the event of natural disasters, the costs of which have to be covered by special budget allocations.
- (iii) Up-grading or improvement works, which may fall under the 'maintenance' heading in certain countries such as Area Four, where maintenance, rehabilitation and improvement work are seen as a continuum and the Engineering Division within each Project Authority is responsible for minor design and construction work as well as maintenance. More commonly, however, these are classified as 'rehabilitation' or new works, and are carried out not only under a different budget but by a different organization from the one responsible for day-to-day project management.

A further distinction needs to be made between the maintenance of civil works on the one hand and of mechanical and electrical works on the other. In the field study areas the management requirements in each case were found to be substantially different. None of the canal (or canal-cum-drainage) systems studied involved the use of any particularly complex technology and their maintenance was largely concerned with civil works: the repair of earthworks and structures and the removal of weeds and sediment.^{1/} For the most part these are routine activities which can be satisfactorily performed by a predominantly unskilled labor force under the supervision of a few civil engineers. However, in the areas with public tubewells (Areas One and Four) the level of skills required for mechanical and electrical maintenance was much higher: there was a need for a sizeable staff of trained field technicians as well as an efficient back-up service from the projects' repair workshops. The performance of Civil and M&E (Mechanical & Electrical) maintenance will therefore be considered separately before more general conclusions are reached.

Civil Maintenance. In both Areas Four and Three (where all major maintenance on the main canal systems was carried out by private contractors), the general level of maintenance was judged to be very satisfactory - though there was criticism in Area Three concerning the absence of stop-logs on certain canal cross-regulators and the accumulation of sediment at tertiary outlets. In Area One, the major canals were maintained to high standards but minors and distributaries in certain areas were found to be in a state of some disrepair. In Area Two, the maintenance of earthworks (canals and canal roads) presented unusually severe problems: in addition to deliberate damage inflicted on canal banks by water users, soil conditions encouraged high levels of seepage, there was heavy weed and rodent infestation, and canal roads were being frequently used by the general public in the absence of an adequate public road network. At the time of the field visit to Area Two, major rehabilitation work was being carried out (including canal lining) but the level of performance achieved under the regular maintenance program fell far short of what the system required.

^{1/} Of the areas studied only those in Areas One and Four had substantial drainage networks (see p. 147 below).

As in the case of other activities, the chief reasons for the level of performance achieved in each case are likely to be found in some combination of the following factors: organizational structure; procedures; resources; skills; and motivation. The difficulty of the maintenance task, which differed considerably in the four locations visited, is also an important variable to be kept in mind.

In Area One, there were no unusual technical difficulties associated with system maintenance. It was essentially a routine task, although exceptionally heavy rains and floods in certain years have called for a periodic capacity to react quickly in times of emergency. There was little evidence to suggest that the deficiencies in maintenance noted on some of the smaller canals of the main system were attributable in any significant degree to inappropriate organizational structures or to inadequate procedures or skills. Organizationally, there was little need for close coordination with other cadres (since the same people who were responsible for maintenance were also responsible for its most closely related function - water allocation); and the centralized pattern of administration within the Project Authority - with very limited devolution of budgetary and other responsibilities to middle- and lower-level executive staff - appeared to have less serious implications for the performance of a largely routine activity like civil maintenance than for other activities requiring greater flexibility and responsiveness to unexpected variations in local circumstances (e.g. water distribution, agricultural extension, mechanical and electrical maintenance). Procedures for the annual planning and budgeting of maintenance programs were clearly set out, as were procedures and job descriptions for day-to-day implementation, and procedures for reporting, and accounting, for money spent. The civil engineers responsible for supervising the maintenance program were more than technically competent to do so, having had the necessary training in surveying, design and the preparation of cost estimates.

To what extent motivation may have been a significant influence on performance is less clear. As in the case of other activities, material incentives for junior staff (in terms of salary levels, promotion prospects, etc.) were extremely limited, but it is possible that members of the largely unskilled work-force employed for civil maintenance activities were less dissatisfied with their jobs than (say) field extension staff since they were less educated and therefore had lower expectations.^{1/} Qualified engineering staff, both diplomates and graduates, seemed to take considerable pride in the appearance of the canals within their areas of supervision. Indeed many of them appeared to give higher priority to maintenance than to water distribution - no doubt a reflection of their basic training. No rumors were encountered that funds designated for maintenance work were being misused for other purposes.

The principal reason put forward by the staff themselves for shortcomings in performance was insufficient finance - and we have no reason to disagree with them. The size of the permanent work-force was

^{1/} Cf. p 189, para 2.

considered satisfactory, but departmental allocations of recurrent expenditure (for additional labor and equipment) were seen as quite inadequate for an effective program of preventive maintenance. Unit costs relating to actual expenditure in 1976-77 are summarized in Table 8.1.1/ The inadequacy of the funds provided through the 'ordinary' (routine) maintenance budget is underlined by the fact that since 1973-74 these funds have been heavily supplemented under a 'special' five-year maintenance program, which is categorized as capital (or rehabilitation) expenditure. But even with these additional funds, it was estimated by one of the Executive Engineers that a system-wide maintenance cycle could only be completed over a 20-year period, instead of the 3-year period considered desirable.

As has already been noted, conditions in Area Two are much more difficult than in Area One and the unit costs required for satisfactory system maintenance are therefore correspondingly higher. More detailed investigations would be needed to assess how much higher required expenditures should be than actual expenditure in each case, but it appears that in Area Two present allocations of recurrent finance are even more inadequate than in Area One. On a per ha basis, total O&M costs (including the salaries of permanent staff) were higher in Area Two than in Area One: \$4.60/ha against \$2.03/ha (or \$3.75/ha if all O&M costs, including emergency as well as 'special' funds, are included). However, they were lower in terms of total canal length (\$421 as against \$521 or \$934 per canal km). Particularly in view of the difficulties of canal bank and road maintenance in Area Two, the latter should be taken as the more significant indicator. Conclusions about organizational structure, procedures, professional skills and motivation were very similar in Area Two to those drawn in Area One. In other words, the fundamental problem here too was an acute shortage of recurrent finance.

Physical conditions in Areas Three and Four are substantially different from those in Areas One and Two (e.g. higher rainfall; smaller but more densely reticulated canal networks; few canal roads but many more control structures). Comparisons of costs between the two pairs of projects are therefore not particularly helpful - at least on a per ha basis. In contrast to Areas One and Two, there were indications in Area Three that the work of engineering staff at the District level and below could have benefited from further technical training in design and construction as well as in water distribution; and there was certainly scope for improving the way in which accounts of past expenditure were recorded. On the other hand, after a long period of political instability in which virtually no public money had been made available for O&M expenditure, funding had reached a level in 1976-77 which was considered adequate for satisfactory maintenance.

At \$9.07/ha, recurrent expenditure in Area Three was less than a quarter of the total recurrent expenditure on canal O&M in Area Four (\$43.62/ha), but costs per canal km were up to 70% of those in Area Four (\$1466 against \$2352) and costs per control structure appeared to be substantially higher (\$1098 against \$909). It should be noted that in Area Four, where funds and

1/ For comparison of staffing levels, see Tables 3.1 and 9.2.

Table 8.1: COMPARATIVE O&M COSTS

(A) <u>Canal systems</u>	<u>Unit costs (in US\$)</u>		
	<u>Per ha</u>	<u>Per canal km</u>	<u>Per control structure</u>
<u>Area One</u>			
'Capital' <u>1/</u>	1.72	442	3242
Ordinary O&M	0.73	188	1376
Staff	1.30	334	2444
	<u>3.75</u>	<u>964</u>	<u>7062</u>
<u>Area Two</u>			
O&M	3.50	320	
Staff	1.10	101	n.a.
	<u>4.60</u>	<u>421</u>	
<u>Area Three</u>			
O&M <u>2/</u>	4.51	729	546
Staff	4.56	737	552
	<u>9.07</u>	<u>1466</u>	<u>1098</u>
<u>Area Four</u>			
O&M	21.18	1142	442
Staff	12.64	682	264
Small Group + other costs	9.79	528	204
	<u>43.61</u>	<u>2352</u>	<u>910</u>
(B) <u>Public tubewells</u>			
	<u>Per ha</u>	<u>Per operable well</u>	<u>Per cumec of well capacity</u>
<u>Area One</u>			
Electricity	6.59	1742	26477
O&M	1.71	452	6869
Staff	2.47	652	9911
	<u>10.77</u>	<u>2846</u>	<u>43257</u>
<u>Area Four</u>			
Electricity	10.89	436	8363
O&M	7.17	288	5503
Staff	5.88	235	4513
Other	2.08	652	1598
	<u>26.06</u>	<u>1042</u>	<u>19977</u>
(C) <u>Surface drains</u>			
	<u>Per ha</u>	<u>Per drain km</u>	<u>Per control structure</u>
<u>Areas One and Four</u>			
O&M	4.95	298	1209
Staff	2.96	178	723
Other	1.43	86	349
	<u>9.34</u>	<u>562</u>	<u>2281</u>

1/ Includes 'special' + emergency O&M.

2/ Includes emergency repairs.

staffing were both considered by senior officials to be adequate for satisfactory maintenance, silt clearance was an item requiring much heavier expenditure than in Area Three. Moreover, the total costs include expenditure on items not necessarily provided for elsewhere (e.g. for Small Group O&M and training; membership fee collection); labor costs in Area Four are high; and there is a particularly high density of canal networks and control structures. Damage is also frequently caused by typhoons.

In addition to the high level of investment which Area Four is able to mobilize both for maintenance work and capital improvements (the latter at the level of \$16.5/ha/yr), its maintenance program is also notable for the detailed planning which goes into the preparation of its annual budgets. The procedures are similar in character to those used for the planning and implementation of water distribution schedules in that there is a high degree of consultation with lower-level staff (and, through them, with farmers' representatives). Detailed proposals are initially prepared by the Project Authority Working Stations at the 1500 ha level and are then forwarded upward for checking, amalgamation and modification at higher levels of the organization.

Apart from the Area One, Area four was the only study area with an extensive surface drainage network; and it was the only one for which cost figures were obtained. The level of expenditure appeared to be much higher than is commonly found in most developing countries where drainage tends to be given very low priority. At \$9.34/ha drainage O&M costs in Area Four were 20-25% of canal O&M costs. By contrast, the present drainage O&M allocation in a project not included in this study, in Andhra Pradesh, is reported to be only \$0.60/ha.

Mechanical and Electrical maintenance. M&E work was of significant importance only in those two study areas where public tubewells were being operated (Areas One and Four). Tubewell maintenance in Area Four appeared to be performed satisfactorily. Project Authority included a Mechanical and Electrical Section with specific responsibility for this work, some of which was carried out at a mechanical workshop; it also supplied junior staff to the Working Stations to supervise well operation and maintenance. Staff within this section had had appropriate technical training and, as in the case of the civil maintenance program, there were clearly established procedures for tubewell maintenance. Estimated unit costs of tubewell O&M in Area Four are given in Table 8.1. Though there is some uncertainty about the accuracy of these cost estimates, they appear to be surprisingly modest compared with tubewell O&M costs in the Area One (e.g. in terms of cost per cumec of well capacity). Part of the reason for this is no doubt the low level of utilization of the Area Four wells (actual pumpage in 1975 was only 18% of maximum yield capacity, against about 36% in Area One).

By contrast, there were major problems associated with the Area One maintenance program which could only be partly explained by inadequacy of funding. An alarmingly high proportion of potential operating time was being lost as a result of electrical, mechanical and other technical faults (sample records showed 17% of the wells in one area out of action during a single month for reasons other than farmers' lack of demand). Enquiries revealed that many of these faults were attributable to failure on the tubewell operators' part to perform their assigned duties properly. Minor stoppages were frequently caused by the electric circuit tripping at times of voltage fluctuation - a factor outside the project management's control. However, if this happened to occur when the tubewell operator was absent from duty (particularly common at night) the fault often remained unremedied until his return. Alternatively, some operators might jam their switches in an 'on' position to prevent them from tripping in their absence - a practice which was reported to have contributed significantly to the large number of burnt-out motors on the scheme.

A substantial proportion of the maintenance costs incurred on Area One were thus avoidable and stemmed from an absence of effective management controls over the activities of the tubewell operators. This in turn was attributable partly to weaknesses in the planning and design of the management system and partly to the poor morale of supervisory staff. Planning weaknesses were manifested in the absence of clearly modified management procedures (i.e., there was no Maintenance Manual); and in the assumption that operators could be relied on to do a responsible job despite poor pay, poor training, unrealistically long working hours and unattractively isolated work locations. Since the operators were highly unionized, the task of their immediate superiors was not an easy one, and their willingness to confront the operators was further undermined by the absence of clear procedures.^{1/}

Although a four-man team (Junior Engineer, foreman, electrician, and fitter, each covering c.40 wells) was detailed to carry out routine tests on each well each month, with more detailed checks every three months, the frequency of breakdowns due to operators' negligence meant that much of the time and energy of maintenance staff in Area One was diverted away from routine, preventive work to unscheduled 'emergency' work. Minor repairs could be effected on the spot, provided the necessary spares were available, but major repairs had to be referred to one of the project's two workshops. Thus, not only were the routine maintenance schedules of the field teams frequently disrupted but the workloads of the servicing workshops was also substantially increased. Indeed, the workshops appeared to be engaged exclusively in doing major repairs on an emergency basis; there was no mention of any regular program of tubewell servicing on the lines employed in another tubewell project in the same country where the machinery of every tubewell is taken out and serviced at the central workshop at least twice a year.

^{1/} There were rumors, too, that a substantial proportion of the operators' 'unofficial' exactions from farmers were being 'passed up the line'.

Further problems were created by the requirement that Area One staff should adhere to the same restrictive rules with regard to authorization of expenditure as those which applied in the Canal Groups. This often led to major delays in obtaining spare parts, even in the case of minor repairs. Field engineers working in Area One argued that these rules caused relatively little inconvenience in the context of canal maintenance, but were quite unsuitable to the requirements of mechanical and electrical maintenance; the latter called for much quicker reactions, and hence the delegation of greater responsibility to junior engineering staff for making local purchases, and a more decentralized approach to the location of stores.

In the absence of an engineering consultant on the Area One study, we were not in a position to make a professional assessment of the technical skills of the engineers employed on this project. Most of them had been initially trained as civil rather than mechanical engineers, but new recruits to the Group were given 4-6 months' in-service training. The aspects of their jobs which appeared to interest them most were mechanical maintenance and watertable control; water distribution received relatively little attention. The activities of the workshops were not observed at first hand, but complaints were made by the field engineers about the quality and quantity of their equipment and personnel.

Conclusions. The evidence from Area One suggests that in general, where there are found to be shortcomings in the performance of public tubewell maintenance, inadequate finance is unlikely to be the only reason and that careful attention may also have to be given to improving the management system and/or staff training. Indeed, on a scheme such as the Area One project it would be necessary as a first step for substantial management reforms to be introduced and tested before it could be decided with confidence what additional resources of finance, personnel and equipment were needed, if any.

From the evidence of the canal systems studied, however, it is clear that the overriding constraint to better maintenance is insufficient funds. This is not to say that there is no scope on these systems for improvements in their procedures and management methods. But civil maintenance is a relatively straightforward activity and engineers have generally given much more thought to developing appropriate procedures for its performance than for the performance of the far more complex activity of water distribution. Water distribution, agricultural and water management extension and M&E maintenance are all areas of activity in which procedural reforms and better training could be expected to bring widespread benefits. But in the case of civil maintenance debates on issues such as optimal maintenance cycles (e.g. whether installations should be allowed to deteriorate by 10% or 20% before each cycle of repairs) are somewhat academic refinements in all those cases where the basic maintenance budget is as low as it is in Areas One and Two, or was until recently in Area three. The fundamental issue here is how to get budget allocations substantially increased. Only then will it be possible to replace the prevailing philosophy of trying to rescue deteriorating systems through periodic injections of 'emergency' (i.e. rehabilitation) funds by a balanced program of preventive maintenance and step-by-step technological improvement; to create conditions in which

systems can be satisfactorily operated; and to provide the additional benefits which such a policy would bring, particularly increased rural employment.

The problem is already widely recognized. However, the proposals most commonly put forward for overcoming it which largely consists of exhortations to governments to increase water charges, rarely have much impact. The simple reason is that such a move in isolation is bound to be politically unpopular. What is needed instead is a set of measures which will break the vicious circle of low budget allocations - poor O&M services - low water charges and recovery rates - low budget allocations. Instead of starting with an attempt to raise water charges, an alternative point of entry into the circle might be through the delegation of greater financial and decision-making powers to managers at the project level, which would enable them to put up genuine budget proposals for discussions with their superiors instead of having to be little more than passive recipients of government handouts; more effective pressure could also be exerted on government to release its promised allocations on time. With larger budgets and more timely releases, O&M services could be improved and farmers would be more easily persuaded to pay higher water charges to cover the budget increases.

However, here too it could be expected that many governments would be reluctant to take the necessary first step. A much more promising line of attack would be (a) to concentrate on introducing measures to improve the official water distribution service, thereby increasing farmers' propensity to pay higher water charges; and (b) to ensure that a substantial proportion of the water charges were retained by the project management for local reinvestment. The latter measure should have the three-fold effect of further reducing farmers' unwillingness to pay higher charges, automatically increasing the financial responsibilities of project managers, and making official O&M staff more accountable and responsive to their clients' needs. As has already been suggested, the most hopeful way of getting such a strategy widely adopted would be through its introduction on an experimental basis in the first instance.

8.3 Agricultural extension

Good agricultural extension is of vital importance for the development of irrigated agriculture in small farm conditions, especially in the early stages of irrigation and/or when farmers' knowledge of agricultural and irrigation techniques is limited. It is an essential complement to good water distribution if farmers are to achieve high returns to the water delivered to them. And in addition to its potential for enhancing productivity, it can have a powerful role to play in the promotion of greater equity as a result of its capacity to give preferential assistance to smaller farmers in a way which is rarely open to the distributors of water. Programs deliberately designed

to provide selective assistance to more backward farmers appear to have been rarely attempted in developing countries, at least within the public sector, though one quite successful experiment has been recorded in a district in Kenya.^{1/}

Agricultural extension experience in developing countries has been widely studied and a large literature has been generated on the subject. This contains substantial differences of view on points of detail, but in broad terms most commentators would probably agree that the following are among the most important ingredients of a successful extension program: (a) an appropriate organizational structure within the extension service; (b) some form of local farmer grouping which will enable information to be widely disseminated; (c) an effective management system (with particular emphasis on work programming and monitoring); (d) adequate resources of manpower and transport; (e) skills in communication with farmers (not only for the transmission of advice but for the prior diagnosis of farmers' problems and needs); (f) good two-way flows of information between extension and research staff (with particular emphasis on the feedback of information from the field to the research station, so that the content of the extension message can be closely tailored to the variety of farmers' needs); and (g) motivation of field staff.

The nature of the extension function under irrigated conditions has several distinctive features. One which has already been noted is that there tends to be greater predictability and homogeneity in cropping patterns and the timing of farming operations in irrigated than rainfed areas; this is particularly so in cases where the operating agency deliberately sets out to control farmers' choices of cropping patterns or else effectively limits the range of their choice through the strict rationing of scarce water supplies. To the extent that this allows a greater part of the extension agent's work to be planned and programmed in a relatively routine manner, it makes his task easier. It does not, however, imply that in the execution of their work programs extension staff in irrigated areas can afford to pay less attention than their counterparts elsewhere to local diagnosis and farmer consultation or that they can expect to be widely effective if they confine their activities to purveying undifferentiated 'packages' designed by distant planners and researchers. Although relatively homogeneous in physical terms, irrigated areas contain as much social diversity as rainfed areas and wherever there are marked differences between the resource endowments of larger and smaller farmers the use of a diagnostic, diversified approach is essential.

The other main distinctive feature of extension under irrigated conditions is the larger range of tasks which staff are (or should be) called upon to perform. Some of these require substantial additional specialist training and supervision. Under rainfed conditions the extension service has four principal tasks:

^{1/} J. Ascroft et al., Extension and the Forgotten Farmer, Wageningen, 1973. More numerous examples of a selective approach can no doubt be found on small-scale projects promoted by voluntary, non-government agencies.

- (a) the identification of farmers' problems and needs (and the referral of the resulting information to senior officials, research stations or other agencies, where necessary);
- (b) the provision of advice to farmers about techniques of agricultural production;
- (c) coordination with agencies responsible for the provision of inputs (seeds, fertilizer, pesticides, etc.) and credit;^{1/}
- (d) data collection for the purpose of monitoring production performance.^{2/}

Under irrigated conditions it has the following additional tasks:

- (e) the provision of specialist advice to farmers about methods of land preparation and frequency and depth of water application (water management extension);
- (f) the development of farm plans which will encourage more economic use of expected patterns of water delivery;

^{1/} In the very early stages of agricultural development (where aggregate demand for purchased inputs may be very small, private commercial activity is low and the public sector's manpower resources are also very limited) there may be no alternative to giving the extension officer direct responsibility for input supplies as well as technical advice. However, once the demand for inputs and credit becomes substantial, the functions should be separated among different specialist agencies. Otherwise the extension staff will be prevented from performing their central advisory task effectively because of heavy demands on their time from other quarters. "The extension service should not be responsible for ensuring the availability of inputs, filling in loan applications, or collecting debts. These are the jobs of the supply and credit agencies". (D. Benor and J.Q. Harrison, Agricultural Extension: The Training and Visit System, World Bank, 1977, p. 17; cf. R. Chambers, "Two Frontiers in Rural Management", pp. 435-9).

^{2/} This can also be a time-consuming task and, where the manpower is available, should be given to a specialized unit within the agricultural development agency rather than to the field extension staff (Chambers, op. cit., p. 438).

- (g) discussion with the water distribution agency about patterns of water demand (short-term: local variations/deviations from seasonal plan; seasonal: joint planning of expected seasonal distribution pattern; long-term: e.g. changes in frequency of channel rotations or in amounts of water delivered per rotation; or major changes in cropping patterns or timing of water releases from reservoirs).^{1/}

A comprehensive review of the management of agricultural extension in each of the study areas would require, first, an assessment of the performance of the above-mentioned tasks, in terms of both productivity and equity; and, secondly, an identification of the principal reasons for the levels of performance attained (organizational structure, management procedures, resources, skills, motivation). A review based on such a framework will be presented briefly here, although in most cases there was insufficient time for very detailed field investigations to be carried out.

Area One. General agricultural extension: Few farmers appeared to have regular contact with agricultural extension staff; low levels of contact, particularly in the case of smaller farmers, were also reported in an independent field survey carried out by a university. There was no evidence that, where contact was made, any attempt was made to identify variations in farmers' needs or to differentiate standard extension messages accordingly. Specialist advice about water management: Field staff were expected to be able to offer farmers advice about water management practices. They appeared familiar with the Agriculture Department's standard recommendations about the timing and depth of irrigation for different crops but were unable to suggest how these could be adapted under different soil conditions; the university survey showed widespread ignorance among field staff about the rooting depths of crops. The Department had no subject matter specialists in water management at the District level. Collaboration in water scheduling: There was no evidence of consultation with the Irrigation Department about short-term variations in local demand; for the purposes of seasonal planning, the senior agricultural officer at District level attended twice-yearly inter-agency committee meetings to discuss the scheduling of tubewells (a largely routine matter, reflected in the rigidity of the schedules adopted); there appeared to be no long-term strategic discussions with regard to possible major changes in cropping patterns or tubewell scheduling (the scope for significant changes in canal supply patterns was very limited). Coordination with input supply agencies: No specific information was obtained on this, though the university survey found that fertilizer use was generally very low, especially among smaller farmers, and reported serious weaknesses in the fertilizer distribution system. Data collection and monitoring: A separate statistical section within the District office collected data on yields by means of crop cuttings in selected villages; crop area data were

^{1/} Discussions of short-term issues can be undertaken by extension staff on their own; seasonal planning may require support from research staff; long-term planning will require substantial collaboration from research staff - agronomists, soil scientists, etc.

collected separately by revenue officials. Quality of data was not assessed. Its value for the purpose of estimating the productivity of irrigation water was limited by a failure to disaggregate results between irrigated and rainfed areas.

Performance assessment: Performance of the general agricultural extension task was poor, with such benefits as there were going disproportionately to larger and more influential farmers; there was negligible impact in the fields of water management extension and water scheduling. Among the most obvious reasons for poor performance was insufficient resources of finance and hence of manpower (Field Assistant: farmer ratios of 1:1000-1500), transport and office facilities. Others include deficiencies in technical and communications skills and lack of material incentives, particularly at the level of the Field Assistants, who are poorly paid and have very limited promotion prospects. These handicaps could to some extent have been counteracted by improvements in organization (e.g. the adoption of a group-oriented rather than an individual-oriented approach) and in particular by more systematic work programming. But to be made really effective the service required major improvements in all fields: substantially increased resources, more technical and communications training, greater material incentives, closer contact with research, structural changes and procedural reform.

It is instructive to compare the ineffectiveness of the extension service in Area One with the relative success which continues to be achieved by the extension service in another project in the same country. This has a somewhat more favorable FA: farmer ratio (1:750) and at the same time when its present management system was first introduced (1969-71) its staff had far more mobility as a result of access to transport supplied under an IDA loan. When the project was visited as part of the present study (late 1977) most of its transport facilities had been requisitioned for other users, but it was remarkable to find that staff were continuing to apply the same management system to the best of their abilities and that the majority of farmers interviewed in the field (in contrast to those in the Area Two) were familiar with the extension staff and their activities.

The principles on which extension in the other project area has been operating are very similar to those of the Training and Visit System which was subsequently introduced with success in India. The responsibilities of field staff and subject matter specialists are clearly specified in job descriptions; field staff are required to make contact with a manageable number of 'progressive' farmers in their areas, help them establish demonstration plots on their land, and organize discussion groups at which they present critical 'extension points' (prepared by senior staff every month); in the case of certain farmers who request the service, help is also given in the preparation of new farm plans based on revised cropping patterns. FAs' work schedules are carefully planned on the basis of a 'tour program' and senior staff are required to monitor their performance by means of random field visits and the inspection of their daily diaries. Field staff are required to complete simple but comprehensive reports of their activities at the end of each month, which are forwarded to head office. The project produces Annual Reports in which agricultural performance is reviewed

in some detail. Indicators of progress made between 1969-70 and 1975-76 (quoted in a recent Annual Report) include increases of 34% in the use of nitrogen fertilizer, 87% in phosphatic fertilizer, 11% in cropping intensities, and 50% and 26% respectively in the yields of the two principal crops - cotton and wheat.

Several special factors which may have contributed to the program's early success no longer apply (untypically good transport facilities, greater opportunities for promotion on merit). The fact that staff morale has continued to be unexpectedly high despite major transport difficulties and low salaries is a tribute to the motivating factors of the established management system: because it has helped them to be effective and a demand has been generated among farmers for their assistance, staff have greater confidence in their worth and more job satisfaction than their counterparts in Area One. Two particular points to be noted about the other project area extension program, in addition to the character of its field staff management system, are the inclusion of a full-time research agronomist among the subject matter specialists and the unusual emphasis given by extension staff to promoting more efficient use of water, particularly through improved farm planning. The principal purpose of the farm planning exercise was to identify periods in which smaller water supplies (though very scarce overall) exceeded demand and to devise alternative cropping patterns which would reduce underutilization of water to a minimum.^{1/}

The only substantial doubts about the other project program concern its equitability. Much of the original extension program was extended to be directed at farmers of all kinds within the project area, but certain parts of it - particularly the farm planning/water management service element - were deliberately aimed at more 'progressive' farmers. As a result, most of the benefits from this service inevitably went to medium-large rather than small farmers. This emphasis on 'progressiveness' in the farm planning program has been justified on the following grounds: "... it was believed that ideally they should be owner-occupiers and that small units of 20-30 acres were likely to give the best results. Bigger farmers tended to have other interests and smaller ones lacked capital. It was seen as essential that selected farmers should have sufficient capital and be prepared to spend it on the necessary seeds, fertilizers and simple machines".^{2/} Average holding size in the other project area is about 6 acres. The program was planned on the assumption that improved practices would be disseminated through 'progressives' to others. Although this emphasis applied originally to only part of the extension program it appears to have been extended since to the program as a whole. The danger now is that the emphasis on 'progressiveness' will become self-perpetuating and that most smaller farmers will remain permanently disqualified as potential clients for extension

^{1/} The water management and farm plan programs are described in M.T. Powell, "Agriculture Extension and Water Management", FAO Farm Management Notes, 5, January 1978, pp. 52-60.

^{2/} Powell, op. cit., p. 55.

advice, as the following comment from the 1975-76 Annual Report makes clear: "The large number of farmers in comparison with the number of FAs makes it impossible for field staff to contact all farmers. In any case this is not desirable as very many peasant farmers are not interested in agricultural development and it is a waste of valuable time to try and persuade them."^{1/}

Area Two: General agricultural extension: With the introduction of the Training and Visit system in 1974, the traditional approach to extension, which relied on the use of multi-purpose Village Level Workers, has been replaced by one in which Village Extension Workers concentrate exclusively on the provision of agricultural advice. The average VEW: farmer ratio has been raised to 1:320, VEWs are required to follow pre-planned work programs which entail regular visits to 'contact farmers' at strategic points within their areas, and they attend training sessions every fortnight for briefing on topical issues by subject-matter specialists. The principal means of identifying problems and disseminating advice is through meetings between VEWs and groups of farmers who congregate at the contact farmers' fields. The guiding principle in the selection of contact farmers was that they should be "receptive to new ideas irrespective of their land holding status". In the provision of extension advice initial priority was given to the improvement of husbandry practices through the use of existing resources on the farm rather than to changes requiring large increases in purchased inputs, thereby greatly increasing the range of potential adopters. There is a research farm in the project area with which senior extension staff are in close contact. Despite continuing problems of water distribution, the extension program in Area Two has undoubtedly been impressive in its impact: substantial increases in production have been recorded since the program started and a survey carried out by project staff in 1975-76 claimed that wheat yields of 'adopters' were 60% higher than those of non-adopters. An independent external evaluation nevertheless found substantial gaps in the knowledge of contact and follower farmers about technical points which should have been included in extension briefings; and some recommended practices were not being widely adopted. There was found to be little variation in knowledge levels between marginal, small, medium and large farmers, though those of small and medium farmers (the major beneficiaries of the program so far) were somewhat higher. Specialist advice about water management: At the time of the field study, little emphasis was being placed on water management extension, partly perhaps because problems of main system and watercourse distribution were compounding the difficulties of control at field level. But it was also admitted by senior officials that the necessary expertise was lacking, not only among field staff but at the subject matter specialist level. Collaboration

^{1/} "Agriculture Work and Progress", p. 6.

in water scheduling: The obligatory attendance of water distribution staff at the extensionists' fortnightly meetings provided an opportunity for regular (though rarely precise) discussion of short-term problems of water supply and demand. However, senior agricultural staff appeared to play little part in pre-season planning for water scheduling; and the absence of collaboration in long-term planning was reflected in the conflict between the ideas of some sort of 'crop zoning' approach being toyed with by the agriculturalists and the engineers' plans to design for strictly proportional distribution. Coordination with input supply agencies: Members of the project's cooperative wing were also required to attend the fortnightly meetings to answer any complaints there might be about inadequate input supplies and to be briefed about expected demand patterns. These exchanges of information were considered very valuable by senior project management. Data collection and monitoring: An evaluation unit was recently set up within the project organization, with the principal purpose of evaluating trends in agricultural production. Estimates of yields and production levels were also being made by extension staff, both for the purposes of compiling time-series records and comparing the performance of adopting and non-adopting farmers. At the time of the field study, there were some doubts about the accuracy and comparability of the latter sets of data.

Performance assessment: Performance of the general extension task was impressive, particularly in comparison with typical extension performance under the traditional system. It appears to have been more equitable in its impact than the other program mentioned for the area country, largely because of its initial emphasis on better cultural practices rather than on increased use of purchased inputs. Even so, an independent report found that marginal farmers were not receiving "full benefits" from the program; it is presumably with a view to remedying this problem that recent proposals have been made to introduce selective extension programs for different categories of farmers. In the particular field of water management the Annex Two program has been weak and there are still major problems to be solved with regard to the long-term planning of cropping patterns and water scheduling.

In those very important fields where it has performed well the reasons for the success of the Area Two program can be largely explained by reference to the points made by Benor and Harrison in favor of the Training and Visit system in general.^{1/} Their principal criticisms of the old system have been of inappropriate organizational structure (multi-purpose field level staff working to several departments, only one of which is Agriculture, with the result that no tasks can be performed effectively); lack of systematic

^{1/} See Benor and Harrison, op. cit., pp. 6-18. The senior management of the Chambal project were not uncritical in their adoption of the T and V approach and made several modifications to the basic model after initial field testing; but the framework is essentially the same.

work planning and supervision; inadequate coverage of farmers owing to insufficient field staff, transport and housing facilities; inappropriate training (over-emphasis on pre-service, theoretical study; not enough in-service training); and lack of ties with research. As a result of all these factors extension staff have had low status (lack of respect from farmers, who rarely see them), low morale and low pay.^{1/} By contrast, the essential requirements for success under the T and V system are seen as a unified extension service directly administered by Department of Agriculture personnel; concentration by field staff exclusively on extension work (no regulatory, input supply, data-collecting or administrative functions); a systematic time-bound program of field visits, easily supervisable; and regular intensive training sessions for field staff concerning the most important recommendations in the coming week or fortnight. Adequate staff numbers and supporting facilities are also obviously required. The importance of achieving an immediate impact in the initial stage of the program is strongly underlined, in order to "give the farmers confidence in the extension agents and the extension agents confidence in themselves. Once this starts, the process is self-reinforcing: farmers will expect and demand more from the agent and the agent will be motivated to work hard to achieve another success."^{2/} It is argued that this implies a concentration of efforts (on the most important crops, on those few practices which can be relied on to produce economic results) and the selection of widely imitable contact farmers (neither the most progressive nor the very weak). To encourage widespread adoption, emphasis at the outset should be on low-risk, low-cost improvements in cultural practices which are known to produce substantial economic returns. After the initial impact has been made and farmers' performance begins to improve, increasing attention will need to be paid to strengthening local research programs and improving the supply of inputs and credit through effective coordination; and the extension service itself will need to be adapted to the increasingly complex demands of its diverse clientele.

Area Three: General agricultural extension: A 'contact farmer' approach had recently been introduced in part of the area and meetings between them and field assistants appeared to be fairly frequent. Variations in frequency between villages suggested the absence of systematized work programming, however; the main determinant appeared to be urgency of local demand. Interviewed farmers felt that extension staff had something of value to offer on the subject of rice cultivation practices (including water control and fertilizer application) but not on the cultivation of other crops. Specialist advice about water management: The Agricultural Department's District Office contained no subject matter specialists in water management and there was no evidence that any field staff had any specialist knowledge in this field, apart from a few who had attended recently initiated in-service

^{1/} "Their low pay reflects their low status and low productivity. A vicious circle develops in which lack of success undermines the extension agent's self-confidence, making success even less likely. Since they produce little, there is no case for raising their standards of pay" (Benor and Harrison, op. cit., p. 8).

^{2/} Benor and Harrison, op. cit., pp. 12-13.

training courses in the project area. Collaboration in water scheduling: Apart from attendance by senior staff at the quarterly meetings of the Irrigation Committee at district level, there was no evidence of any kind of involvement in decisions about water scheduling. (Information on short-term variations in demand is collected in some detail by junior irrigation staff.) Coordination with input supply agencies: Liaison with the agencies supplying inputs and credit under the special report program (mainly for rice) was achieved through meetings of the Special Program District Committee. However, farmers reported difficulty in obtaining credit for items not included in the official "input" package. Data collection and monitoring: An administrative wing of the Agriculture Department collected statistics on crop yields and areas. Inspection suggested that, like those collected by irrigation staff, they were often full of error, both in initial field measurement and in subsequent computation.

Performance assessment: The exceptionally unfavorable FA: farmer ratio of 1:3200 was undoubtedly somewhat offset by the very high population densities, strong social cohesion and generally high standards of farming practice within most villages. Limited investigations suggested that the extension program was having some influence on farmers' decision-making, though there was clearly need for a strengthening of technical expertise, particularly with regard to crops other than rice and to water management; there was also some room for improvement in data collection. For the extension service to be made more effective the most immediate requirements were probably increased resources of staff and facilities and intensified in-service training, but substantial improvements also appeared to be needed in the overall management system.

Area Four: General agricultural extension: Very little first-hand information was obtained about the performance of the extension services in Area Four which (together with credit and input supplies and marketing services) are provided by the Farmers' Associations. However, one of the reasons frequently cited for the present very high quality of farm management on the part of most Area Four farmers has been the heavy emphasis given by government to agricultural research and extension work over the past 50 years. A wide variety of agricultural research programs continues to be sponsored by a Federal Commission and with a field assistant: farmer ratio of 1:300 (1:150 ha) in the project region, there is clearly scope for good dissemination and feedback. Specialist advice about water management: Agricultural staff contributed lectures on crop water requirements and methods of water application to training courses for the project's Small Group members; it may be assumed that advice on these subjects was also included in their regular extension meetings. Collaboration in water scheduling: Short-term demand issues were dealt with exclusively by the project authorities in consultation with Small Group leaders. However, Farmer Association and Project Authority staff collaborated on a number of medium-term programs requiring local alterations in water distribution patterns. Long-term strategic questions, involving significant changes in cropping or water scheduling patterns, would be discussed at a higher - probably technical - level. Coordination with input supply agencies: Activities could be

very closely coordinated, since a substantial proportion of all agricultural inputs were supplied by the FAs. Data collection and monitoring: Detailed information on agricultural production (unfortunately not disaggregated between irrigated and rainfed areas) is collected by separate agencies - the Township Councils.

Performance assessment: Another commentator has criticized certain aspects of the extension services in Area four, but his judgements were based on a very stringent criteria of excellence. He acknowledged that their performance, when compared with those of most extension services in developing countries was greatly superior. He was particularly struck by the high level of motivation of field staff. This was attributed to the fact that, like their counterparts in the Project Authority, they were mostly of rural origin and had personal interests in farming; many had had vocational secondary school training - i.e. education with a practical rather than an 'academic' slant. There were also substantial opportunities for in-service training and promotion on merit.

General conclusions. The Area Four experience was, generally, very different from those of the other countries visited although shining exceptions to the general rule were observed elsewhere also. From their positive examples as well as from the much more frequent negative examples elsewhere, the following general conclusions can be drawn:

- (a) Agricultural extension services in most parts of Asia are grossly underequipped, particularly in terms of field staff numbers, transport and accommodation. Staff, often including those at a higher level, also lack the necessary technical skills, particularly in the field of water management, as well as the necessary skills of communication with farmers. This inadequacy of resources and skills - a reflection of the low priority accorded by most governments to the activity of agricultural extension - guarantees ineffective performance. Ineffective performance in turn generates poor morale, which is a further guarantee of ineffectiveness. This serves to confirm official views about the low priority of agricultural extension, so that the following self-perpetuating cycle is established: low status - low investment - low pay - poor performance - low morale - low status. In all the countries visited, with the possible exception of Area Four (where the borderlines between agriculturalists and engineers were much less sharply drawn), the professional status of engineers was far higher than that of agriculturalists, and this was reflected in the investments made in the engineering sector and in their own personal rewards. One of the merits of the Development Authority organizational structure in areas where these conditions are the norm is that it can help to raise the status and the effectiveness of the agriculturalists vis-a-vis the engineers. This was seen to happen in Area Two, where engineers and agriculturalists were also working together in one project organization.

- (b) The essential keys to breaking the vicious circle of poor morale and ineffectiveness are adequate resources and facilities, a well-designed extension message and a management system which will ensure that the message is widely communicated. Once the extension program begins to be effective and stimulates client demand, this will in itself have a potent effect on staff morale even in the absence of significant changes in salary or promotion prospects. These additional incentives can follow later, and are likely to be much easier to negotiate once it can be demonstrated to politicians and senior administrators that the service is achieving a positive impact.
- (c) In the interests of promoting the objective of equity, the initial emphasis should be on widely imitable farmers rather than those classified as 'progressive' and the extension advice should start by focusing on the improvement of cultural techniques rather than on substantial increases in purchased inputs. Even this approach is unlikely to be successful in reaching a large proportion of the poorer, smaller farmers, especially in areas of marked social inequality. To meet their specific needs a more diversified and complex program will be required, but in most cases it is unlikely to be operationally feasible to launch it until the opening phase of the program has had its desired impact and been demonstrably successful. A sequential plan seems to be needed here.
- (d) The case for an organizational structure in which field staff are agricultural specialists and work under the direction of a single (agriculturalist) master is very powerful, and there should be no difficulty in getting it accepted in most countries. India is an exception because of its long-standing commitment to a 'community development' panchayati raj approach involving the use of a multi-purpose field level worker; there the introduction of major structural changes is inevitably attended by problems and careful planning is required to ensure that the creation of a cadre of agricultural specialists is not achieved at the expense of diminishing the funds and manpower available for the continuing provision of social service advice (health, nutrition, etc.) through employees of the panchayats. Elsewhere, the main requirement is to strengthen the existing extension structure, including the local research networks.

In the long run, it may be possible to contemplate the formation of Farmers' Associations of the kind used in Area Four, in which extensionists would be employed by a farmers' organization. But this entails the development of viable input supply and marketing businesses to help finance the extension work; and critics of the Area Four system have pointed out that, unless government is prepared to give differential subsidies to less-endowed areas, only the more prosperous areas are able to afford good extension services. There is a strong case for arguing that extension should

always be regarded as an essential social service and should therefore be a prime responsibility of the public sector. Over time, an increasing number of richer and better-educated farmers will be able to buy technical advice from the market-place, but there will continue to be a need for a public service to assist the rest.

- (e) We agree with Benor and Harrison that, except perhaps where a single high-value cash crop predominates over a large area, a single extension service with a 'farm management' approach, including a wide range of subject-matter specialists, is preferable to a proliferation of services specializing in particular products or activities.^{1/}
- (f) Within the organization responsible for providing agricultural services a specialization of functions is needed between advisory and other activities, wherever sufficient manpower resources allow it. Otherwise the demands made on the extension agent's time by the other tasks will erode his effectiveness in performing his primary advisory function; also the different management styles required for the performance of each function (advisory, regulatory, etc.) will usually be incompatible and will create problems for the individual concerned. Thus there should be, wherever administratively possible, a separate cadre responsible for the collection of agricultural statistics, either within the same organization or outside it. The same applies to input supplies and credit.
- (g) Finally, there is the question as to how much extension staff need or ought to be involved in any other aspects of irrigation management besides the provision of advice to farmers about field-level water management. In the case of short-term supply adjustments in response to local variations in demand, the degree to which they need to be involved depends mainly on: (i) the nature of the system design (density of control structures and scope for flexibility of operation); and (ii) the quality of the communication systems between water distribution staff and farmers. Where communications are poor and there is some scope for local adjustments in supply, field extension staff can play a useful role as negotiators on the farmers' behalf (as Area Two). But their intervention should not be needed where water distribution staff are in regular contact with farmers with regard to both the planning and implementation of water schedules, as in Area Four.

There is, however, a universal need for senior agricultural staff (both extension and research) to participate in the planning of seasonal schedules and in the long-term review of alternative

^{1/} Benor and Harrison, op. cit., pp. 9, 11.

cropping and water distribution strategies. In practice, seasonal plans are often routine exercises with little effective input from the agriculturalists and long-term strategic plans are rarely undertaken at all. These are crucial activities in which the role of the agriculturalists needs to be greatly strengthened. Their present weakness stems from the same imbalance between the influence of engineers and agriculturalists as can so often be found at the design stage.^{1/}

Two brief points may be worth adding. The first is that, despite the need in most developing countries for major increases in manpower and other resources to make agricultural extension effective in irrigated areas, these increases should on no account be made at the expense of rainfed areas.^{2/} The second is that, where material incentives are poor, the motivation of junior extension staff should be somewhat easier to achieve (at least in theory) than that of junior water distribution staff. Extension staff, by being effective, can generate widespread client satisfaction and thereby enjoy greater job satisfaction themselves. By contrast, increasing the effectiveness of water distribution staff frequently means antagonizing an influential section of their clientele, as well as depriving themselves of a source of unofficial income. If they are to be motivated to perform well, additional compensatory incentives are required beyond the level of those offered to extension staff.

8.4 Watercourse improvement and advisory services

In all the study areas, the official staff's direct responsibility for operation and maintenance of the irrigation system ends at the watercourse outlet. Below each outlet water distribution and maintenance work is the collective responsibility of all the farmers with land in the area commanded by it, although (on paper at least) officials are always charged with some supervisory responsibilities. The widespread failure of irrigation development agencies to promote effective farmers' institutions for collective O&M within watercourse commands has undoubtedly been a major contributor to poor overall management performance - although it cannot be too frequently emphasized that a necessary condition for good O&M below the watercourse outlet is a reliable

^{1/} See pp 57-60 and 76-77. Among the field study countries Area Four was the only one in which crop water requirement formula and water rotation intervals were based on field experiments carried out by agricultural research stations (p 130). An interesting example of lack of coordination between the work of agricultural researchers and irrigation system operators was observed by the author in Tamil Nadu, India: an agricultural research station was offering farmers advice about optimal irrigation intervals for different crops (e.g., 5 or 10 day intervals), but the local canal system was being operated on a strict 7-day rotation.

^{2/} Cf. p 82.

service of water distribution above it. Another essential condition is, of course, that the watercourse channels (and the associated drainage channels) are adequately designed and are physically capable of being well operated and maintained by the farmers concerned. Where this is not the case, the first requirement is a program of watercourse improvement or rehabilitation. Only after such work has been completed can effective advisory and institution-building work begin.

Not all the study areas were in need of extensive watercourse improvement work, but the organization and management of such work is substantially different from that of regular advisory work and it needs separate (and prior) discussion.

Watercourse Improvement. The amount of investment and manpower required for watercourse improvement work (often misleadingly described as 'on-farm development' work) varies greatly, according to the characteristics of the irrigation system concerned.

In certain extreme cases, as in Area Two, the provision of an adequate watercourse and drainage layout was entirely ignored at the time of main system construction. The installation of a satisfactory layout has therefore become one of the most important activities of project management and can, in effect, be regarded as a fundamental but much delayed part of the basic construction program. Because of the poor drainage properties of their soils and their uneven micro-topography, many parts of the project area can only be effectively rehabilitated through a comprehensive catchment-based program, requiring substantial land levelling and realignment of farm boundaries as well as construction of new irrigation and drainage channels. A complete wing of the Area Development organization (comparable in numbers to the irrigation group) is permanently engaged in planning, designing and executing the program. The average cost of the capital works involved has been in the region of \$350/ha.

The physical problems posed in Area One have been substantially less severe, although watercourse losses are undoubtedly very high. The watercourses originally laid out at the time of the Area One construction were technically adequate, though (in the absence of close supervision and advice) farmers have encountered considerable management difficulties because of the length of the channels, problems of maintaining a correct slope, and silt accumulation. Additional problems have recently been added in fresh groundwater areas because of the failure of the planners to make proper provision for the enlargement of the watercourses below the tubewells; this has contributed to the notably high watercourse losses in SCARP areas. As a result, there is a general need for watercourse rehabilitation and a further particularly urgent need for channel enlargement in public tubewell areas. Drainage is not a problem and the micro-topography is even; there is therefore no need for land consolidation or major land levelling work, as in Area Two. Following experimental work at a research station, a pilot program for watercourse improvement (largely consisting of channel realignment, improved earthworks and junction boxes) was introduced in the Area One region in January 1977, with mobile teams operating in

a few selected districts (none yet in Area One). Costs are in the region of \$10/ha of watercourse length, for improved earthworks, and up to \$100/ha in short sections of concrete lining.

In Area Three, the physical condition of most watercourse channels appeared relatively good; and drainage and micro-topography present no particular problems. On the other hand, this is a very densely populated, intensively cultivated area which is liable to severe water shortages in the dry season. Substantial benefits in the form of water savings and improved rotational distribution could therefore be expected to follow from an upgrading of the present watercourse layout (denser channel networks, channel lining, improved junction boxes, etc). In the area two Pilot Tertiary Projects have been constructed, to high technical standards, at a cost of \$355/ha, excluding farmers' labor. Meanwhile, in another area of the country, a more widely extended program of watercourse improvement is being executed with lower technical standards and at much lower cost (from \$35/ha upwards, depending on intensity of canalization, lining, etc).

In Area Four, programs to improve physical conditions within the watercourse commands have had the purpose of upgrading existing facilities (as in Area Three) rather than their rehabilitation (Area One) or new construction (Area Two). Much has been done through incremental improvements carried out over time by the Small Groups themselves, mainly in the form of channel lining, but there has also been a program of land consolidation in certain areas (about 30% of Area Four), most of which had drainage problems. In addition to improving the drainage, the rectangular layouts in these consolidated areas contain a dense reticulation of irrigation channels and provide access roads to each farm. The cost of such work in different parts of the country has ranged from \$175 to \$500/ha. More modest improvements to the watercourse layout, with the object of improving rotational irrigation (including a turnout gate at the 50 ha level, a measuring device and junction boxes for each 10 ha unit), have cost from \$50 to \$100/ha.

We were in no position to carry out detailed evaluations of these programs, which would have required a comparison of actual performance against objectives and an analysis of costs and benefits. We were however able to form some impressions about the quality of their organization and management through observations of the manner in which they were planned, executed and monitored. These are recorded briefly in the paragraphs that follow.

The first point to be emphasized about the Area Two program is that it has been confronted with far greater problems - both technical and social - than any of the others; those charged with planning and executing it have been faced with a formidable task. Before the present program was launched in 1974 under the new Area Development organization, several pilot projects had been undertaken for experimental and demonstration purposes from 1967 onwards. Some of these suffered from technical flaws and there was a failure to provide the farmers with follow-up advice about maintenance procedures, but they demonstrated clearly that, because of the drainage requirements, a comprehensive catchment development approach was required, involving reallocation of farmers' land. Farmers in the pilot areas were

generally quite cooperative, largely no doubt because there appeared to be clear benefits to be gained from major investments which were to be 100% subsidized. On the basis of this experience, detailed thought was given to the planning of the 'on-farm development' (ofd) program: work was to be carried out on catchments of c.500 ha; most seriously waterlogged areas were to be tackled first, since potential benefits and farmers' propensity to cooperate were expected to be greatest there; the work was to consist of a 'package' of irrigation channel realignment, drainage provision, and reallocation and levelling, and access roads to each farm; the collective agreement of all farmers within each catchment area was required for the work to be undertaken, though new legislation was enacted to empower the development authorities to carry out work compulsorily where necessary; and most of the costs of the work were to be paid for by the beneficiaries, through long-term loans (which could only be granted provided 70% of the outstanding debts of the beneficiaries had been cleared first). Numerous agencies from within the development organization were involved in this planning work: (a) the extension service (to explain the program to farmers and encourage their acceptance); (b) the revenue group (to check land records in preparation for boundary realignment and to recover certain outstanding loans); (c) the Cooperative Group (to recover other overdues); (d) the revenue section of the Irrigation Group (to recover overdue water charges); (e) a special credit officer (to prepare farmers' loan applications); and (f) the Land Development (ofd) Group, to survey and prepare detailed plans for each catchment.

Execution of the ofd program was extremely slow to start and was soon well behind the planned schedule. The chief reasons for this were the extreme difficulties of recovering outstanding debts before loans could be issued; complexities and delays in the loan allocation procedures; disagreements within the organization as to whether land levelling (a major cost item) should be made an obligatory part of the work and be executed by Land Development staff, or be left to the farmers themselves to carry out voluntarily at lower cost; the shortage of time available for the work within the designated summer months; and problems of coordination between different development of groups, especially Land Development and Irrigation. On the first catchment to be completed, little land levelling was in fact carried out - reducing farmers' costs considerably but also creating the danger that if crop yields were poor as a result farmers would use this as an excuse for not repaying. A sample survey of farmers within the catchment concluded that preliminary consultation with them had been inadequate, that they had not been made fully aware of the program's financial implications, and that a greater range of technical options should have been offered to them. Subsequently, the pace of the program has been speeded up, partly no doubt because of lessons learnt by the authorities in the initial period of planning and execution, and partly because of increasing farmer confidence once the first catchment was complete and its benefits were demonstrable.

Provision has been made to monitor the costs and benefits of the program through the establishment of a monitoring unit within the development organization; and the program has also been subjected to a searching external evaluation. Final judgement must be reserved until the results of the program can be viewed over a longer-term perspective.

The short-term impression is that the basic strategy was correctly conceived; but (with the wisdom of hindsight) it is now clear that the loaning conditions were far too complex and stringent, that the initial insistence on a comprehensive and undifferentiated 'package' unnecessarily restricted the range of technical and financial options which were feasible, and that quicker and better results could have been achieved through closer consultation with farmers. A disturbing conclusion reached by the external evaluators was that on the first completed catchment area virtually no provision had been made for follow-up extension work on operation and maintenance; it was assumed that farmers would do this on their own. Because of the attention given in this program to monitoring and evaluation, these lessons are no doubt in the process of being learnt and acted upon.

Despite problems of coordination between the Land Development Group and other sections of the organization during the planning and follow-up stages, the organizational structure appears to have been broadly correct: the Group was staffed by agricultural engineers, seconded from the Agriculture Department, the more senior of whom had worked in the project area since on-farm development experiments began the late '60s; and coordination would undoubtedly have been much poorer in the absence of the unitary Area Development structure.^{1/}

The pilot program for watercourse improvement in the Area One country was preceded by a major externally-supported experimental program which included research on water losses on unimproved watercourses, technical and economic analysis of alternative improved designs on reconstructed watercourses, and investigations into the institutional requirements for increasing collective responsibility for watercourse O&M. Some additional 'action research' was undertaken on a pilot watercourse by staff of a local university. An unfortunate weakness of the program was that its terms of reference confined it strictly to investigations below the watercourse outlet, with the result that the degree to which watercourse losses could have been reduced by better main system operation were never ascertained. Within this serious limitation, the conclusions drawn from the work concerning optimal watercourse design and local institution-building were very sound.

The same approach to design was taken up in the new government pilot program, which was directed by a section of the Agriculture Department. In relation to the vast area to be covered, the initial staffing of the

^{1/} At the time of the author's field visit to Area Two (early 1976), execution of the program had not yet started and it was therefore possible only to observe its preparatory planning. A brief return visit was made in late 1977. Since then an excellent account of the program and the early phases of its execution has been written by an external evaluation team whose views have been drawn upon in the above summary.

program was very small indeed - the principal constraint being the shortage of qualified agricultural engineers (this is only a relatively newly introduced discipline and until very recently job opportunities in the field for soil and water management work have been virtually non-existent). However, in-service training is being provided at a new Water Management Training Center, with a view to rapidly expanding staff numbers and building up to a complement of 40 mobile teams. It is intended that, once each team has completed its work over a compact area of about 20,000 ha, a Land Development Officer should be left behind to supervise watercourse maintenance and farm-level water management in the area. He would act as a subject-matter specialist, working through the existing extension organization. The program appears to be generally well-conceived, but recent reports suggest that, as in Area Two, follow-up extension work on institution-building and watercourse maintenance is tending to be neglected. The work of this program was not observed at first hand, but part of the problem may have been that the physical rehabilitation teams were under pressure to do too much in too short a time; and the decision to make their services available to farmers on a 100% subsidy basis (excluding farmers' labor) was almost certainly a serious mistake, since farmers' propensity to maintain a system tends to be much greater where they have invested substantial resources of their own in its improvement.

The program of Pilot Tertiary Projects (PTPs) recently initiated in Area Three with World Bank support was preceded by some research on water losses on unimproved watercourses, but this was much less detailed than the work done in the Area One country. Local conditions of topography, soils and water availability are much more variable than in Area One and there is therefore a correspondingly greater need for local experimentation with alternative approaches to technical and institutional improvement. All major construction on completed PTPs was undertaken over a relatively short period, with all costs except farmers' labor borne by government. Layout and level of infrastructural investment appears to have been heavily standardized, varying little from one PTP to another. Technical standards adopted were high and the costs were very high indeed (about the same as Area Two, where a large proportion of total costs were associated with drainage and land levelling work, not required in Area Three). In addition to construction work, the program also made special provision for training farmers in watercourse management and the development of stronger local institutions at the quaternary and tertiary levels (irrigation and extension staff were also trained to enable them to carry out this work). Provision was also made for internal monitoring of the performance of the PTPs.

If performed objectively the monitoring exercise could have provided a sound basis for an evaluation of the program's strengths and weaknesses. Unfortunately, however, the results of the monitoring were valueless, because the PTPs were being given preferential access to water and other inputs over other areas. This was apparently being done in order to 'demonstrate' to farmers the superiority of the PTPs' performance to those of the surrounding watercourses. However, these practices clearly rendered the 'demonstrations' invalid and deprived the monitoring activities

of objectivity and meaning. The only scientific basis for an objective evaluation of the social and economic costs and benefits of the PTPs would have been the provision of exactly equal treatment (in terms of all inputs, especially water) to all watercourses in the locality, improved and unimproved alike.

In the absence of such data, only general observations are possible. The program can be commended for its emphasis on farmer training and institution-building - although, ironically, Area Three is already much better endowed with effective local institutions than Areas One and Two. Fairly severe criticism must however be labelled at the excessively technocratic approach used in the planning and implementation of the physical improvement program. Though significant economic benefits could no doubt be expected to accrue from a certain level of physical improvement as a result of having scarce and valuable dry-season water supplies, no attempt was made to experiment with alternative designs before proceeding with the one selected. Consultation with farmers about the designs was minimal, and their high capital costs (100% subsidized) and abnormally high levels of administrative supervision guaranteed that they would be unreplicable on a large scale. The whole program appeared to be based on the assumption that inefficiencies on the main delivery system were attributable solely to technical causes and the major problems of management began only below the watercourse head. Our own investigations into main system management have shown this assumption to be wholly erroneous. The correct approach would have been to look at the issue of watercourse management in the context of management practices on the system as a whole; to adopt a more experimental approach to the design of watercourse layouts, involving close consultation with farmers and a substantial financial contribution on their part to the costs of the improvement work; and to establish a carefully designed and objective local monitoring system.

Many lessons could still be learnt from the experience of the much more flexible program promoted by the Agriculture Department in an adjacent jurisdiction, which requires a high degree of farmer participation in the planning and implementation of improvement works, at far lower cost. External assistance is provided for survey and design work, but a substantial proportion of total costs has been borne by the farmers themselves; and they decide what level of investment should be made. This has led to the initial adoption of considerably lower levels of technology, but the approach is one of gradual, incremental improvement. In addition to being much more easily replicable than the PTP program, it holds out better prospects that farmers will sustain a long-term commitment to further investment and regular maintenance.

No investigations were made into the detailed processes whereby the watercourse improvement program in Area Four had been carried out. However, it was interesting to find that the areas which had received highest priority for the more radical land consolidation program were ones with serious drainage problems. Although the denser networks of irrigation channels in these areas in theory permitted a higher degree of

control over rotation of water in periods of greatest water scarcity, it was found that strict micro-rotation was practised only in a very few of these areas; this was where the pattern of water supply from the main system was characterized both by scarcity and by a high level of predictability. Elsewhere, water was either abundant enough, in which case the need for micro-rotation never arose; or there was too much fluctuation and uncertainty in the supply pattern to make it practicable. This finding underlines the point that land consolidation/'on-farm development' is not in itself a sufficient condition for successful micro-rotation and, conversely, that the returns to strict rotational irrigation are significantly reduced if water supplies are uncertain and/or relatively abundant. The chief benefits of land consolidation to the farmers in the areas concerned were better drainage and (a point which was becoming increasingly important with the rapidly growing mechanization of Area Four farming) the provision of farm access roads. In unconsolidated areas, the strongest interest in consolidation (offered with a 50% government subsidy) was shown in tail areas of the main system; farmers in these areas saw potential benefits from the opportunities which a denser layout of watercourse channels would give for improved water distribution, as well as from the increase in access roads.

Comparison of experience in the four study areas allows the following general conclusions to be drawn:

- (a) Before embarking on a major program of watercourse improvement (of any kind - whether its purpose be new construction, rehabilitation or upgrading), the management of the main distribution system should be thoroughly investigated and, as far as possible, improved within the constraints of the existing design; the extent of the work needed at the watercourse and farm levels can then be seen in the correct perspective.
- (b) Where there is found to be a need for substantial redesigning of watercourse layouts, work carried out on them must be consistent with the design (or redesign) of the main system; where different agencies are responsible for work at the two different levels (usually civil engineers above the watercourse outlet and agricultural engineers below), particular care must be taken to secure close coordination in overall planning.
- (c) In areas where there are major waterlogging and/or salinity problems and sub-surface drainage is infeasible, the only satisfactory lasting solution will be provided through a realignment of irrigation and drainage channels along carefully graded contours; this in turn implies the need to achieve collective agreement by farmers within each catchment area to land reallocation and a realignment of farm boundaries; in order to secure the cooperation of these farmers as a group, the planning agency must be prepared to devote substantial resources of time and personnel to consulting them closely, allowing them to participate directly in decision-making and keeping them fully informed of all final decisions.

taken; as a last resort the agency must also be able to apply legal sanctions in the event of individuals' obstruction of work agreed to by the large majority.

- (d) Before attempts are made to introduce a watercourse improvement program over a wide area, experimental pilot projects should be established in different localities; the number of pilot projects needed will depend on the variety or homogeneity of the physical and social conditions within the region concerned.
- (e) Except in the case of items of improvement which are considered essential on long-term environmental grounds (drainage facilities in particular), farmers should be offered a range of technological choices (e.g. with respect to land levelling, channel lining, farm roads); to assist farmers' choice, pilot demonstration areas should be designed in such a way that the likely costs and benefits of alternative levels of investment can be clearly illustrated.^{1/}
- (f) To encourage continuing group responsibility for subsequent operation and maintenance, the beneficiaries should be required to make a substantial contribution towards the costs of work they have agreed to have carried out, though especially in cases where high costs are inevitable care must be taken to ensure that upper limits are set on their contributions in accordance with their capacity to pay.^{2/}
- (g) Farmers should be encouraged to participate actively in planning and construction activities; the principal function of the development agency concerned with the improvement of a particular watercourse area should be preparatory extension and consultation work, technical and social survey, assistance in planning, detailed design work, assistance in construction, provision of follow-up extension, and objective monitoring of technical, economic and social factors (before/after, and with/without project).
- (h) Where major works are required, involving particularly large inputs from the official development agency, a permanent Land Development wing should be included within the project organization, but elsewhere mobile teams are likely to be more appropriate; chief responsibility for the work should be given to civil engineers; where, as in many countries, demand for their work

^{1/} One very simple and effective method of demonstrating the benefits of watercourse improvement to farmers is to compare the time taken to irrigate a field at the tail-end of a watercourse under improved and unimproved conditions.

^{2/} Compensation should also be given, in cases like Area Two, for losses in production brought about by fundamental deficiencies in the original design of the main irrigation system.

greatly exceeds their supply, substantial investments will be required to expand basic and in-service training courses; the numbers of official staff required to direct an improvement program effectively will vary greatly from place to place, depending on the technical complexity of the work required and the capacity of farmers in the locality concerned to reach collective agreements and work together in groups.

- (j) Once the construction of improvement works has been completed, adequate provision must be made for follow-up extension work to ensure good operation and maintenance; the responsibilities of official staff and farmers with regard to watercourse O&M work must be clearly defined and understood.

O&M Advisory Services. On any large irrigation system where primary responsibility for watercourse O&M is in the hands of farmers, it should be one of the regular and continuing tasks of the official operating agency to supervise their activities, strengthen their capacity for communal decision-making and joint action and extend the adoption of improved O&M techniques (e.g. rotational irrigation). A precondition for the effectiveness of such work is that the basic design of the watercourse command should not be so deficient as to make significant improvements in operation and maintenance impossible - a condition not met in Area Two, but met in all the other study areas. In fact, the amount of work of this kind done in any of the areas visited was very limited indeed, with the exception of Area Four.

In Area One the stated responsibilities of the Irrigation Department below the watercourse outlet are confined to establishing official rotational irrigation schedules to which farmers are expected to adhere; providing advance notice of canal closure dates and the expected periodicity of canal rotations, if any; checking on standards of watercourse maintenance; and disciplining farmers in the event of damage to irrigation facilities or water stealing. Of these, the most conscientiously performed task was probably the design of rotational schedules. Otherwise intervention in farmers affairs was largely limited to assessing and collecting water charges and to punishing offenses against the irrigation rules. It has not been part of the Department's terms of reference to train farmers in techniques of watercourse O&M or to help organize them for the purpose; nor has it had the necessary staff which would have enabled it to do so. Watercourse management staff have however been employed in the Mona experimental area and it was the original intention of the State Agriculture Department's pilot program that this pattern should be widely extended.

A rather bizarre situation had arisen in Area Two at the time of the field study as a result of insistence by the CAD project's financial supporters that all watercourses within the project area should adopt the rotational system of irrigation within a period of two years from the start of the project's rehabilitation program and that water users' associations should

be set up within each watercourse command. Because of this insistence, project officials were under pressure to claim major progress in both these respects, but visits to the field quickly revealed that most of their achievements had been made on paper only. This was hardly surprising, since the conditions in which either of these objectives could have been realized had not yet been created. In the absence of the necessary physical controls on the main system, head-reach areas were saturated with water and supplies to the tail, if any, were meager and irregular. In such circumstances, rotational irrigation was impossible and the creation of water users' associations an irrelevance. Makeshift attempts by project authorities to use water revenue staff as part-time extension advisers on watercourse management were commendable, though of doubtful utility. It was clear that a logical sequential approach to planning would have called for very low priority to work of this kind until after the completion of the physical improvement works. Ironically, now that the time has arrived when this advisory work is beginning to be urgently needed in the wake of old activities, it is reported that adequate follow-up services are not being provided.

There is much more regular contact between official staff and farmers in Area Three than in Areas One or Two - particularly between the most junior official and the village 'common irrigator'. Contact is particularly frequent in Area Three because the system of water distribution requires the junior officials to collect estimates of cropped area from the common irrigator every ten days. It has not however been a traditional part of the junior officials' task to advise farmers on watercourse O&M to help build up local institutions. Since farmers are highly skilled in the techniques of irrigated agriculture and there is an unusually strong community spirit in most Area Four villages, this omission cannot be regarded as a matter of such grave concern as in Areas One and Two. In the new Pilot Tertiary Project areas, however, the practice has been introduced of engaging some watercourse management extension staff on a regular basis.

It was only in Area Four that sufficient importance was attached to watercourse affairs for a separate section within the project organization to be specifically charged with responsibility for work in this area. The principal concerns of the Project's Supervision Section (part of the Management Division, which also oversees water distribution) are with training members of the Small Groups; providing adequate opportunities for feedback of information and requests from SGs to Project management; and discipline. Training activities are directed mainly at improving water distribution (rotational practices, functions of the SGs' Common Irrigators, etc.); improving maintenance; and improving the collection of membership fees. In support of their training activities annual competitions are organized among SGs, with testimonials and small prizes going to the most meritorious. Infringements of the irrigation rules (water stealing, etc.) are normally dealt with internally by the SGs themselves and the Supervision Section only intervenes if a dispute cannot be resolved without reference to a higher authority. The general prevalence of good discipline on the part of present members, despite a marked reduction in reliance on 'irrigation police' (a potent deterrent in years gone by), can be attributed to a long and cumulative process of careful training and education.

If it is found beneficial to have a special section of the project organization to advise the advanced farmers of Area Four about watercourse management, it can hardly be doubted that similar units are also required elsewhere. In their case, the need appears to be for an entirely new cadre of watercourse management extensionists, made up largely of junior staff with similar backgrounds and levels of training to the junior agricultural extension staff. They could be directed and supervised by the same senior officials who are responsible for water distribution or (as in Area Four) by a small separate group of specialists. On no account should agricultural extension staff be asked to take on this work because (a) it would divert their attention from their other work; (b) the activity to which this work is most closely linked is water distribution; and (c) a significant part of the work is likely to be concerned with the resolution of local conflicts over water and the imposition of discipline - functions which are incompatible with, and damaging to, the agricultural extensionist's intended primary role as each farmer's individual counsellor and friend.^{1/}

The intensity of staffing needed for the effective performance of this function is likely to vary greatly, depending on the present level of technical skills of the farmers in the areas concerned and on their capacity to work together in the common interest. In certain societies, characterized by wide disparities in income and status and an absence of local cohesion, there can be expected to be many initial difficulties in generating a sense of greater communal responsibility; for a watercourse advisory service to be effective in these conditions, high staffing levels are strongly indicated. A particularly important point to note in such circumstances is that until a greater natural capacity for group action does begin to build up, small farmers and tail-enders, if offered the choice, will tend to favor the stricter application of external rules capable of protecting their interests rather than have a premature devolution of responsibilities to a water users' group. For example, a survey of farmers in the first completed ofd catchment in Area Two revealed that smaller farmers in particular had a much stronger preference for close external supervision of water distribution within the watercourse than for a relaxation of supervision in favor of more local responsibility. Similar reactions have been observed elsewhere and underline the heavy inputs of extension work required in many cases before truly representative watercourse groups can begin to take shape.^{2/}

^{1/} On the importance of trying to avoid giving a single cadre responsibility for functions which involve incompatible management styles, see R. Chambers, "Two Frontiers in Rural Management: Agricultural Extension and Managing the Exploitation of Communal Natural Resources", op. cit., p. 437.

^{2/} ... Other evidence from the Philippines has been reported by P.S. Ongkingko, "Organization and Operation of 15 communal irrigation systems in the Philippines", in IRRI, Water Management in Philippine Irrigation Systems, Research and Operations, 1973, p. 242; and by T. Wickham and A. Valera in "Practices and accountability for better water management" in ADC, Irrigation Policy and the Management of Irrigation Systems in Southeast Asia, 1979, p. 72.

8.5 Management Support Services: Finance, Personnel and Monitoring

The principal support services required to assist project management in the performance of its field activities are finance and budgeting (including revenue assessment and collection); personnel management; and planning, research and monitoring.

Finance and budgeting. In all the study areas except Area Four, financial management at the project level is conceived as consisting of two separate and largely unrelated activities: the assessment and collection of water charges (or land tax in the case of Area Three) on the one hand, and budgeting and accounting on the other. Separate units are used to perform each task in Areas One and Two, the irrigation wings have revenue sub-sections with large staffs employed exclusively to assess and collect water charges, under the direction of the Executive Engineer (Canals). In Area Three, where there are no water charges, a land tax is collected by the District administration. In all three cases budgeting and accounting are carried out by clerical staff attached to the offices of senior engineers (Superintending and Executive Engineers in Areas One and Two; District and Section engineers in Area Three).

No attempt was made to carry out detailed assessments of the work of revenue staff. Despite very low average annual rates for water charges (c. \$4/ha in Area Two; c. \$5/ha for canal water only in Area One, and c. \$10/ha for canal and tubewell water) recovery rates were also very low - about 48% in Area Two and 60-70% in Area One. Land tax rates in Area Three were relatively high (on average c. \$14.50/ha), with farmers making large additional payments to their common irrigators for watercourse O&M expenses (maybe up to another \$14); but information was not obtained on recovery levels. The poor recovery rates in Areas One and Two do not necessarily reflect badly on the water revenue staff themselves. In Area Two it is clearly associated with the great difficulty which many farmers have in obtaining water reliably or at all; and in Area One there was evidence that farmers in tubewell areas were particularly reluctant to pay - again no doubt a reflection of the poor water distribution services they were receiving.

A common criticism of the land and water revenue system used in large parts of Areas One and Two (which involves recording the precise area under each crop and charging different rates accordingly) is that it encourages corruption between officials and farmers and does nothing to promote attitudes and relationships which are conducive to agricultural development. It is often urged that these systems should be abolished and replaced by a simpler tax, such as the 'flat rate' combined land-and-water tax recently introduced in Sind. Certainly there is a strong case for simplifying the present structure of water charges, as well as some of the elaborate procedures now in force, particularly since average water charges are so low and the additional administrative costs entailed by the use of so many rates cannot possibly be justified. On the other hand, the value, or

potential value, of the revenue records as an input to the planning of water allocation (particularly in tubewell areas) should not be forgotten.^{1/}

In view of the very limited powers of senior irrigation staff in Areas One, Two, and Three to influence the amount of recurrent expenditure allotted to them by their government departments, budgeting and accounting are largely routine activities in all cases. The annual budget is little more than a 'shopping list', intended to squeeze a little more out of government than the usually inadequate sum it is expected to provide. Budgeting and accounting procedures in the Area One and Two projects were specified in detail and appeared to be followed conscientiously and efficiently by the engineers and clerical staff concerned, though very tight control over the delegation of financial responsibility down the official hierarchy clearly worked against flexibility in decision-making and the development of initiative at lower levels. In Area Three, however, the quality of budgeting and accounting appeared to be substantially poorer.

In Area Four leading responsibility both for revenue matters and for budgeting is vested in the Finance Division, which in the view of the Project Chairman ranks second in importance after the Management Division (water distribution), ahead of the Engineering Division (maintenance). The reason for its importance is that, unlike the other study areas, Area four is obliged to depend for a very large proportion of its total finances on its members' fees. Revenue generation is therefore an integral part of the planning and budgeting process.

In 1976 the Project Authority recovered all its recurrent costs and a proportion of its capital costs through membership fees. At \$87/ha average fee charges were very high (\$60/ha for canal and drainage O&M, \$20/ha for tubewell and pumps O&M, \$7/ha towards new construction and rehabilitation work). Levels of recovery were also high - 97.8%: 40% of all the project's Small Groups were reported to have achieved 100% recovery rates. This may be attributed largely to the good service given by Project staff to its members (in the tail-end area which had been experiencing unreliable water supplies several years previously, farmers had been refusing to pay their fees on the grounds of "poor service": recovery levels in the area fell to 28% - in the case of one Working Station, 3%). Recovery is also reported to have improved since Small Group leaders were given responsibility for fee collection on behalf of the Finance Division - an innovation introduced in 1975. The Finance Division is very active in pursuing late payers, imposing fines after 30 days from the date of billing and then instituting court proceedings if members fail to pay within another 30 days. According to the senior official in charge of fee collection, "the courts never fine in favor of the farmer".

^{1/} Despite widespread allegations of 'malpractices' by water revenue staff, it was estimated by local researchers that inaccuracies in their records usually did not exceed 5-10%.

Two possible criticisms could be made of the methods of fee assessment, however. The first is that fee rates are based on variations in actual O&M costs in different areas and do not reflect the very different quantities of water delivered to areas with different cropping patterns; they are thus very inequitable in terms of the amount of water supplied.^{1/} The other is that, as a result of a policy which has allowed Small Groups to vote for the retention of a proportion of their fees for reinvestment in their immediate locality, there are now over 100 rates at which fees are charged within the project, many varying only marginally from each other. This creates substantial administrative difficulties and costs: even with the use of a computer, bill preparation still takes 2 man-months (as against 30 man-months before the computer was introduced.)

Budgeting in Area Four is a dynamic activity, very different in character from the passive preparation of 'shopping lists' which is common elsewhere. In preparing the annual budget various alternative allocations of expenditure are considered in detail, both among different categories (new construction, maintenance, staff salaries, Small Group activities, etc.) and within each category. To some extent budgeting is also a participative process: the maintenance program is built up through a submission of plans from the Working Stations which are passed upwards to headquarters, and the planning of the Small Group programs involves similar consultation with local SG leaders. And, although the budget has to be prepared within fairly stringent government guidelines and is closely inspected before approval is given to the contribution of government supporting funds, the project management is given some further flexibility by the fact that the ability to increase its total funds from the source of membership fees is to some extent within its own power.

In addition to having greater choice over the spending of their money than their counterparts elsewhere, project managers are also under heavier pressure to account for what they have spent. The Area Four Project Authority accounts for its budgeted and actual expenditure in remarkable detail. The pressure for accountability comes from two quarters. First from the government, which has traditionally expected projects to depend heavily for their finances on membership fees and to use the minimum of government subsidy possible; and secondly from the members themselves; in the absence of a Representative Committee, they have no means at present of voting how much their overall membership fees shall be, but the project management still needs to have their confidence and support in order to ensure that fee recovery levels are high and one way in which it can seek to do so is by demonstrating to them that their contributions are being well spent.

Personnel Management. As with budgeting, personnel management has a much wider meaning and scope in Area Four than in the other study areas - and for the same reason. Owing to the much greater degree of financial

^{1/} But see also Section 9.3.

autonomy it enjoys as a result of its heavy dependence on members' fees, the project management is in a position to recruit staff on a long-term basis, offer them periodic bonuses when finances allow it, and promote them within the organization. By contrast, on the projects where financing is dependent wholly on external budget allocations from government, project managers have virtually no formal powers to influence salaries or promotions, and they themselves as well as their qualified staff are subject to frequent transfers to jobs in other parts of their country's irrigation bureaucracy.

Frequency of transfer (often every 2-3 years) is a common feature in most irrigation schemes in developing countries, particularly on the Indian sub-continent, and is probably one of the most damaging to morale - both of the individual officials transferred and of the organizations to and from which they are being moved. The transfer decisions are usually made by personnel officers located in departmental headquarters, who often know very little about the individuals concerned. Since they expect to be transferred after relatively short stays in each posting, few officials are likely to feel that they have a special stake in the success of the particular project they happen to be working in; and the morale of locally-appointed junior staff is unlikely to be enhanced by the lack of continuity among their superiors.

The demoralizing effects of frequent and often arbitrary transfers within the Irrigation Department of Andhra Pradesh has been described by Robert Wade:

".....Engineers see themselves as subject to remote and inconsiderate decisions about transfers by the personnel manager of the Irrigation Department. They have no legitimate way, they believe, of informing the personnel manager of their particular circumstances and preferences. Until the mid 1970s, one man, assisted by clerks, handled all personnel matters which came to departmental headquarters: all promotions from Junior Engineers upwards, all transfers of JEs and Assistant Engineers beyond the Circle, all transfers of Executive Engineers and Superintending Engineers, pension matters, leave applications for EEs and above. There are 2000 JEs, 1120 AEs, 374 EEs, and 70 SEs. The personnel manager is a man of SE rank, without any training in personnel planning. In 1975 he was given an EE assistant, equally untrained. It is hardly surprising, then, that from the standpoint of any particular engineer he is subject to remote and impersonal decisions - which have a vital bearing on his life and that of his family. Stories are legion of men who unexpectedly received orders to report to another post at the other end of the state in seven days time, in the middle of their childrens' school term." 1/

1/ Robert Wade, unpublished paper.

This situation is in total contrast to that prevailing in Area Four. There one of the most striking features about the staffing structure is the very long time which senior (non-graduate) field staff have been working on the project - some of them for over 30 years. Most of them are natives of the area and know it intimately. The ability to provide this continuity of employment is, of course, crucially dependent on a capacity to offer junior staff opportunities for regular upward mobility within the organization as a result of its flexible promotion policies. These have placed almost as much emphasis on local knowledge and on-the-job experience, backed by in-service training, as on academic qualifications. Elsewhere, locally employed staff may be found who have worked on the same project for similarly long periods, but in the absence of significant opportunities for promotion, it can hardly be expected that the same degree of incentive and loyalty will be generated.

For those projects which are almost wholly dependent on external decisions with regard to recruitment, salaries and promotions, the scope for 'personnel management' is largely limited to ensuring that subordinates are closely supervised and controlled. In other words, project management has sticks to wield but very few carrots to offer. Getting good results from staff in such conditions calls for very careful judgement, and the danger is that it will encourage either a very authoritarian approach or a very permissive one.^{1/} Where junior staff were fairly closely supervised, as in Areas One and Two, unusually authoritarian behavior was not observed; on the other hand, permissive attitudes were apparent in the tubewell portion of Area One and in Area Three.

In Area Four managers had far more room for maneuver in their relations with their junior staff since they were able to use a judicious blend of sticks and carrots. There was no evidence during the field study of management having to resort to heavy use of the stick; supervision and control were largely achieved through well-devised techniques of monitoring staff performance in the execution of particular activities (water distribution, fee collection, maintenance, etc). Reports on the performance of each staff member are also studied annually by a Review Committee, headed by the General Manager. But these provisions for management control are balanced by a good information feedback system from field staff to headquarters and measures such as the annual competitions between Management Offices and Working Stations, which provide additional means of stimulating incentive. Moreover, all staff down to the Working Station (1500 ha) level are actively involved in the planning process and substantial executive responsibilities are delegated to them.

Planning, Research and Monitoring. For the effective management of large organizations such as the irrigation projects studied, there is a need at project headquarters for the supporting services of a small but well-trained multi-disciplinary unit for planning, research and monitoring. Its purpose

^{1/} Or it can lead to a combination of both. Wade found in Andhra that senior irrigation officials were authoritarian in their manner towards subordinates, but were permissive in practice with regard to the enforcement of irrigation rules (p.137).

should be to assist project management in the overall planning of annual work programs and monitoring performance against selected objectives and targets, as well as carrying out more specialized research or monitoring work (of a technical, economic or management nature) in particular subject areas such as water distribution. Its capacity to be effective is likely to be closely linked with the development of well-planned management procedures: indeed it should be one of its functions to test existing procedures and suggest possible improvements in methods of data collection and analysis.

None of the projects studied (including Area Four) had units with capabilities of this kind. Monitoring on Area One was confined to recording canal discharges and cropping patterns (from irrigation revenue records) and to recording tubewell operating schedules (unreliable), groundwater depths and water quality. Much of this information could have been organized in such a way as to monitor productivity and equity with some degree of effectiveness (despite lack of information on crop yields), but in fact it was not used systematically for that purpose; instead, apart from the data on groundwater depths and water quality (collected by external monitoring agencies), it was mostly filed away and only collated if some information on past performance was required for an Annual Report.

In Area Two, a monitoring unit was set up shortly before the field visit with the object of monitoring the project performance in terms of increased agricultural output, with particular emphasis on the agricultural extension and ofd programs. The unit was staffed by economists and statisticians. It was too early to judge whether it was going to be used exclusively for the purpose of measuring actual performance against government or donor agency targets or as a dynamic tool of management as well.

In Area Three, two new monitoring initiatives had recently been introduced. The first was the internal assessment of the watercourse improvement carried out under the Pilot Tertiary Program, which turned out to be fraudulent. The other was a Water Operations Center, which had only just been set up to assist the Section Engineer with water allocation planning and monitoring. Inspection of its early work revealed inaccuracies. However, its intention was good: there was certainly a need for the abundant data being collected on water distribution to be more effectively analyzed for planning purposes. Most of the data which passed through the Section and sub-Section offices, in addition to being inaccurate, was not used for management purposes but was merely compiled and aggregated for inclusion in routine reports on past performance.

In Area four, there was a small research and monitoring unit within the Chairman's office which was largely concerned with technical problems (e.g. improvements in the planning of water scheduling, research into alternative methods of water application and system maintenance, and monitoring of water conveyance losses). The functions of overall planning, budgeting and work programming were effectively performed by senior managers in association with the specialist sections concerned, without the unit's assistance. The only weakness in the system was that, because of a division

of responsibilities with the Farmers' Associations and in the absence of economists and other social scientists, there were some deficiencies in the monitoring of certain very important aspects of project performance - productivity in particular (i.e. there were no accurate statistics on crop yields).

The principal criticism of the data collecting activities of the projects studied is not that they failed to collect enough but that some of it was inaccurate, and that it was not selected or analyzed in a way that made it effective as a tool of management. Even the particularly difficult problems associated with measuring the productivity of water could in most cases largely be solved through a better organization of existing data.^{1/} If planning, research and monitoring units are to be set up for the purpose outlined here, it is essential that their information needs should be precisely identified beforehand and that a management information system be built up specifically to meet these needs. This could lead in many cases to very large reductions in the amount of time at present spent by numerous people on collecting and processing data which have little or no operational utility.^{2/}

^{1/} For present problems, see p 44 - 45.

^{2/} For an example of a management information system drawn up for developing country conditions, see R.C. Terry, "MIS Development Project for the Bangladesh Agricultural Development Corporation", Ford Foundation, Dacca, October 1977 (mimeo). Major weaknesses in the existing system were identified as report delays; excessive detail; forms poorly designed; too many reports; data wrong or "doctored"; and needed data lacking.

9. Priorities and sequences for action

9.1 The primacy of procedures

The most common of the major weaknesses in organizational structure and management process which have been discussed in the last three chapters are listed in Table 9.1, together with what appears to be their most appropriate remedies. A principal concern of any agency engaged in planning a programme of organizational and management reform in a particular context must be to establish the priority which should be given to the component parts of that programme, both in terms of the expected importance of their impact on performance and in terms of their temporal sequence. In many cases it is probable that high priority of importance should be given to overcoming certain fundamental structural weaknesses. However, as the Table clearly shows, most of the remedial action required for this purpose is fairly controversial, requiring high-level policy decisions, and/or involves a relatively long gestation period before its effects can begin to be felt. Temporal priority therefore needs to be given to other measures which are less controversial and easier to introduce. Foremost among these is procedural reform.

We strongly endorse the views of Robert Chambers about the 'primacy of procedures,' ^{1/} not only because procedural reform can be relatively quickly and painlessly introduced but because it is so often of central importance in its own right. Procedures are important for a number of reasons which have already been mentioned in the course of this report but it may be useful to give further consideration to their range and significance here.

First, there is the general point made by Drucker that in the case of any public service institution the clear specification of objectives and methods of achieving them is particularly vital because of the tendency for management and staff to be deflected away from those objectives in the absence of a system of payment which is directly affected by customer satisfaction. In this context he places special emphasis on the need to establish a clear idea of the organization's function and mission and then of its objectives and goals; to identify clear priorities, and with them targets, standards (minimum acceptable results) and deadlines, and an explicit indication of who shall be accountable for the results; and to develop measurements of performance for the purpose of feedback and day-to-day monitoring as well as for a longer-term audit of objectives and results. ^{2/}

A second reason for giving such high priority to procedures is that they are of particular importance in the context of the management of

^{1/} The phrase is quoted by Leonard, op. cit., p. 218.

^{2/} Drucker, op. cit., p. 158. Cf. Chapter 7, Section 3.

TABLE 9.1 Components of Organisational and Management Reform - Implications for Sequential Action

Common Weaknesses	Remedies (by sequence) ^{/1}	Remarks ^{/2}
Structure		
A. Poor horizontal coordination	1. Unified planning agency at Provincial, National levels 2. Unified project structure	Major policy decision Major policy decision/L
B. No specialist water distribution cadre	1. In-service courses for existing engineers 2. New university curricula for training new engineers 3. Establishment of new cadre	S M L
C. No watercourse management extension cadre	1. In-service training for existing field staff 2. Recruitment and training of new staff (where necessary)	S Negotiation with Finance Ministry
D. No planning, research and monitoring unit	1. Design of procedures 2. Recruitment of new staff 3. Some in-service training	P Minor expenditure S
E. Overcentralised responsibilities within project organisation	1. Changes in work scheduling, job descriptions 2. Major changes in definition of responsibilities	P Policy decision
F. Excessive staff stratification and barriers to upward mobility	1. Changes in promotion policy 2. In-service training	Policy decision S
G. Excessively differential salary structure	1. Changes in salary structure	Major policy decision
H. Overcentralised location of field offices	1. Better local facilities and/or bonus payments for 'hardship' posts	Policy/financial decisions
J. Insufficient powers to project managers	1. Improved management system 2. Unified project structure (A2) 3. Bonus payments to project for good performance	P Major policy decision Major policy decision
Process		
I. Overall Project Management		
K. Confused objectives	1. Clarification at government level 2. Clarification at project level + incorporation into written procedures	Policy/S P
L. Unsystematic budgeting and work programming, without participation	1. Improved procedures	P
M. Departmentalism	1. Improved procedures (inter-departmental committees, etc) 2. Structural change (A2)	P Major policy decision
N. Authoritarian behaviour	1. Procedural reform 2. Management training 3. Structural change (F1)	P S Policy decision
P. Poor monitoring	1. Improved procedures	P
II. Specialist Activities^{/3}		
*Q. Deficient system design	1. Physical rehabilitation	L
*R. Inappropriate water distribution methods	1. (Change in system design, if necessary) 2. Research into new methods + incorporate into procedures	(L) S/M; P
S. Deficient procedures for planning, implementation, monitoring	1. Develop new procedures, handbooks 2. In-service training	S/M; P
T. Inadequate skills	1. In-service training for existing officials and staff 2. Long-term training for new engineers (cf. B1-3)	S M
U. Inadequate resources (finance, staff, equipment)	1. Improved procedures 2. Reassessment; detailed case to be made for new resources 3. Increased water charges and/or bonus payments to project for good performance (J3)	P Negotiation with Finance Ministry Major policy decision
V. Poor motivation	1. Improved procedures 2. Changes in promotion policy, plus training (F1-2) 3. Bonuses for good performance (following from J3)	P Policy decision Major policy decision
*W. Ineffective legal framework	1. Implementation of existing legislation 2. Changes in existing legislation	S M

^{/1} Sequence is sometimes determined solely by the importance of the initial remedy (in the absence of which no other action can be of any assistance) but more frequently by the likely ease and speed with which it can be introduced.

^{/2} L = Long-term M = Medium-term S = Short-term P = Procedural reform

^{/3} Items with an asterisk apply only in the case of water distribution.

irrigation. As has already been pointed out, most aspects of the activities of water distribution and maintenance can and should be systematised and programmed. Even agricultural extension, which naturally requires a greater degree of adaptability on the part of staff to local variations in circumstance, can profitably be invested with a very substantial degree of planning and control under irrigated conditions. It is clear that any irrigation project which does not have detailed and carefully-designed procedures is lacking an essential tool of management and cannot be expected to perform at a level approaching its potential. Yet on the majority of the projects reviewed in the field studies, even these basic operating procedures were far from satisfactory.

Finally, the work of Belshaw and Chambers in Kenya has shown that procedural reform, if applied imaginatively, can contribute to the improvement of performance in several different ways: not only through a more efficient use of existing resources of staff, equipment and time (properly planned work programs, closer monitoring and control) but through various measures which combine to reduce the propensity of senior officials towards authoritarianism and as a result enhance the morale and motivation of junior staff. Moreover, as Table 9.1 suggests, improved procedures, once established, can produce other indirect benefits and also provide a more favorable climate for the introduction of more difficult changes. For example, if relatively minor procedural changes (in job descriptions, etc) can be introduced which lead to a significant de facto decentralization of responsibilities within an organization (Table 9.1, item E), the subsequent chances of getting some more profound de jure structural changes introduced are increased. The same applies with regard to the powers of the project manager (item J), whose actual powers, responsibilities and status will be automatically increased as a result of the better performance which will follow from an improved management system. Similarly, by helping to reduce departmentalism even in the absence of major structural change (item M), good procedures can help to create a climate of opinion which will help to hasten the advent of such a change. And once effective procedures have been developed for improved water distribution there will be much better opportunities for introducing a whole range of other improvements such as increased water charges (item U).

A simple way of illustrating the kind of procedural reforms which could be introduced on irrigation projects is to outline the basic elements of the Belshaw/Chambers Programming and Implementation Management (PIM) system, which was devised, applied and tested for use in area development programs in Kenya. The system of procedures required for certain aspects of irrigation management would need to be substantially different in detail, particularly in the case of water distribution, but the same broad principles could be applied to the performance of all activities. The pattern outlined here is most immediately applicable to the activity of overall project management. 1/ The PIM system has three main components:

1/ For a full account of the system, see R. Chambers, Managing Rural Development, pp. 43-54.

- a programming exercise, which was carried out annually in the Kenyan case and was held just before or just after the beginning of the financial year. This is a meeting attended by all those directly concerned with implementation at which they jointly and freely draw up a phased work program for the coming year;
- a management meeting, usually held monthly, at which progress is reviewed against the phased work program, bottlenecks are identified and remedial action is agreed upon;
- an action report, a monthly management report which briefly summarizes the progress made and problems encountered, and names those responsible for action; it is sent simultaneously to all those concerned at different levels of government.

The programming exercise, which is the most crucial part of the system, starts with an open-minded examination of the objectives of the project and various component programs of action. Once agreement has been reached on objectives, their desirability and the potential of the project for achieving them, the programming process can begin. Its main stages are:

1. listing and agreeing on the operations to be carried out;
2. identifying and agreeing who is responsible for each operation;
3. agreeing start and completion times for each operation;
4. agreeing targets and a completion indicator for each operation;
5. checking for feasibility, agreement and acceptance of targets.

Various techniques - involving the use of blackboards, phasing forms and programming charts - are recommended as aids to the programming process. These are designed not only to promote clarity of thought but to stimulate free discussion of feasibility of alternative proposals. Through open discussion and testing for feasibility the senior manager tries to ensure that the proposals are realistic and that all those responsible for execution are fully and freely committed to the program and to achieving their part in it.

At the monthly management meeting the senior manager checks on progress with all responsible. Entries are then made in the programming charts (in green for on time or on target, or in red for behind time or below target). Remedial action is then discussed and decided.

The action report is, in effect, an operational control device; it is not (as reports often are) just a means for communicating routine information. It follows on directly from the management meeting and records its findings. It contains a short sharp statement of progress made, whether or not targets have been achieved, the remedial action required if they

have not been achieved, and who should take that action. The report is written by the senior manager and distributed quickly and widely - to other departments and to different levels of government, in the Kenyan case right up to the ministry level.

Evaluations of the PIM system showed it to have had the following benefits:

(i) authoritarian management. The system and its procedures required a more democratic, egalitarian and less authoritarian management style than was customary. The requirement of joint programming meant that contributions were demanded not only from different departments but from different levels within each department. Subordinates found it easier to communicate their difficulties and needs to their superiors in a programming meeting than in other situations. The action report often brought out that the main bottlenecks to further action were occurring at fairly high levels of the system, with the result that subordinates were encouraged to put pressure on their superiors to provide whatever assistance was needed to improve their productivity.

(ii) wasteful meetings. Meetings were not general talking shops. The procedures for meetings required their adherence to the details of implementation, who should do what, when and how.

(iii) excessive reports. "Routine ritualistic reports describing the weather, visits, miscellaneous statistics and minor matters have no place in the system". The action report was problem- and opportunity- oriented, and was designed not as a 'report' but as a direct management tool for getting things done.

(iv) departmentalism. Departmentalism collaboration was greatly improved by the system.

(v) top-down targetry. The essence of the joint programming exercise was that staff should themselves agree and set their own targets. Initial experience was that staff set themselves quite high targets and did not take refuge in low target-setting in order to make their achievements look better. By drawing up their own programs, they developed a greater commitment to the programs they were responsible for.

(vi) inadequate resources. Joint programming helped to identify the resources needed. The action report made the senior manager identify and show up the reasons for failure and delays; the damaging effects of late releases of funds to the project from higher levels were sharply dramatized.

(vii) ineffective work programming. The joint programming exercise forced staff into thinking about their work commitments for the following year and made it easier to recognize that there might be overloads at certain periods. The programming chart showed clearly who had to do what and when. The "how" of programming was taken care of in the discussion generated by the procedures used in the meetings.

Further benefits identified by the evaluators of PIM were: (a) that it encouraged 'collegial control' among senior officials of the same rank; because of the existence of public records of their performance, they were anxious to keep their own standards high to avoid criticism from their peers; (b) that it increased the capabilities and confidence of lower-level staff, who were encouraged by their participation in discussions and their ability to contribute local knowledge; and (c) that it helped to build up the effectiveness and hence the status of the senior manager.

Chambers considers these to have been the most important principles embodied in the PIM system: (i) procedures requiring joint programming by all those responsible for implementation; (ii) staff taking part in setting their own work targets; (iii) collegial sanctions against poor work; (iv) lean and functional reports; (v) communication direct from the implementer to the point of bottleneck or delay; (vi) functional meetings used sparingly; and (vii) sophistication in simplicity.

The last point needs especially strong emphasis. Although apparently very simple, the particular procedures developed for the area development programs in Kenya were the product of many man-months of detailed work in which techniques were tried out, tested and often dropped or radically revised because it was found that they were too complex or otherwise inappropriate for use in that specific context. It was not simply a question of a brief visit by a management consultant. The basic principles of many familiar management techniques (MBO, etc.) can be used as a starting-point but much adaptation and simplification is needed if procedures are to be produced which will work in a particular rural developing country environment. One of the conditions of the successful adoption of such procedures elsewhere is that they should be devised and tested by someone who has a detailed understanding of the local social and technical environment. The full range of his responsibilities should be "to design appropriate procedures, to introduce them, and through continuous monitoring and evaluation in collaboration with those who are operating them, to modify them and introduce simplifications". Regular discussions with the users of the procedures is particularly important. Chambers suggests that such a system should first be tried out on a trial pilot basis. ^{1/}

Despite demonstrable success in its initial years, reports on the later history of the PIM system in Kenya have been much less encouraging. As in the case of any kind of management reforms designed to increase the accountability of senior officials, an essential requirement for the sustained success of such procedural systems is that they should be backed by high-level political support; and that the officials entrusted with instituting and directing them should have strong personal interests in making them work effectively.

^{1/} Chambers, op. cit., pp. 53-54.

9.2 Training and the conditions for its effectiveness

Analysis of some of the most common weaknesses which have adversely affected the performance of large irrigation projects indicates that various forms of improved training should be expected to bring beneficial results. As with procedural reform, the development of training programs is relatively uncontroversial and can usually be brought about within a fairly short space of time.

In the case of senior officials, there is a clear need in many countries for the civil engineers who are responsible for irrigation O&M to receive further specialist in-service training in water distribution. The main object of the course should be to educate them in the agricultural aspects of their work and, through an analysis of alternative techniques of water distribution, to persuade them that it is not a routine and boring activity but one which requires a large amount of professional expertise if it is to be done well. Many of the skills required will be more akin to those of systems engineering than those of construction engineering. ^{1/} On the agricultural side, there appears to be a widespread dearth of water management specialists. This could also be rectified by appropriate training programs. Many senior officials could also be expected to benefit from an inclusion in their predominantly technical training programs of a substantial element of general management training.

Much of the most useful training for junior staff can be provided to them on the job: training of this kind can be incorporated into the basic management procedures of the agency concerned, as it has been in the Training and Visit agricultural extension system. However, there are two subjects for which some special in-service training may be required: the extension of advice on watercourse O&M; and field-level water management extension.

For such training proposals to have a significant and lasting effect, however, certain important conditions need to be met. Where there are plans to establish training programs which will have the effect of creating new cadres of specialists where none existed before (as with the irrigation engineers and the watercourse management staff), it is essential that governments should already have committed themselves to making changes in the administrative structure which

^{1/} There is a serious dearth at present of appropriate training material relating to the theory and practice of water distribution. A valuable but apparently unique document is R. L. Anderson and A. Maass, A simulation of irrigation systems, USDA Technical Bulletin 1431, 1971. More recently A. Hazlewood and I. Livingstone have shown how linear programming techniques could usefully be applied to crop pattern planning and timing of water releases in "Complementarity and competitiveness of large- and small-scale irrigated farming: a Tanzanian example", Oxford Bulletin of Economics and Statistics, 40, 3, August 1978, pp. 195 ff. In the majority of ldc areas where appropriate water distribution techniques have still to be developed, training institutions could profitably be required to assume a research role as well. This would provide opportunities to involve trainees in a program of 'action research' and help them to discover in the process how complex and intellectually stimulating the subject can be.

allow these new cadres to be accommodated and provide them with attractive career prospects. Otherwise, senior staff in particular are unlikely to have much incentive to acquire their new qualifications. For example, engineers' interest in acquiring detailed knowledge about soils, crop water requirements and water distribution techniques can be expected to be much greater if there is a probability that they will become specialists in the fields of system design and operation than if they are due to return to a department which will continue to use them primarily for construction and maintenance work. Commitment to long-term structural change would therefore seem to be a necessary condition for the successful development and expansion of training programs of this kind.

Another general point about the effectiveness of training programs, which is particularly relevant in the case of junior staff, is that unless the training is linked to some prospects of promotion its effectiveness may often be severely limited. If training has been of any value at all, one of its likely effects will be to raise the trainee's capabilities to a level which makes him ambitious to undertake more challenging work. If he has no promotion prospects, the long-term effect may merely be to make him more dissatisfied with his lot and hence lower his morale and motivation instead of raising them. 1/

This is likely to be a particularly serious problem in the case of junior staff concerned with water allocation. Since they are usually under heavy pressure to perform their unpopular rationing function badly, they require a more than usually powerful reward and penalty system to encourage them to resist that pressure. Salaries are low and unlikely to be raised; and senior staff cannot be expected to achieve good results through the exaction of penalties alone. A combination of training with better prospects of promotion on merit seems to be the measure most likely to produce significant improvements in motivation. This implies that, among the more difficult and controversial policy measures which could contribute to improved irrigation management, the development of more flexible promotion policies should receive particularly high priority.

9.3 Water charges

Water charges in most developing countries tend to be very low and many would argue that high priority should be given to raising their level

1/ Leonard found in his study of Kenyan extension workers that those with higher educational levels performed less well, because their education had created expectations which could not be fulfilled. "Problems of administration in developing countries cannot be overcome by a simple, frontal assault on the training of personnel. Higher levels of skill create new incentive problems which themselves have to be solved if the new capacity is to be used fruitfully." Similarly, Norman Uphoff, quoted by Leonard: "as many donors have discovered, training (to increase competence) without more appropriate organization and more compelling incentives for better performance, will yield few benefits" (D. Leonard, op. cit., pp. 126-7).

substantially, for a number of reasons discussed below. We would agree that there is often an urgent need to raise the level of water charges, but we see it as a secondary issue in terms of sequential action, for two main reasons. The first is that it is a highly political issue. In a few countries - e.g. Malaysia - water charges are deliberately kept low because the farmers who receive irrigation are, untypically, among the poorest sections of the rural populace and the government wishes to subsidize them with funds from other sectors in the interests of regional equity. Much more commonly, however, the chief reason for low water charges is that large farmers with irrigation, who are among the most privileged rural groups, object to higher water charges and apply political pressure to keep them down.

Low water charges, like low rates of interest on credit, are a politically attractive policy to many governments and can plausibly be defended on the grounds that they are intended to benefit the very poor farmer, who cannot afford to pay more. In fact, the greatest beneficiaries of low water charges (as of low interest rates) are the largest farmers. Not only are they able to make the largest profits out of the cheap water to which they are legally entitled but the reduced quality of operation and maintenance service which is a logical consequence of reduced revenue from water charges also tends to give them a further comparative advantage over smaller farmers, especially in tail-end areas. 1/

The highly politicized nature of the water charges issue means that it is often among the least promising areas for reform, at least in the initial stages of the reform process. Another reason for regarding it as a secondary issue is that in most cases farmers are unlikely to become more favourably disposed to the idea of higher water charges unless certain other changes are introduced first. The most important and easily attainable of these is an improved water distribution service; this is nearly always possible through the introduction of better procedures and training, even in the absence of any increase in resources of finance or personnel. A highly desirable supplementary reform, but one which would imply a major change in policy, would be a decision to allow project organizations to retain a substantial proportion of revenue from water charges for direct use in local reinvestment. 2/

Conventionally, three arguments tend to be advanced in favor of a high water charges policy:

1/ On the assumption that larger farmers tend to derive greater advantage from lax water administration than smaller farmers. Cf. Section 2.1.

2/ Cf. Section 7.3.

- (a) It will increase government revenue, part of which can be expected to come back to irrigation projects in the form of much needed increases in recurrent finance.
- (b) It will act as a tax on the relatively privileged section of the agricultural community which is benefitting from access to irrigation water and thereby help to promote greater inter-regional equity.
- (c) It will encourage farmers to use water more sparingly.

The first and second of these arguments are indeed important ones, but it is doubtful whether the last has much significance in the context of most developing country irrigation systems. It is often assumed to be very important by economists, who have expended a great deal of effort and ingenuity on advocating various different methods of marginal pricing, volumetric charging etc. Most of these proposals are beside the point, however. Apart from the fact that strict volumetric charging is practically impossible on irrigation systems with huge numbers of small holdings, arguments in favor of marginal pricing presuppose a free market in water on developing country canal systems. This is not the case, nor is it desirable on equity grounds that it should be. Most developing country canal systems are inevitably fairly inflexible in their pattern of operation and are supposed to be run on a strict rotational basis: the object is to ration scarce water as efficiently and equitably as possible among a multitude of users. If water has been made scarce to all users through such a process of strict rationing and they are regularly informed about the timing and quantity of deliveries, each user will be strongly motivated to use it as sparingly as possible. The potential value of the water, rather than its cost, will be his main criterion. ^{1/}

Under such a system the essential condition for efficient and equitable water use is an adequate and predictable pattern of water supply, not a policy of high water charges (except inasmuch as the charges generate revenue to support good O&M services). If water supplies are not reliable, attempts to raise water charges are unlikely to make a significant impact on efficiency of water use; their principal effect will be to strengthen farmers' opposition to higher charges. Certainly, a policy of low water charges combined with lax water administration is calculated to create a 'careless' attitude to water among farmers. But the first remedy here, as has already been emphasized, is to improve the water administration. A better atmosphere will then be created for the raising of water charges.

In calculating the level of charges to be made, both cost considerations and farmers' capacity to repay will need to be taken into account. The method of charging is probably less important than many economists imagine, but quasi-volumetric charging would often appear to be best (i.e., charges calculated in proportion to the water requirements of different crops).

^{1/} This argument applies with less force to more local and flexible sources of water such as tubewells, for which volumetric charges can more easily be made.

Simplicity of administration is also an important criterion with regard to methods of water charge payment and collection. 1/

One important contributory reason for the prevalence of low water charges in many countries which governments should be able to combat more effectively than they do has been inflation. Despite often rapid inflation rates, the level of water charges in many countries tend to remain fixed for long periods of time, with the result that the real value of revenue received is constantly declining. A simple expedient which has been used in Area Four to prevent this happening (and also to help keep charges in line with farmers' capacities to pay) is to link the charge to the monetary equivalent of a certain quantity of staple farm produce. At the time of the field study visit, the upper limit of the basic Project membership fee per ha had been fixed at the equivalent of 270 kg of rice, which worked out at about \$70/ha in 1975-76 and \$80/ha in 1976-77. There seems to be no obvious reason why other governments should not be able to introduce similar system without arousing hostility.

9.4 Finance and staffing levels

Many planners of new irrigation projects or of projects due for rehabilitation are anxious to receive guidance about optimum levels of recurrent finance and staffing. But, useful though it may be to try to develop such 'norms', it is in practice extremely difficult to do so for developing country conditions at present owing to the large number of other factors which are adversely affecting the quality of irrigation management performance. 2/ Inasmuch as the amounts of finance and staff required to manage a project efficiently depend critically on these other factors - skills, motivation, quality of operational procedures, organizational structure - the determination of optimal levels of their use must inevitably, in terms of sequential action, be a secondary issue.

A prior requirement for estimating financial and staffing norms is to find a number of projects with contrasting characteristics which are

1/ For an argument against volumetric or quasi-volumetric pricing and in favor of cost-based pricing, based on Taiwan experience, see Fung Chung-yue, "Alternative methods of implementing irrigation water management", in W.J. Staub (ed), Implementing Public Irrigation Programs, East-West Center, Hawaii, July 1977, pp. 224-227.

2/ C. M. Nelson's comments on staffing levels for extension staff on Latin America projects: "The quantity and quality of extension agents are aspects of colonization project design about which it is almost impossible to set ground rules ... No standard basis can be established to justify a ratio of 1:100 over 1:1,000. Critical factors include the nature of the clientele, the volume of supporting credit, and the quality and availability of extension agents. ("C. M. Nelson, The Development of Tropical Lands: Policy Issues in Latin America, Johns Hopkins, 1973, p. 234)

already well organized and managed (i.e., from which most of the confusing 'bad management' variables have been excluded). It should then be possible to build up different sets of norms for a range of different physical economic and social conditions which could be used as approximate guidelines by planners. It should not be forgotten, however, that such norms can never be more than a convenient tool for planners; when it comes to actual management, local variations in the physical and social environment and/or in management methods will usually make further adjustments necessary. Nor should it be imagined by planners that, once such norms are developed, their task of planning for management need consist of no more than prescribing the quantities of finance and manpower which appear to be appropriate to a particular environment. They also have major responsibilities for ensuring that effective management procedures are developed, that necessary training provisions are made and that (as far as possible) an appropriate organizational structure will be adopted. ^{1/} If these issues are ignored or dealt with superficially at the planning stage, few measures are likely to be less cost-effective than the application of financial and staffing norms (which are based on the assumption of good management, but are by themselves far from sufficient to guarantee it).

Comparative data on recurrent O&M costs have already been presented in Table 8.1. ^{2/} Information on staffing levels, for both irrigation and agriculture staff is summarized in Table 9.2. In all the areas except Area Four, there was substantial deficiencies in the present organization and management services of farmers which (a) make it difficult to determine with any confidence the minimum levels of finance and staffing which would be compatible with good performance if those deficiencies were removed ^{3/} and (b) render them unsuitable for inclusion in any exercise of comparative analysis designed to identify financial and staffing norms. Nevertheless, a recapitulation of the chief physical, economic and social characteristics of the four study areas may help to clarify the direction future studies on this issue might take by pointing out the key variables which would need to be examined, to determine the particular structures and skills combinations likely to be most appropriate in different environments.

If we look first at the finance and staffing required for the O&M of the irrigation system, we must start by recognizing that there are at least three main activities which will need to be carried out under this heading in all developing country small farm conditions: (a) main system

^{1/} cf. p 63.

^{2/} Page 146.

^{3/} Hence the tentative nature of many of the comments on adequacy of staffing and finance earlier in the Report, e.g., in pp 110-118 and Chapter 8. This does not mean that certain blatant inadequacies cannot be confidently identified; e.g., inadequate finance for O&M in Area One and Two; inadequate finance and staffing for agricultural extension in Areas One and Three and virtually total neglect of watercourse management extension in all cases except Area Four.

Table 9.2. Comparative Staffing Levels (selected indicators)

Area of Supervision

(1) <u>Canals O & M</u>	<u>Canal Length (km)</u>	<u>Control Structures</u>	<u>'000 Ha</u>	<u>'000 Farm Units</u>
<u>Area One</u>				
Executive Engineer (G)	2442	83	157	37.5
Junior Engineer (G/M)	50	7	12.8	3.1
Maintenance Labourer (U)	5.6	...	...	...
<u>Area Two</u>				
Executive Engineer (G)	833	n.a.	76	23
Junior Engineer (G/M)	80	n.a.	7.5	2.3
Maintenance Labourer (U)	3-6	...	...	...
<u>Area Three</u>				
Section Engineer (M)	205	273	33.1	150
Juru (S)	4.4	6	0.7	3.3
Maintenance Labourer (U)*	4.4	...	...	...
<u>Area Four §</u>				
Chief, Management Office (M)	314	608	16.9	37.5
Chief, Working Station (M)	29	57	1.6	3.5
Junior WS Official (M)	6.5	13	0.35	0.7

(2) <u>Tubewell Operation</u>	<u>Well Numbers</u>	<u>Cumec Capacity</u>	<u>'000 Ha</u>	<u>'000 Farm Units</u>
<u>Area One</u>				
Executive Engineer (G)	689	77	173	41.2
Junior Engineer (G/M)	39	4.4	9.8	2.3
Tubewell Operator (S)	1.5	0.2	0.4	0.1
<u>Area Four</u>				
Chief, Management Office (M)**	118	3.7	16.9	37.5
WS Tubewell Operator (M)	11	0.3	1.6	3.5

(3) <u>Agricultural Extension</u>	<u>'000 Farm Units</u>	<u>'000 Ha</u>
<u>Area One</u>		
District Officer (G)	189	787
Agricultural Assistant (G)	10.5	43.7
Field Assistant (M)	1.3	5.2
<u>Area Two</u>		
Director, Agriculture (G)	69	229
Agricultural Assistant (G)	2.5	7.8
Field Assistant (M)	0.5	1.6
<u>Area Three</u>		
District Officer (G)	306	90
Agricultural Assistant (M)	17	5
Field Assistant (M)	3.2	0.9
<u>Area Four §§</u>		
Township Officer	7	3.5
Agricultural Assistant	1.4	0.7
Field Assistant	0.3	0.15

(4) <u>Ratio of Senior Canal Officials: Senior Agricultural Officials</u>			
One 1.1 : 1	Two 1 : 1.5	Three 1.4 : 1	Four (1 : 1.3)

(5) <u>Ratio of Junior Maintenance Staff: Agricultural FAs</u>
One 2.6 : 1 Two 2.4 : 1 Three and Four: n.a.*

G = Graduate
M = Matriculate
S = Secondary Education
U = Unskilled

* In Areas Three and Four most maintenance work is done by outside contractors.

§ In Area Four the IA staff also have substantial drainage O&M responsibilities.

** The same officials are responsible for supervising both canal and tubewell O & M.

§§ Very rough estimates.

water distribution; (b) main system repair and maintenance; and (c) watercourse management support services. Activities (a) and (b) often need to be further subdivided into reservoir, canal and well operation on the one hand; and civil and M&E maintenance on the other. Land development may also be an important additional activity (d), particularly in the early stages of a project and sometimes at intervals thereafter.

In practice, actual costs and staffing levels for activities (a) - (c) are hardly ever differentiated or shown separately in project records, because they are carried out by members of the same single cadre. Area Four however, is an exception in that each activity is performed by a separate cadre and its costs are separately accounted for. A similar breakdown of costs between different activities would be needed as a starting-point for any worthwhile norm-building exercise.

In the case of the activities and sub-activities referred to, the following are the variables most likely to have significant effects on the levels of finance and staffing required under different conditions:

- (a) Main system operation: Size of project area; frequency and predictability of rainfall; seasonality of operation (perennial, non-perennial); with or without storage; scope for conjunctive surface and groundwater management; density of control and measurement structures; aquifer conditions and water quality (for well management); complexity of water distribution method, particularly with regard to 'demand management' (e.g., differential supplies to areas designated to different crops; need for high/low responsiveness to local variations in demand); social characteristics of farming community (extent of pressure on officials to misallocate; capacity to communicate demand accurately, etc); telecommunications; transport. 1/
- (b) Main system repair and maintenance. Climate; soil characteristics; extent of channel lining; density of control structures; extent of canal roads; well technologies; labor-intensive v. mechanical maintenance methods; social characteristics of farming community (affecting level of damage to irrigation facilities). 2/
- (c) Watercourse management support service: Social characteristics of farming community; size of watercourse command and number of farm units; physical characteristics of watercourse command; complexity of water distribution procedures. 3/

1/ Cf. pp 127 - 129 and ff.

2/ Section 8.2.

3/ Pp 172 - 174, Sections 10.3 and 11.1.

- (d) Land development: Drainage requirements; micro-topography; choice of technology (e.g., for land levelling); soil characteristics of farming community. 1/

Another important activity which would need to be equally carefully considered is agricultural extension, together with agricultural research. Here the principal variables affecting the equation will be the social characteristics of the farming community, farmers' levels of agricultural knowledge, population densities, and road and transport facilities. 2/ Other important variables might include the nature of the land tenure pattern and the level of agricultural mechanization (particularly in the case of projects like Mwea in Kenya, where farmers' land is prepared by a central tractor unit managed by the project organization).

On projects with an 'integrated management' structure, thought would also have to be given to the financing and staffing of input supply, credit and marketing services. 3/ And in all cases, management support services would need to be taken into account too. 4/

The key variables affecting optimal finance and staffing levels for performance of the principal activities of irrigation management can be grouped into the following broader categories: physical and climatic characteristics of the farming community; and technical aids to management which can be used as substitutes for administrative manpower (e.g., maintenance machinery, telecommunications, roads and transport). Of these, the first two are of particular importance for system operation; and the second for system maintenance. The third and fourth tend to be important, to a greater or lesser degree, for all major activities. The better developed the management capacity of the farming community, the more tasks can be delegated to it by the project administration. 5/ The extent to which technical equipment can substitute for manpower and vice versa is of crucial importance for calculating optimal staffing levels in any context, and the amount of equipment available on any scheme should therefore be clearly specified whenever such calculations are attempted.

Differences with regard to these key variables account for a large part of the wide variations in the ratios shown in Table 9.2, although, as has already been stressed, strict comparability is impossible because only the Area Four figures can be confidently regarded as approaching the optimal (in that particular context). Even if comparisons for the purposes of norm-building are confined to projects which can be identified as well managed

1/ Pp 163 - 174.

2/ Section 8.2.

3/ Pp 74 - 75.

4/ Section 8.5.

5/ Pp 93 - 95.

(which we have argued they must), there are so many variables which could radically affect financial and staff requirements under different conditions that it is likely to provide extremely difficult to reach operationally useful conclusions through wide-ranging cross-country comparisons. ^{1/} This is not to say that the collection and analysis of relevant data from many sources could not be valuable. But it does strongly suggest that the value of most global comparisons will be limited (except as a means of pointing up the reasons for inter-regional differences), and that most detailed analysis should be focused on regions with strong agro-climatic and cultural similarities.

The object would then be to build up for each region a set of norms which could be further adapted to the particular circumstances of local projects. An important constraint which would have to be incorporated into all calculations of requirements would, of course, be the overall availability of finance and different categories of manpower within each region. Failure to do this could lead to undesirable recommendations for excessively high levels of funding and staffing on individual projects which would only be realisable at the expense of some other part of the agricultural sector or the irrigation sub-sector.

Little work appears to have been done so far by others towards the development of such norms. On the basis of data collected through a worldwide ICID questionnaire, Bos and Strosbergen have attempted in a short paper to reach some general conclusions about desirable staffing levels on irrigation projects. However, the methods of analysis used are crude and it is doubtful what significance their findings have. From a comparison of staffing levels on a range of projects of different sizes they conclude that the average number of staff employed per 100 ha of irrigated area decreases significantly as project size increases from the 50 ha level up to 6000 ha (from 3 to 0.37 staff per 100 ha) and that on larger projects the average number remains constant at about 0.35 per 100 ha. This is combined with another finding, again based on the same sources of data, that the highest conveyance efficiencies are found on projects with areas of 4,000-6,000 ha, to produce the "obvious conclusion ... that for the most efficient use of both water and manpower, the optimum area of an irrigation project is between 4,000 and 6,000 ha". Leaving aside the validity of the conclusions about conveyance efficiency (which are based on

^{1/} There are also other factors which make strict comparison very difficult. For example, costs comparisons are often very misleading, because of differences between countries' levels of economic development (wage rates in particular). In the case of staffing comparisons, the qualifications and responsibilities of staff at what appear to be corresponding levels of different organizations are rarely equivalent. Failure to notice local variations in practice - e.g., the use of contractors to carry out maintenance work in Areas Three and Four - can lead to misleading conclusions. And, of course, there are often considerable uncertainties as to the accuracy of a project's records (and to the correctness of an evaluator's interpretation of them).

data from projects with very different technologies and costs, with individual results scattered widely round the mean curve), the conclusions about optimal staffing levels are open to criticism on many counts. For example, (i) in the selection of data no discrimination appears to have been made between well-managed and poorly-managed projects; (ii) no differentiation is made between staff of different levels and skills (so that a manager and a watchman are given equal weighting); (iii) projects are not differentiated by any factor other than size or area; and (iv) if the discussion is confined to O&M staff (as it appears to be in this case), staffing per ha is usually of less relevance than staffing per unit of canal length, or per number of pumps or control structures. Moreover, the individual results are scattered still more widely round the mean curve than in the case of the conveyance efficiency results. 1/

A sounder approach is adopted by Haissman in a study of skilled personnel requirements in irrigated areas of N. W. Mexico. 2/ His object is "to give the planner a method for estimating the number of personnel in each occupation as a function of relevant project parameters, and for designing the schooling system to produce the necessary personnel at the required numbers and times". Staffing levels in N. W. Mexico are judged to be appropriate to local requirements because it has been a region of "rapid and successful irrigation development". 3/ The activities of project management for which manpower requirements are considered are water management; land preparation; pest control; agricultural research; extension and credit; input supply, storage and transportation - a range of services similar to that provided under an 'integrated management' system.

Unfortunately for our own study, Haissman pays little attention to the irrigation system, failing to describe its technology or the method of water distribution and focusing instead on the principal parameters affecting skilled manpower for agricultural services. These are identified as the size of the irrigated area, the cropping pattern and the tenure system. 4/

1/ M. G. Bos and C. Storsbergen, "Irrigation Project Staffing", ICID Transactions of the Tenth Congress on Irrigation and Drainage, Athens, 1978, pp. 35.348-354, (also ILRI Reprint No. 9, International Institute for Land Reclamation and Improvement, Wageningen). Calculated on the same basis, staff per 100 ha in Area One could be computed (depending on who is included or excluded) to be 0.25; Area Two 0.20; Area Three (excluding contractors for maintenance) 0.56; Area Four (excluding contractors for maintenance) 0.81. These figures would not support the writers' argument.

2/ I. Haissman, "Generating skilled manpower for irrigation projects in developing countries: a study of Northwest Mexico", Water Resources Research, 7.1, Feb 1971, pp. 1-17.

3/ The criteria used in reaching this assessment are not mentioned.

4/ There are four principal tenure systems in the area: large private farms (50-100 ha or more); giant plantations (several thousand ha); small farms (c.10 ha, quite large by Asian standards); and corporate farms (administered ejidos) of 1000-1500 ha.

The detailed recommendations he comes up with are relevant only in the context of N.W. Mexico or other very similar physical and social environments, but some of his general observations are worth noting here. For example, he concludes that irrigation engineers should be agronomists with special training in plant-soil-water relationships and some knowledge of hydraulics, not hydraulic engineers ("There is practically no use for a hydraulic engineer on an irrigation project in the post-construction stage"); the appropriate ratio of 'agricultural sub-professionals' (irrigation technicians and water-masters) to agricultural professionals was found to be 1:1 in all tenure systems, not 3:1 as is often claimed; and the demand for civil, mechanical, electrical and chemical engineers was found to be minimal, less than 10% of the total demand for agronomists, even taking the demand for engineers in agricultural industries into account. The last two conclusions would not necessarily apply in the same degree elsewhere (Area Four), but they do reinforce the conclusions from the case studies that the role of agriculturalists on many irrigation projects needs to be greatly strengthened. 1/

With some modifications (mainly in the form of an increase in the number of parameters to be considered, particularly on the water management side) Haissman's analytical framework could usefully be applied on well-managed projects elsewhere. Meanwhile, in regions where there are at present no conspicuous examples of good irrigation management to be found, the most effective method of identifying financial and staffing requirements must be through programs of action research. Accurate estimates of requirements could be built up in the context of an improved management system, with new procedures and newly-defined staff responsibilities. No other method is capable of generating results which would carry anything like the same level of conviction. Detailed testing in field conditions has the great virtue of ensuring that questions of finance and staffing levels will be firmly placed in their proper context - as variables which are heavily dependent on other aspects of organization and management. In areas which have hitherto been characterized by a predominantly maintenance-oriented approach, major changes can be expected in future recommendations for finance and staffing as a result of greatly increased emphasis on the activities of water distribution, watercourse maintenance and agricultural extension.

1/ Pp 77 - 78 and Section 8.3.

IV. THE FARMER'S ROLE IN MANAGEMENT

10. Scope and performance

10.1 Scope for farmers' participation on large irrigation projects

It is generally agreed by scholars who have studied both large and small irrigation systems in developing countries that in each context there is a certain point along the spectrum of size above which the level of performance can be expected to decline if executive responsibility for operating and maintaining the system is left exclusively in the hands of the farmers themselves. Above this dividing line, better results can be achieved if executive responsibility for the O&M of the main distribution system is given to an independent specialized agency (usually in the public sector), with small groups of farmers retaining responsibility for O&M below each watercourse outlet.

On the basis of an analysis of irrigation practices in South India and Sri Lanka, Chambers argues that for the purpose of reaching strategic decisions before each crop season (based on information about water availability and cropping intentions) joint discussion is needed between farmers' representatives and government officials, whatever the size of the system. However, when it comes to the execution of these decisions,

"... the question is how far the bureaucracy should extend down the irrigation system... On major irrigation in the dry zone of Sri Lanka it extends down the main channels to the points at which water is issued to field channels to communities. Communities are unlikely to agree among themselves that those higher up will take less in order that those lower down may profit. More usually an independent and impartial organization is needed and this is mostly some form of bureaucracy.... A crucial link is, it seems, between the strategic decisions and those who implement them. A degree of impartial independence is required - with willingness and ability to carry out instructions earlier arrived at - without bowing to particularistic local pressures."

Chambers concludes that the allocation of water and arbitration of disputes within communities "can usually be left to those communities, with perhaps some provision for appeal and for intervention by the bureaucracy in emergency". But responsibility again needs to be held by the bureaucracy for policing the main system and prosecuting infringements above the community level. ^{1/}

Hariss, on the basis of a detailed study of the Kirindi Oya Right Bank scheme in Sri Lanka, a loosely-managed system with a command area of about 1000 ha and 11 official outlets - has come to similar general conclusions:

^{1/} R. Chambers, "Men and Water: the Organization and Operation of Irrigation", in B. Farmer (ed.), Green Revolution?, pp. 357-360.

- "(i) that the maximum possible control of water should be given ^{to build up improved} smallest possible groups and that these groups should manage ^{a policy} their own affairs;
- (ii) there must be some authority capable of adjudicating between the ^{at} interest of smaller units within the whole irrigation system;
- (iii) ... this authority must be unitary and impartial, and capable of applying objective technical standards regarding the productivity of water use, certainly where water is scarce;
- (iv) there should probably be an effective authority to ensure that the system is not disrupted by water piracy, especially from main channels; and
- (v) as these points imply, there must be efficient and rapid information flows between 'authority' and cultivators." 1/

Similarly, Pasternak has commented in connection with irrigation in Taiwan that: "There is a threshold of complexity in irrigation systems at which cooperation must give way to coordination; at which those served by the system relinquish their decision-making power and their direct role in settling disputes". 2/

Precisely where this threshold or upper limit comes on smaller systems depends on a number of factors, of which the most important appear to be the simplicity or complexity of the technology concerned, the abundance or scarcity of the water supply and the social cohesion of the community or communities concerned. The last factor is likely to be heavily influenced by the nature of the system's origins: whether it is an 'indigenous' system which was constructed exclusively by the farmers themselves and has subsequently been operated and maintained by them with little or no external support; or whether it was constructed by government. In the former the motivation to act cooperatively is likely to be much more strongly developed. Where unusually complex multi-community systems are found to be operating successfully under farmers' management alone, they appear invariably to be indigenous systems with a long tradition of cooperative action: for example the remarkable Dusi-Mamandur tank in North Arcot District, Tamil Nadu, which serves 18 villages through an irrigation board consisting of representatives of each of the villages, or the immensely sophisticated subak systems of Bali.

1/ J. Harriss, "Problems of Water Management in Hambantota District", in B. Farmer (ed.), Green Revolution?, p. 375.

2/ B. Pasternak, "The sociology of irrigation: two Taiwanese villages", in W. E. Willmott (ed.), Economic Organization in Chinese Society, Stanford University Press, 1972, pp. 193-213.

On the other hand, where the initial design and construction of an irrigation system has had to be carried out by government on account of its size and complexity - which is the case on all the major systems in the four field study areas - there is no natural community of interest among the farmers to be served by it such as that which accounted for the creation and development of the indigenous systems in the first place. 1/

In the case of these larger government-constructed systems, farmers' propensity to cooperate in irrigation matters is likely to be restricted to their own immediate community (village or section of the village) and sometimes, depending on the social structure, it may not be strong even at that level; as, for example, in the Area One and Two study areas. Hence the emphasis placed by Harriss on the desirability of local watercourse groups being made as small as possible: the smaller the group the greater the probability that community of interest can be established and conflict avoided within the group and the lower and probability that it will be dominated by powerful members of the local elite. 1/ Moreover, the main systems are too large and complex for the farmers to be able to concern themselves with the details of day-to-day operation; nor is it likely that they would be interested in doing so unless they supposed that this would enable them to obtain more water than they were entitled to, at the expense of other groups dependent on the same system. We have seen no evidence from our field study including the extremely well managed Area Four, which would cause us to disagree with the conclusions of Chambers and Harriss that on large irrigation system which serve numerous communities, farmers' executive responsibilities for O&M should be confined to small groups at the watercourse level; and that the day-to-day management of the main system should ideally be in the hands of a technically capable and impartial government or quasi-government agency. Farmers' representatives should however participate in the development of each season's water allocation agency's day-to-day performance, wherever possible through a farmers' organization, on which tail-enders and small farmers should be prominently represented. 3/

The fact that the natural propensity to cooperate is often so low in areas of large-scale irrigation where there has been no tradition of indigenous small-scale systems suggests that, particularly at the early stage of a project's development, the main thrust of a project agency's efforts to stimulate increased farmer participation in decision-making should be through the encouragement and support of effective groups at the

1/ On Dusi-Mamandur, see Chambers, op. cit., pp. 345-6, 352, 356-7, 360-1; on the Balinese subaks, A. W. Birkelback, "The Subak Association", Indonesia, (16), 1973, pp. 153-169 and C. Geertz, "Tihingan: a Balinese village", in Koentjaraningrat (ed), Villages in Indonesia, Cornell, 1967; also Chapter 12, Section 1. For more on the different bases for motivation to undertake group action on small/indigenous and large/government systems, see Chapter 11, Section 1.

2/ Cf. the argument in the Section on "Farmer Groupings" in G. Hunter, (ed), Agricultural Development and the Rural Poor, ODI, pp. 40-45.

3/ Cf. p 132.

watercourse level; in other words, its principal aim should be to build up group responsibility round the common interests of its members in improved local O&M. 1/ Apart from the obvious immediate advantages that such a policy can bring (reduced administrative burden for the project agency, greater economic benefits to the farmers concerned), successful group formation at this level can also provide the foundation for more effective farmer participation at higher levels of the irrigation organization.

Chamber's main reasons for advocating the participation of farmers' representatives in water allocation planning are that decisions taken by administrators or technocrats on their own tend to ignore some of the users' needs, leading to later difficulties; and that if certain decisions have to be taken about actions within the farmers' own sphere of responsibility, such as planting dates, they are more likely to adhere to those decisions if they have agreed to them than if they had been imposed from outside: "Better decisions are likely where they result from discussion which benefits from an engineer's knowledge of water availability, an agriculturalist's appreciation of the cropping position, farmers' knowledge of their resources and problems, and a presiding administrator's appreciation of all of these". 2/ The case for a representative farmers' organization for monitoring purposes is also clear. Chambers advocates a fairly small body, "elected by 'irrigation constituencies' which would ensure that tail-enders were included". Others have also suggested the construction of similar representative hierarchies in the interests of making the irrigation agency more accountable to farmers in its decision-making. 3/ However the creation of truly representative farmers' institutions is easier said than done. In many societies there is a likelihood that, unless such a water users' body is fairly highly formalized, usually in accordance with regulations specified by government, the farmers who take part in the discussions with the operating agency will only be large farmers lobbying for their own sectional interests. To the extent that the operating agency is required to pay particular attention to larger farmers from tail-end areas, even this form of 'representation' could help in many cases to bring about substantial short-term benefits in terms of both productivity and equity, as in Area Two. 4/ But, in the longer term, the chances of producing a

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- 1/ Where propensity to cooperate is higher, particularly at the local level, as in Areas Three & Four, one of the reasons may often be that small indigenous systems have already existed in the area before the advent of the larger systems. Even within the present systems, however, cooperation and group activity is highest in those areas where 'indigenous' features of management and operation continue to be retained.
- 2/ Chambers, op. cit., pp. 357-8.
- 3/ Eg. D. Bromley, D. Taylor, D. Parker, "Water Reform and Economic Development: Institutional Aspects of Water Management in the Developing Countries" Economic Development and Cultural Change, 28, 2, January 1980, pp. 365-387.
- 4/ Cf. Section 2.1. For references to the ad hoc measures used in Area Two to improve water supplies to the tail, see pp 116 and 135.

genuinely representative body at the apex (project) level are likely to be much enhanced if active and purposeful groups have already been established at the primary level.

A further useful function which could be performed by a farmers' representative body at the project level is to discuss questions of finance with the project management and act as a watchdog on the way in which it is being spent. This appears to have been the principal function of the Representative Committee of the Project Authorities in Area Four until their temporary suspension in 1975. These committees also had the power to vote on what the level of the members' fees should be.

There are thus three main levels at which the quality of farmers' management can have an effect on the overall performance of a large irrigation project: at the individual farm level (field-level water management and farm management of watercourse O&M) and at the project level (participation in planning and monitoring of water distribution and/or project finance). Some of the strengths and weaknesses of actual performance in the field study areas will be briefly reviewed and analyzed in the next three sections of this chapter. The problems of developing farmers' groups on large irrigation systems and the potential benefits they can bring are further discussed in Chapter 11.

10.2 Management at the farm level

Neither the time nor the manpower were available on the four field studies to carry out the sort of sample surveys which would have been needed for an authoritative assessment of farmers' management performance at the farm level. Where surveys had already been done by others their assessments were made use of, but elsewhere judgements were inevitably impressionistic.

In a comprehensive evaluation a sample farm survey could serve two valuable purposes. It could help to clarify how much the quality of water management decisions at the farm level was being constrained by deficiencies in the distribution of water, both above and below the watercourse outlet. It could also shed light on the extent to which farmers' decisions with regard to water management - and indeed farm management generally - were being constrained by other important factors, particularly the farm family's resource-endowments and the quality of other government services besides water delivery: agricultural extension, the supply of complementary inputs such as fertilizer, and marketing. The farmers selected for interview in such a survey should reflect as wide a range of contrasting conditions as possible: large and small farmers; farmers within head-reach and tail-reach watercourses; and farmers at the head and tail of the same watercourses.

For the purposes of the kind of evaluation with which we are concerned, the quality of a farmer's decisions with regard to the management of his farm, and more specifically to the management of water on that farm, can be regarded as being a function of the following factors:

- (a) the farmer's present level of knowledge about farm and water management practices;
- (b) his capacity to apply that knowledge within the constraints imposed by the farm family's resource endowments;
- (c) the effectiveness of the agricultural extension service in providing advice about farm and water management;
- (d) the adequacy and predictability of irrigation water deliveries to the farm;
- (e) the quality of service provided by the agencies supplying inputs complementary to water; and
- (f) the availability of, and ease of access to, profitable outlets for the farmer's marketable surplus.

In the four field studies the following observations were made.

In Area One access to the results of recent field surveys by a research team provided a better insight into farm level conditions than was possible elsewhere. There was evidence that, to the best of their ability, farmers made rational use of the scarce water they received by 'under-irrigating' (i.e., providing fewer waterings per crop than would be required for maximum yields). This practice of extending the irrigated area and reducing yields may have resulted in higher total production and income than a more intensive pattern of water use, 1/ though it can also induce salinity. However, certain deficiencies in water management practices were identified in the recent Water Management survey. Interviews with farmers revealed that their knowledge of crop water requirements was very poor. Serious water losses were also occurring because fields were not finely levelled. These two factors contributed to a tendency to 'over-irrigate' on the occasion of each water application, but there was also evidence that poor operation of the main water delivery system, particularly tubewells, was another contributory factor: average application efficiencies in areas with supplementary public tubewells were found to be 44%, against 57% in areas with canal supplies only and 59% in areas with supplementary private tubewells. In other words, deficiencies in farmers' knowledge and in main system operation were both adversely affecting performance; the fact that fields were often poorly levelled may have been partly a reflection of farmers' skills and partly of constraints imposed by lack of labor or appropriate technology. Certain changes in agronomic practices which could have enabled farmers to control water better in the higher-rainfall season (furrow irrigation, ridge planting, etc) were found to be impossible to introduce because appropriate technologies were not available.

1/ This is a moot conclusion, disputed by many soil-plant-water scientists. Recent US research indicates that deficit-irrigation results vary greatly with crop, soils, and irrigation timing. Some positive results have been obtained with cotton, sugar beets, wheat, sorghum, and some fruit trees. Potato yields on the other hand are highly sensitive to less-than-optimum irrigation regimes. Maize and other fruit trees have shown intermediate responses. Much more research is needed. (Ed.).

The agricultural extension service was found to be doing very little to improve farmers' knowledge of farm and water management practices: contact, particularly with smaller farmers, was minimal and extension staff's understanding of crop water requirements was rudimentary. Very low average levels of fertilizer use were partly attributable to high prices and water scarcity in non-tubewell areas, but serious weaknesses were also reported in the fertilizer distribution system. Large farmers tended to make more intensive use of fertilizer and there was also evidence that, particularly in tubewell areas, they succeeded in obtaining more water per unit area than small farmers.

In Area Two much less detailed information was available about farm level practices. However, it was clear that most farmers in the area had had only a short experience in irrigated agriculture and were still adjusting to the changes in cropping patterns, farm management practices and input use which irrigation implies. Understanding of crop water requirements was low; there was a tendency to over-irrigate, particularly in head-reach areas; and the farmers' unwillingness to practise night irrigation contributed further to high levels of water wastage. Land preparation was difficult in the heavy soil conditions and uneven micro-topography prevailing in most of the region and smaller farmers in particular probably lacked the resources as well as the skills to level their fields satisfactorily.

The agricultural extension service was having a significant impact on farmers' management practices generally, although staff lacked specialist training in water management extension. Under the new management particular emphasis was being laid on timeliness of input supplies and there was evidence of rapid increases in fertilizer use. There were several marketing problems, however: transport was difficult and costly in the absence of a good road network, particularly in the rainy season, and the cultivation of certain new crops which were suitable for the region - particularly soyabeans - was hampered by the absence of convenient marketing outlets. But the single greatest overriding problem was the inability of the project management, under existing conditions, to control the pattern of water delivery equitably between head-reach and tail-reach areas or to introduce a disciplined approach to rotational irrigation at the watercourse level. Only after the necessary physical changes have been introduced (removal of illegal outlets in head-reaches, installation of water metering systems, improved watercourse layout) will it be possible to induce farmers to increase their efficiency of water use substantially: head-reach farmers in particular, who are at present receiving excessive supplies, have no incentive to be economical in using them.

The level of farmers' water management skills in Area Three was judged to be significantly higher than in Area One and far higher than in Area Two. Nevertheless, there was evidence of a widespread tendency to over-irrigate in the upland head-reach areas of river systems - a particularly common feature of areas with predominantly rice cultivation, where additional water can be used as a substitute for labor-intensive method of weed control. Interviewed farmers showed themselves generally very knowledgeable about the characteristics of the numerous different varieties of rice available and they also had considerable experience of cultivating dry season crops,

particularly soyabeans, maize and tobacco. A major constraint cited by farmers was the difficulty experienced by many, especially smaller farmers, in obtaining timely access to power (either bullock or mechanical) at the time of land preparation for wet season rice. This may well have been one of the principal reasons for the conspicuous variability in the timing of cropping activities observed in the study area: those farmers who fell behind at the wet season land preparation stage through lack of access to motive power would continue to be at a disadvantage throughout the whole year with regard to access to water, particularly under the differential distribution system.

The system, even if applied according to the rule book, would tend to work against the interest of any farmers who, for whatever reason, are slow to get their first wet season rice crop planted. Because of the regular meetings every 10 days between village water officials and junior irrigation staff, farmers appeared to be well informed about short-term variations in water supply patterns, but the lack of strict rotational distribution within the watercourse command probably contributed further to the disadvantage of smaller farmers in many cases. The effectiveness of the agricultural extension service appeared to be increasing, although it was thought to have little of value to offer on the cultivation of crops other than rice. The Government fertilizer and credit packages were also geared mainly to rice production and neglected other crops. The use of complementary inputs was quite high, although there were criticisms of the timeliness of delivery of inputs under the Government program. Marketing did not appear to be a significant problem in the area.

Farmers in Area Four have had long experience of irrigated agriculture and showed great skill in the cultivation of 'irrigated dry' crops as well as rice. Very intensive crop rotations (up to four crops a year) were common and widespread use was made of intercropping. Heavy use was made of fertilizer, plant protection and improved seeds; power tillers were widely employed. The remarkable regularity of crop stands within single fields indicated high standards of water management and of husbandry in general. The uniformity of stands between fields within the same locality, which was in marked contrast to Area Three, suggested that the power constraints experienced in Area Three were absent. It also testified to the predictability of the pattern of water delivery to the farm achieved as a result of the strict adherence of the irrigation staff to its detailed operational schedules. The quality of other support services was also high.

Three points are worth noting from this brief review. First, weaknesses in water distribution at the main system level had a significant adverse effect on farmers' ability to manage water at the farm level in at least two cases (Areas One and Two); in the Area Three case, main system water distribution was inequitable, but once the unequal pattern had been established supplies to the watercourse outlet were probably more predictable than in the other two cases. Secondly, lack of timely access to motive power at the time of land preparation caused major delays and loss of income to smaller farmers in Area Three, and similar resource constraints were almost certainly having adverse effects on performance in Area One and Two. And finally, in

the areas where farmers' knowledge and management capacities were least developed, supporting services in general tended to be least efficient - i.e., in Areas One and Two before the introduction of the Area Development program. Particularly high returns could therefore be expected from investment in improved services in these areas.

10.3 Watercourse management

As in the case of farm level management, the assessment of watercourse management on the four field studies was based on only brief visits and observations. Here too a comprehensive evaluation would require much more detailed investigations.

In all four study areas the tasks of water distribution and maintenance below the watercourse outlet were the collective responsibility of all the farmers with land within the watercourse command. Staff of the main system water distribution agency were required to supervise their activities, to a greater or lesser degree. The quality of performance of watercourse management would appear to be a function of the following factors:

- (a) Average farm size (number of farms per watercourse);
- (b) Social characteristics: skewness of land and income distribution, degree of social cohesion;
- (c) Farmers' level of education and experience of irrigated agriculture;
- (d) Technical characteristics of the watercourse command area;
- (e) Size of the watercourse command;
- (f) Unit on which water users' organization is based: village or channel;
- (g) Closeness of supervision by main system water distribution agency; and
- (h) Adequacy and predictability of irrigation water deliveries to the watercourse outlet.

In the case of two of these factors (e, g) the appropriateness of what is required in each particular situation depends on the nature of other factors. For example, the optimum size of watercourse for the purpose of its management by a group of farmers is dependent on average farm size; on the social homogeneity and/or cohesion of the farmers concerned; on the difficulty of the operation and maintenance tasks the farmers are expected to perform; and on further considerations, such as the amount of water which an individual farmer is capable of handling at the field level. Similarly, the amount of external supervision required depends to some extent on all the preceding factors (a)-(f).

The level of performance achieved in the four study areas and the reasons which appear to have contributed most to that performance will be briefly discussed in turn.

In Area One clear procedures had been established for the rotation of water within the watercourse on a proportional time basis. The official time schedule appeared to be adhered to fairly closely in most areas dependent on canal water alone (water scarcity ensuring that each farmer was strongly committed to protecting the integrity of his own turn), though the high level of water losses during conveyance within the watercourse channels meant that tail-enders inevitably received less water during their time allocations than head-reach farmers. On watercourses with supplementary public tubewell water, supplies were more abundant and water wastage was higher both in conveyance and on the farm; there was more evidence of trading of irrigation time among farmers (introducing a greater degree of voluntary flexibility of operation) and - much less desirably - of increased unevenness of distribution as a result of erratic tubewell operation, with larger farmers almost certainly benefiting disproportionately. In the Water Management survey watercourse conveyance efficiencies were found to be generally very low: 47% on commands with supplementary public tubewell water, 54% on commands with canal supplies only and 59% on commands with private tubewells. There are several reasons for this.

One of the most conspicuous reasons, which applied on nearly all watercourses, was that there were technical problems associated with their maintenance, particularly silt accumulation and the difficulty of maintaining channels at the correct elevation and slope in a region with very gentle gradients. This, combined with the size of the average watercourse (225 ha., with 3.3 km of main channel, 40 km of farm ditches and often 50 or more farmers), was bound to create difficulties of organization in societies which were lacking in social cohesion and had no strong local institutions of any kind. A further technical reason for the particularly high losses on public tubewell commands was the failure to enlarge the watercourses after the installation of the tubewells: much water was simply lost through overtopping and spillage. Bad tubewell operation was another very significant factor. There was also evidence that farmers were often unaware of how much water was being lost during conveyance along the watercourses and that, if they had known, they would have tried harder to improve their maintenance.

Although there were no formal water users' groups in Area One, informal arrangements existed on all watercourses for mobilizing farmers to carry out maintenance on a communal basis. Surveys showed that the effectiveness of these informal maintenance groups (which were invariably channel-based) varied substantially, according to the degree of cohesion or conflict among kinship groups within the watercourse command. On some of the watercourses which had been physically improved under pilot government programs, and where the benefits of improved design and maintenance had been demonstrated to farmers, there was evidence of increased interest among the beneficiaries in establishing more formalized rules and institutions for watercourse maintenance, as well as for the closer internal supervision of rotational schedules and the settlement of intra-watercourse disputes.

Although the conditions for group action at the watercourse level in Area One are hardly ideal, they are far more favorable than those prevailing in Area Two. Social cohesion in Area Two is no greater than in Area One, length of experience of irrigated agriculture is much less and the essential conditions for the establishment of rotational schedules - a moderate degree of water scarcity, a complete watercourse layout which makes it physically possible for water to reach each farm unit, and a capacity to operate the main delivery system in a controlled and predictable manner - are all absent. Until these deficiencies are rectified, through on-farm development work and the installation of APMs and additional canal control structures, there is no reason to expect that attempts to introduce rotational irrigation or water users' associations will be successful. In the head-reach watercourses irrigation supplies to those who had access to them are abundant and there is therefore no incentive to adopt rotational irrigation, which is a rationing device; while in tail-reach watercourses supplies are often so scarce and erratic that an orderly approach to water sharing is ruled out there too. The only advantage which Area Two has over the Area One is that average watercourse size is much smaller. Even when main system and watercourse design have been improved, watercourse maintenance is likely to require considerable inputs of labor owing to the heavy soils, weed infestation, etc. Small group size should help to overcome some of the organizational difficulties this will create, but close official supervision and training will also be essential.

Compared with Areas One and Two, Area Three is fortunate in having highly developed and cohesive village-level organizations. Tertiary and quaternary channels were generally quite well developed and favorable slopes made watercourses somewhat easier to maintain than in Area One (and much easier than in Area Two). However, the scarcity of water in the dry season, combined with the very small average size of farm plots, suggested that a still denser pattern of reticulation was required. Some deficiencies in the performance of maintenance work within the watercourse were noted, but arrangements for regular maintenance on a group basis existed in all the villages visited during the field study.

One of the main weaknesses in Area Three appeared to be that average watercourse size (c. 115 ha) was too large for the purpose of promoting effective group action, particularly since this would imply a total population of over 400 farm units per watercourse. However, it was observed that even on watercourses which were not included within the government's Tertiary Improvement Program (PTP) there was a natural tendency to form smaller groups at the 10-15 ha level to supervise local water distribution and maintenance. Another weakness was that the organizations responsible for directing O&M work at the watercourse level, though highly sophisticated (having their own locally-appointed water officials, supported by contributions in kind from farmers), were village-based and not channel-based. This had several disadvantages, but the principal one was that it made the estimation of water requirements for each watercourse channel much more difficult, both for the village water official and for the junior water distribution field staff.

Finally, there was also some doubt as to how equitably or efficiently water was being distributed within the watercourse commands by the village officials. Under the system of Area Three water is not allocated proportionately to cropped areas, and operation at the watercourse level cannot therefore be governed by strict rotational time schedules as in the other Three Areas. Village officials were allowed a great deal of discretion with regard to the timing and length of irrigations given to different crops. Only detailed research would be able to indicate precisely how the present system actually works in practice and how well it works in terms of productivity and equity of water use. Despite these criticisms and doubts, it is clear that the strong local organizations, not only in Area Three but elsewhere in the country, have great advantages. Their potential as agencies for the improvement of irrigation facilities and practices at the local level has been demonstrated in the PTP program and still more in a less heavily subsidized program in a nearby area.

Area Four, like Area Three, has well-developed village-level organizations, though their powers and degree of autonomy are probably rather less than those of their Area Three counterparts. However, the Project Authorities contain strong channel - based organizations - the 'Small Groups' - at the 150 ha level, whose leaders are elected for four-year terms by farmers within the SG areas concerned. SG leaders in turn delegate certain responsibilities to 'team leaders' at the 50 ha (Rotation Area or water-course) level, and routine operation and maintenance function are also further sub-divided among farmers at the Rotation Unit (10-15 ha) level. Thus, although the Small Group has a large membership (about 300 farmers on average) there are smaller units within it which help to promote 'face-to-face' participation. The relatively egalitarian society of the rural native also helps to promote members' ease of access to and communication with SG leaders. Their principal functions are supervising watercourse maintenance and water distribution, exercising discipline within the watercourse and helping to collect membership fees. They sometimes hire 'Common Irrigators' paid for out of Authority funds to supervise water distribution by strict rotation in periods of scarcity.

SG leaders are in regular contact with project field staff and also have four formal meetings with them each year either for training or for discussions of work plans and budgeting. Until recently, the Small Groups were expected to carry out all their repair and maintenance activities with their own funds (as the irrigation groups do in Area Three) but sharp decreases in the availability of rural labor have lately made them dependent on additional funds from the Authority. This contribution of funds may have led to an increase of Project supervision of SG affairs, but SG leaders are still allowed a considerable degree of autonomy, particularly in certain small hill-stream command areas where there was a long history of indigenous small group activity before the Project Authority was ever formed. The division of responsibilities between project staff and SG officials appeared to be well calculated, varying according to changes in economic circumstances: SG leaders had clearly-defined and manageable tasks and most of those interviewed seemed to command respect from the farmers they represented as well as maintaining good working relations with Project field staff.

It is clear from this brief review that there are far greater difficulties in establishing group responsibility for watercourse affairs in societies such as those of Areas One and Two, which are much more stratified and less cohesive than those of Areas Three and Four. The high level of farmers' education and experience in Area Four has no doubt contributed to the present ease with which their Small Groups operate and to their capacity to collaborate closely with Project staff in local planning decisions. Technical factors also have a very important influence on group formation, as the negative example of Area Two demonstrates particularly clearly. The Area Three case confirms Coward's view that irrigation organizations should be channel-based, not village-based. ^{1/} Optimum size is also a complex issue, but it would seem reasonable to hypothesize that the need for a group to be small increases with the degree of social divisiveness and the technical complexity of the operation and maintenance tasks; on these grounds the Area One watercourses would appear to be too large (though some of the problems of organization could no doubt be reduced by internal divisions into sub-groups, as in Areas Three and Four).

Where the social and technical conditions are more difficult there is a clear need for closer official supervision of watercourse group development. In fact, supervision and regular contact between officials and farmers are weakest in Areas One and Two, where they are most needed, and strongest in Areas Three and Four. It is also clear that, especially where natural social cohesion is lacking, deficiencies in main system operation must contribute to the difficulty of establishing effective communal management at the watercourse level, both with regard to operation and maintenance. This is evident from the case of the public tubewell operation in Area One and still more conspicuous in Area Two. ^{2/}

10.4 Participation at the Project Level

In none of the areas studied were there any representative farmers' organizations at the project level, although the Area Four Irrigation Association had had Members' Representative Committees until 1975. These Committees were directly elected by members and had substantial powers, including the right to appoint the Chairmen (who in turn had the right to appoint their own staff). Their principal concern appears to have been with various aspects of financial management, including the agreement of the level of fees to be paid by members. The Committees' approval was also required for the overall plans for water distribution at the beginning of each main crop season, but detailed day-to-day decisions on operations and maintenance were left to the official staff. In the other three study areas there was in effect no formal farmer

^{1/} E. W. Coward, "Irrigation Management Alternatives: themes from indigenous systems", Agricultural Administration (4, 3), July 1977.

^{2/} The importance of good main system design and operation as a precondition for good watercourse management is also emphasized by S. Hashim Ali in his comments on large irrigation projects in Andhra (op. cit., pp. 190-191).

participation in decision-making at the project level, although in Area Three some village headmen were invited to the deliberations of the irrigation committees at District level four times a year. Elsewhere, meetings between farmers' 'representatives' (i.e., larger and more politically influential landowners) and project officials were of an ad hoc, informal nature and were mostly convened at the farmers' request for the purpose of lobbying (for more water, reduced water charges, etc.), either on their own private account or on behalf of their area of local influence.

The decision of the government in Area Four to suspend the Representative Committees was accompanied by other measures, including a reduction of staff numbers, which were largely designed to combat the financial difficulties being experienced by many projects as a result of changes in the overall economic environment. It was also argued that the Chairmen should be government appointees in order to ensure that they had the necessary technical qualifications: many of those appointed by the Committee had had no specialized technical management experience. The suspension of the Committee also carried the implication that some elected members were indulging in nepotism and using their positions for their own financial and/or local political advancement. If the Committees are reinstated, it is expected that government will retain the right of veto over their choice of Chairmen and other safeguards and controls are also likely to be insisted upon.

The difficulties of finding a satisfactory pattern of farmer representation at project level, even in the more economically advanced and egalitarian climate of Area Four, underlines the problems likely to face anyone with ideas of establishing similar organizations in a less favorable environment. Apart from the difficulties of achieving genuine representation in highly stratified societies, there will nearly always be strong financial reasons why governments will wish to retain a substantial degree of control or supervision over the manner in which large irrigation projects are managed: full self-management on such projects is very rarely found, owing to their very high capital and recurrent costs. Even before 1975, Area Four Irrigation Associations were much more subject to Government intervention than the Farmers' Associations, many of which have been able to become self-financing as a result of their commercial activities (credit, input supplies, marketing). To find large Irrigation Associations in which all the major strategic decisions are taken by farmers' representatives it would probably be necessary to go to relatively advanced economies such as those of Spain or the United States; and even there the element of government subsidy is usually substantial.

The organization in Spain, together with some of their strengths and weaknesses, had been described by Sagardoy. Their structure is very similar to those in Area Four previous to the 1975 reforms: a General Assembly which elects a Board of Directors, which in turn establishes overall policy and oversees the work of the professional manager, who is appointed by the Board and is expected to carry out their mandate. The manager is supported by a body of professional field staff. A comparative evaluation of the Irrigation Associations and other publicly-managed irrigation systems in Spain showed that the former tended to be more cost-effective, particularly in terms of their administrative requirements, were more successful in recovering water

charges, were able to obtain more respect from farmers for rules and regulations and communications between farmers and officials. On the other hand, they were found to have some limitations. One of the most important was their tendency to use a 'semi-demand' system of water distribution rather than a strict rotational system. This was found to lead to significant operational water losses. Another weakness was that, partly because of the limited technical and managerial capabilities of their staff, they tended to confine their responsibilities rather narrowly to the tasks of operation and maintenance. As a result important supporting services - e.g., water management research and extension, monitoring - were rarely provided.

Sagardoy emphasizes that even in the relatively favorable social and economic circumstances of Spain, where Irrigation Associations have had a very long tradition, long periods and considerable administrative effort are required before a new project can be handed over to the farmers themselves for full self-management. Depending on local conditions, the period of 'tutelage' (during which government agencies are responsible for taking major management decisions and also for providing farmers with the necessary training to enable them to take over) may last from as little as 5 years under favorable conditions to periods of up to 15-20 years in more difficult cases. ^{1/}

An important point to note about the Irrigation Associations is that they were never federally structured organizations even when the Representative Committees were in existence. Committee members were not elected from the ranks of Small Group leaders but from a very different category of people, mostly local 'notables'. Indeed, we know of no examples of an Irrigation Association with a federal structure (e.g., primary organizations at the watercourse levels, secondary organizations at an intermediate level and an apex organization at the project level). In Spanish or US conditions, individual farms are so much larger that there is no watercourse nor any need to form farmer groups for communal operation and maintenance work: the Project field staff are responsible for supervising O&M work down to the individual farm outlets. However, theorists who have addressed themselves to the problem of how to promote greater farmer participation in decision-making on large developing country irrigation systems have generally argued in favor of some kind of federal structure. For reasons explained in the next chapter, we would agree that where governments are interested in encouraging formal farmer representation at project level such an approach is likely to produce the most satisfactory results.

^{1/} J. A. Sagardoy, "Associations of irrigation water users", Paper to ODI Workshop on Irrigation Management, Canterbury, September 1976. See also A. Maass and R. L. Anderson, ... and the Desert Shall Rejoice: Conflict, Growth and Justice in Arid Environments, MIT Press, 1978 Chapter 2-4.

11. Government's Role in Stimulating Participation

11.1 Conditions for small group development

It has been argued in very general terms earlier on in this report that it is desirable for governments to encourage increasing participation by farmers in decision-making over time. 1/ Such a policy is like to have three main advantages: the quality of decisions will be improved, particularly those which are dependent on intimate knowledge of local conditions; administrative costs will be reduced; and it will contribute generally to long-term social and political development by enhancing farmers' capacities to take a more active part in other local decision-making forums (e.g., local government bodies).

On large irrigation projects participation is possible at two levels: at the project level, where it has been suggested that farmers' representatives are likely to have the most beneficial influence on performance if they focus their attention on financial issues and the planning and monitoring of water allocation rather than on details of its day-to-day management; and at the watercourse level, where the principal concerns of local groups will be with water distribution and maintenance within the watercourse command. As has already been indicated, it is possible even in rural societies with marked inequalities in income and power for government agencies to bring about significant improvements in the productivity and equity of water distribution by giving weight to the demands of fairly ad hoc pressure groups from tail-end areas, which tend inevitably to be dominated by larger farmers. However, it has also been argued that in the longer run genuinely representative farmers' organizations can be established at the project level only if effective water users' groups have first been built up at the watercourse level. 2/ One of the first priorities for the promotion of farmers' participation on large irrigation projects must therefore be the development of viable watercourse groups. Such groups are in any case administratively essential under most developing country small farm conditions, since official agencies lack the manpower to manage watercourses and field channels directly. Similar arguments can be advanced in favor of the creation of small groups for other agricultural service activities, such as extension, input supplies, and savings and credit. 3/

The importance of having specialist cadres with responsibility for training farmers in watercourse management has already been emphasized earlier in this report. 4/ One of their principal tasks should be to help

1/ Section 6.3.1.

2/ P 203.

3/ See, e.g., G. Hunter (ed), *Agricultural Development and the Rural Poor*, pp. 40-45.

4/ Pp 84 - 85, Section 8.4.

develop watercourse groups. In many cases this is likely to be far from easy, however. The long-term objective should be to produce self-sustaining groups which will serve the interests of smaller and tail-end farmers as well as those of larger and head-reach farmers. The dimensions of the task can be illustrated by reference to what appear to be the principal conditions which need to be met if the formation of any kind of small group is to be successful.

The first condition for success is that it must be possible through group action to secure a 'collective good' - i.e., one which can benefit each individual member but which is realisable only if he collaborates with others in an organization to obtain it. Secondly, the net private benefit to which each person is given access through membership of the group (taking into account the transaction costs and loss of individual discretion which membership involves) must exceed what he can obtain by any other means. Thirdly, the nature of the group's activity should preferably be such that individuals, in pursuit of their own private benefits, are inclined to do so in a manner which benefits the group as a whole and promotes its long-term growth. Fourthly, each member of the group must agree to share the benefits it yields on the same terms as his fellows: the basis of group membership must be a reciprocal one. Fifthly, there must be agreed sanctions, which may ultimately have to be supported by government, to protect the group against external harassment or private exploitation by any of its own members. And finally, the group must be of a size which is appropriate to its functions and the management capacity of its members. Although the performance of certain activities (particularly commercial activities such as marketing) may benefit from economies of scale in which case the group will often require the assistance of professional management - community of interest is generally much easier to secure in relatively small groups: domination by local factions or elites is less likely in smaller than larger groups. 1/ This last point has often been used as an argument against the establishment of conventional village-level cooperative societies, particularly in highly stratified societies. 2/

Several conclusions can be drawn from this list of conditions. The first is that the more stratified and/or faction-ridden a society is, the more difficult it will be to simulate the development of self-sustaining watercourse groups. There may be very little natural social cohesion among those whose land happens to fall within a particular watercourse command. In such circumstances a reciprocal relationship among group members is likely to be hard to secure.

1/ These ideas are adapted from V. S. Doherty and N. S. Jodha, Conditions for Group Action among Farmers, Occasional Paper 19, Economics Program, ICRISAT, Hyderabad, October 1977, pp. 7-14, though they have different views on appropriate size. See also M. Olson, The Logic of Collective Action, Harvard University Press, 1971.

2/ E.g., in Hunter (ed), op. cit.

A second more general conclusion is that certain functions provide a more promising base for group formation than others. This point can be illustrated initially by reference to the function of credit on the one hand and the functions of marketing and savings on the other.

There are strong a priori reasons why credit is likely to offer a particularly insecure foundation on which to build any kind of lastingly successful group action. The reasons lie with the motivation of the individual who wishes to join the group. Where the principal purpose is to acquire access to credit provided by a source external to the group, his immediate overriding interest is likely to be a short-term private gain and he may have little or no concern about the adverse effects which un-cooperative behavior (e.g. default in repayment) may have on the long-term future of the group as a whole. Moreover, in stratified and factional societies there can be no identity to be used as a weapon by one sub-group against another. With reference to cooperative credit in India, Doherty and Jodha have commented: "For large farmers it ... represented patronage and for small farmers it represented independence. Local political/economic leaders sought through faction-based societies to deny credit to their adversaries or to those persons whom they wished to see continue as tenants and agricultural labourers". 1/

By contrast, in the case of a marketing cooperative an individual will benefit from membership only if it enables him to get a better price for his product than an alternative agency. This will not happen unless the group as a whole is commercially successful and it will therefore be in his own interest to seek ways of encouraging its long-term expansion and increasing its share of market power. This coincidence of private and common interests also contributes towards a weakening of class and sectional barriers and explains why marketing and processing cooperatives for cotton, milk and sugar in Gujarat and Maharashtra have attracted a much more diverse active membership than credit cooperatives in the same area: "It soon becomes apparent to members that their individual share of market power is increased if more rather than fewer persons join. This improvement in the collective good as the organization grows is probably the main reason for the relatively quick acceptance into the societies of lowcaste members by highcaste members". 2/

For similar reasons, savings is likely to prove a better leading function for sustained group action than credit. When a group is formed for the initial purpose of mobilizing savings and if savings are then made the condition on which loans are issued, an element of discipline and control is introduced into the lender-borrower relationship which is often missing from official credit programmes. The borrower is more likely to respect a contract with conditions than something which has the appearances of a government handout.

1/ Doherty and Jodha, op. cit., p. 16.

2/ Doherty and Jodha, op. cit., p. 19.

There are some close parallels here with the contrast in circumstances (and in individual motivation) between indigenous groups which have formed themselves for the purpose of constructing and operating their own small irrigation systems and groups which are formed, often at the instigation of an external agency, in order to take responsibility for watercourse management on large irrigation systems. In the first case all the farmers within the irrigated common area have a common interest in maintaining the whole system, including the headworks: if they fail to do so no-one else will maintain it on their behalf and all of them will suffer as a result. In the second case, however, which is the one we are concerned with here, the circumstances are quite different. Decisions concerning the operation and maintenance of the main system are outside their direct control and their attitudes to the small part of the system for which they have been assigned responsibility may often be analogous to the receivers of credit - particularly if the government has encouraged them to regard public sector water as something of a handout through its pursuit of a low water charges policy. There will not necessarily be any spontaneous commitment to activities which will benefit the group as a whole. On the contrary, the over-riding interest of group members is likely to be in taking as much as they can as individuals, irrespective of the effect of their behaviour on others within the same watercourse. There will usually be a particularly sharp conflict of interest between head-reach and tail-reach farmers, the former being much more reluctant than the latter to contribute to communal watercourse maintenance work.

There should therefore be no illusions that the process of group formation within the watercourse of large irrigation systems (especially where there is no natural propensity towards social cohesion) is likely to be as easy as farmers themselves appear to have found it on many indigenous systems - although there is a great deal which development agencies can learn from the way in which indigenous groups operate. Coward has noted three particularly common characteristics of the organization and management of indigenous irrigation systems which, he argues, are equally applicable on large publicly-operated systems: (i) an 'accountable leadership' (leaders of each group are selected by members of that group, their performance is regularly reviewed by them, and they are compensated for their services directly by the group); (ii) a high degree of 'management intensity' (each irrigation system, although itself small, is usually further divided into smaller sub-units, each with its own leader); and (iii) a pattern of organization based on the channel, not the village ^{1/}. However, there is another crucial aspect of indigenous group organization to which Coward gives less emphasis, although it is to some extent implied by the concept of accountable leadership. This is the acceptance by group members, particularly where water is scarce, of often very stringent rules and regulations, including fines for failure to contribute to maintenance and work misdemeanours ^{2/}. Similarly powerful internal

^{1/} E. W. Coward, "Irrigation management alternatives: themes from indigenous systems", op. cit.

^{2/} See, e.g., the case cited from Aceh, North Sumatra, p 223, fn. 1.

sanctions (against fraud and defaulting) exist in most of the rotating savings and credit associations, which are another common form of indigenous organization found in many parts of the Third World. 1/

For the successful formation of watercourse groups, particularly in unfavourable social environments, an essential requirement is the existence of clear rules and effective sanctions against those who contravene them. Initially the sanctions as well as the rules will almost certainly have to be externally imposed, though a major objective should be to get the group itself to take over responsibility for applying sanctions against its members as soon as possible. This objective is most likely to be achieved if the leadership of the group is vested in a committee on which tail-enders and small farmers are well represented. However a still more fundamental precondition for members' acceptance of internal sanctions is that they be provided with a high quality of service by official irrigation staff: adequate and predictable water deliveries to the watercourse outlet and effective watercourse management extension 2/. These, together with improved agricultural extension, constitute the 'collective good' to which group members can have access - provided they agree to abide by the rules of the group. If they fail to do so (e.g. if they do not maintain the watercourse properly or attempt to misappropriate water, either collectively from the main delivery system or individually from each other), one of the most effective penalties will be to deny water supplies to the watercourse as a whole. This is a similar penalty to that of denying a new loan to the whole of a credit group, one or more of those members have failed to repay an old loan, and is based on the same principle of collective liability.

Such an interventionist approach to group formation is unlikely to appeal to those who believe that this is a process which should develop spontaneously 'from below'. However, in the particular context of water distribution, which involves the rationing of a scarce 'open access' resource, it is unrealistic to suppose that on large publicly-operated systems in areas without strong social cohesion watercourse management will ever be efficient or equitable under permissive, laissez-faire conditions - particularly if, as so often, there are major deficiencies in the management of the main system. 3/ In fact, experience has shown (e.g. from the early

1/ See F. J. A. Bouman, "Indigenous savings and credit societies in the Third World - A message?", Savings & Development, April 1, 1977.

2/ e.g. through simple demonstration of the benefits of improved watercourse maintenance, such as measuring the time required to irrigate a unit of land before and after improvement (Section 8.4).

3/ The same arguments apply to the management of rangelands, forests, watershed, soil and water conservation.

experiments at Comilla, Bangladesh and Daudzai, Pakistan) that farmers understand and respect the kind of conditional, bargaining, quid pro quo approach of the kind advocated here. In Comilla and Daudzai, for example, farmers were not allowed immediate access to credit: they only became eligible for it on condition that they agreed to form a group and contributed regular savings to a group fund for a substantial period of time. What farmers do not respect is a quasi-handout - highly subsidised credit, highly subsidized and loosely controlled water.

Once farmers have accepted externally imposed rules and sanctions in return for the benefits that these can bring, it should be possible to devolve increasing responsibility to them for maintaining those rules and sanctions, provided the official operating agency adheres to its sides of the bargain by keeping up a high standard of service. These principles of watercourse management have been recognized in Taiwan where, after an initial period of very strict external control, most of the rules and restrictions are accepted as necessary by Small Group members and the imposition of punishments for local violations of the rules can be left to SG leaders. Even now, however, the Irrigation Association continues to provide a substantial amount of training and supervision to the Small Group. Good watercourse management requires such a continuing (but changing) relationship between officials and farmers at all stages of social and economic development. An important condition for the success of the relationship is that as it changes over time the precise division of responsibilities between the two parties at any given point in time should be clearly defined and understood.

Finally, there is the question of the optimum size of watercourse for successful group formation. This is a subject for research as far as the design of new projects is concerned. In the case of already established projects where the watercourse units appear to be too large for easy communal management, as in Pakistan, one obvious expedient is to look for ways of dividing responsibilities for operation and maintenance on different sections of the watercourse among different sub-groups. This follows the pattern advocated by Coward and applied both in Java and Taiwan.

11.2 Potential of Water Users' Groups

Although successful watercourse groups are likely to prove difficult to establish in many environments, at least two other major advantages can follow from their establishment besides the primary one of improved watercourse management.

The first advantage is that they can help to provide a point of contact between government and small farmers for other supporting services, e.g. agricultural extension, credit, input supplies, marketing. This may be particularly important in areas where village organizations such as cooperatives are weak and/or have become dominated by a local elite. We know of no attempts so far to use watercourse organizations as focal points for other service activities, although the idea was proposed in connection with an improved experimental watercourse in Pakistan. One obvious advantage which such a policy could bring is that the 'collective good' available to members of

the group would be enhanced by the additional advantage of access to other services and inputs, and members' commitment to the group would therefore be strengthened.

An interesting characteristic of groups which are dependent on an area-based activity such as watercourse management (or soil and water management within a small catchment) is that they are much more likely to be socially heterogeneous than small interest groups which have been spontaneously formed for almost any other purpose (e.g. savings or credit). Anyone whose land happens to fall within the perimeter of the irrigable command area automatically becomes a member of the group whatever the size of his holding. This is, of course, one of the principal reasons for the difficulty of watercourse group formation in many cases, but if such difficulties can be successfully overcome these groups could become particularly effective means of promoting greater cooperation across class and caste divisions.

The second additional advantage of successful watercourse groups is that they should provide a sound foundation on which to build a system of representative farmer participation at the project level. As within the primary groups themselves, it would often be necessary to establish certain rules which would ensure the election of a substantial proportion of smaller and tail-end farmers to the project level body. As has already been argued, farmers' interest in participating in policy discussions at the project level is likely to be greatly increased if a substantial proportion of their payment of water charges were to be retained by the project organization for local reinvestment. ^{1/}

Arguments are sometimes put forward in favour of making watercourse groups formal legal entities. ^{2/} It is not altogether clear that this would be a great advantage, particularly in the early stages of their development. However, it might well be desirable to give the apex organization formal status once it had become firmly established and the same could also apply to the watercourse groups themselves if they were to take on a substantial number of additional responsibilities.

^{1/} p 121.

^{2/} G.E. Radosevich, Water Users Organizations for Improving Irrigated Agriculture: Application to Pakistan, Water Management Technical Report No. 44, Colorado State University, Fort Collins, 1975.

12. Some Observations on Small-scale Irrigation Schemes

12.1 Small surface schemes

Small surface schemes fall into two different technical categories; run-of-the-river diversion systems, many of which are to be found in hill-stream areas; and systems dependent on 'tanks' or small reservoirs, which are particularly common in South India and Sri Lanka but are also to be found in Taiwan and Mainland China among other countries. Within each technical category, the schemes may be divided into further sub-categories on the basis of their origins and their present pattern of management, as follows:

- (a) indigenous systems (i.e. ones constructed by the farmers themselves), which continue to be communally managed by their beneficiaries with no external assistance;
- (b) indigenous systems which remain self-contained but now receive some government assistance;
- (c) indigenous systems which have been incorporated for management purposes into larger government-directed irrigation projects; and
- (d) systems constructed by government, whose management responsibilities are usually divided between government and farmers.

River diversion schemes. Systems falling within the first two sub-categories (indigenous systems which are either wholly communally-managed or received only limited government assistance) have been favourite objects of study by anthropologists and sociologists. ^{1/} The majority of them are self-contained systems located in upland river valleys and are to be found in these localities in many parts of the world; those in South-East Asia have attracted particular attention. Rice is usually the dominant crop. They are typically very small (50-200 ha, with between 40 and 100 members) and depend for their water supplies on simple diversion weirs of boulders or brushwood, which are designed, constructed, operated and maintained by the farmers themselves. Because of their upstream location, their water supplies are usually relatively abundant and assured compared with those of larger river basin systems.

The simplicity of their technology, the abundance of their water supplies and their small size undoubtedly reduce the difficulties their

^{1/} For a guide to the literature, see E. W. Coward, Irrigation Institutions and Organizations: an international bibliography, Department of Rural Sociology, Cornell, January 1976.

members have to contend with in their internal decision-making and contribute greatly to the social cohesion and sense of common purpose which have attracted so much scholarly attention. Their achievements in organization and management are nevertheless impressive by any standards and reflect the application of many basic management principles which have been neglected or overlooked by government agencies on their much larger projects. The activities of water distribution, system maintenance and repair and financing are all performed by the farmers themselves, though they are of course dependent on outside support for extension advice and input supplies. Particularly remarkable is their capacity to self-finance all their costs (construction as well as operation and maintenance). So too is their willingness to accept often stringent discipline from their leadership; for example, a scheme in Aceh, North Sumatra, is operated according to a set of very detailed rules which, among other things, prescribed fines of up to \$5 or 14 days in gaol for farmers who fail to assist in construction and maintenance work or do not adhere to a pre-planned schedule for land preparation and crop cultivation. 1/ Three particularly important principles of management which Coward has found to be common on all indigenous systems have already been referred to: accountable leadership; the use of still smaller sub-groups within each small group; and their channel-based character. 2/

The most remarkable of the indigenous river-valley irrigation systems, on account of their size and the intricacy of their distribution systems, are the Balinese subaks. Subaks (areas irrigated from a single dam) usually consist of a number of interdependent systems and, because of high population pressure and relative water scarcity, water is commonly rotated between and within them. There are linkages with government officials at watershed level, but the subaks themselves (varying from below 10 ha to over 300 ha, according to topography, with membership of 25-700) are entirely locally organized. Their leaders, who are elected by all subaks members, tend not to be notably different from the rest of the group in terms of landownership or political power - they are usually chosen for "goodness" or "worthiness". 3/ Decisions are customarily taken by the group as a whole. The head of the subak collects taxes, fees and fines and certain members are given responsibility

1/ Quoted in Binnie and Partners, Feasibility Study of Krueng Jreue and Krueng Baro Projects, Aceh, North Sumatra, Vol V, pp 100 ff., March 1976.

2/ P 218.

3/ This is untypical of indigenous groups as a whole. Levine has observed of most groups in the Philippines that, though cohesive, they also reflect the generally inegalitarian character of the surrounding society. ("The Management Component in Irrigation System Design and Operation", Seminar Paper, Cornell University, 1971, p 29)."

for water allocation and system maintenance. Great care is paid to the detailed measurement of water and to equity of water distribution. 1/

Despite their many admirable organizational features, there is often considerable scope for improving the performance of most indigenous schemes at relatively little cost, not only through better extension (which tends to be particularly weak in 'peripheral' upland areas) but also through advice and assistance from irrigation engineers on various aspects of system design. For example, clear benefits can frequently be obtained, in areas of heavy seasonal rainfall, from installing permanent diversion structures in place of the traditional temporary weirs, since the substantial time previously lost by farmers at the end of each rainy season on repair and reconstruction work can be used instead of more immediately productive farm activities. The Indonesian Public Works Department has designed and constructed such structures for several of the subaks, and investigations are also being made into the possibilities of reducing water losses through the installation of control structures and measuring devices within the subak command areas. The latter type of intervention obviously requires careful handling, since it is in everyone's interest that the main responsibility for the internal management of the subaks, as well as other simpler types of indigenous system, should remain in the hands of their members.

Unfortunately, it has been a common experience that when governments have attempted to influence the development of indigenous systems, particularly through their incorporation into larger projects, the old groupings have tended to disintegrate, because they lose many of their original responsibilities and are given no new ones in their place.2/ The greatest problems are likely to arise when the principal reason for government intervention is to reduce the level of water extraction by the indigenous upstream systems in order to enlarge the quantity available to increasingly water-short farming communities in downstream areas. Since upstream systems are often very prodigal in their use of water, such interventions are difficult to argue against but they are naturally resented and tactful diplomacy is required by the government agencies concerned.

Coward has recorded a sensitive and apparently successful attempt in western Laos to incorporate small independent irrigating communities into a larger officially-administered project of about 2,000 ha (serving about 900 farmers in 21 water users' groups). The traditional leadership pattern was maintained, but the role of the villages' 'water headmen' had had to be changed. They had previously been concerned with repair and maintenance work and settling disputes about water allocation within the community, having little or no contact with external authorities. But after the change their primary function was to supervise water allocation among villages and they were required to act as link-men between the irrigation bureaucracy and the

1/ See studies by Birkelback and Geertz, op. cit.

2/ ... in the Philippines, see G.T. Castillo, All in a Grain of Rice, S.E. Asian Center for Graduate Research in Agriculture, 1975, pp. 391-2.

water users. Coward argues for the importance of providing traditional officials of this kind with real and continuing responsibilities under a larger bureaucratically directed system because of their local accountability: they are known to the small group they serve, they are selected by them and they are compensated by them for their work, in cash or kind. 1/

There appear to have been very few case studies carried out on small surface schemes constructed by government. However, we suspect that many of them would reveal a pattern of experience similar to that recorded on the Mombo irrigation scheme in Tanzania. This was established in 1967 with 200 ha and 80 farmers but soon came to a standstill after operational responsibility had been handed over to the farmers without sufficient technical or management training or service support. This scheme is now in the process of rehabilitation. 2/

Tank schemes. Most of the indigenous tank schemes in South India and Sri Lanka have small command areas, serving the lands of a single village and sometimes only a small proportion of them (in Andhra Pradesh, village tanks of over 4 ha are regarded locally as "large"). They form an important part of the total irrigation resources in these regions, often acting as a significant stabilizing influence on agricultural production in areas of markedly uncertain rainfall. They are substantially more difficult to manage than the typical hill-stream system and this no doubt accounts for the much more variable quality of their performance. They have two main problems. One is the unpredictability of the rainfall pattern, which introduces major complexities into the operation of the reservoir: communal decisions have to be reached as to when the water shall be released, how much of the command area shall be cultivated and which sections of it shall receive water. 3/ The other is the heavy accumulation of silt in many of the tanks, which greatly increases the difficulties of maintenance.

In Tamil Nadu and Sri Lanka the main responsibility for operation and maintenance of these small village tanks still lies with cultivators' committees. In areas like Andhra, where many of the smaller tanks were constructed by large landowners (zamindars) who have now lost many of their earlier rights, formal responsibility for their management has been taken over by the local panchayat or a government department (Public Works or Revenue). Elsewhere too there is a tendency towards more government involvement, either in the form of financial support or technical advice on operation or maintenance matters. Very often, however, the divisions of responsibilities between government and cultivators is not clearly defined.

1/ E. W. Coward, "Indigenous organization, bureaucracy and development: a case study of irrigation", Cornell University, 1975 (mimeo; since published).

2/ K. E. Kikaho, "Mombo irrigation schemes", Case study paper to Commonwealth Workshop on Irrigation Management, Hyderabad, India, October, 1978.

3/ Questions of alternative cropping patterns may also be considered in some cases, though on the majority of tank schemes the water is used exclusively for rice.

Many of the older tank systems in Tamil Nadu and Sri Lanka have had elaborate procedures for achieving equitable patterns of water distribution, for example, through the deliberate fragmentation of each cultivator's land holdings into different sections, one favourably located below the tank and the other less favourably. 1/ Some of the old practices have been retained but many of them appear to be breaking down and the overall picture, both from these areas and Andhra, is one of deterioration both in the quality of management and in the level of performance. Chamber's conclusion from his review of tanks in Tamil Nadu and Sri Lanka was that their water distribution was "usually both inequitable and inefficient in terms of productivity". The principal reason for this deterioration seems likely to be population pressure, combined with increased problems of maintenance, and in many cases lack of clarity in the definition of government and communal responsibilities. There also appears to be evidence in Andhra and Tamil Nadu that further problems have been created by "secular shifts in the rainfall pattern". 2/ The level of technical knowledge on which many important operational decisions are taken is usually low, water management practices at the field level are often wasteful (most tanks are used exclusively for rice cultivation) and, as Waheeduddin Khan has pointed out in the context of Andhra, measurement and control structures are almost totally absent. 3/

The case for improved technical advice and support from government small tank schemes appears extremely strong. Unfortunately the level of management achieved by official staff on most of the larger tanks which have been more recently constructed by government has itself tended to be conspicuously poor. In Sri Lanka, Shammugarajah has recorded the case of a fairly typical tank in the Dry Zone, constructed and operated by government (c. 5000 ha command area), in which high levels of water wastage had been occurring under normal conditions of management. As a result of the wastage, a situation of critical water shortage was created in early 1976, which led to the intervention of the special team from the Irrigation Department's Water Management Division. Under their advice, farmers agreed to accept a system of rotational irrigation - a practice previously unknown to them - and following the imposition of strict management, total production was about 50% higher than it would have been with the same water supplies under

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- 1/ See E. R. Leach, Pul Eliya, a village in Ceylon. A study of land tenure and kinship, Cambridge, 1961, p. 158. Report No. 1, p. 56.
 - 2/ M. von Oppen, "Instability of area and productivity under tank irrigation in selected districts of Andhra Pradesh and Tamil Nadu", Discussion Paper 9, Economics Program, ECRISAT, July 1978.
 - 3/ Chamber's review of tanks in Tamil Nadu and Sri Lanka is in B. Farmer (ed), Green Revolution?, pp. 347-355. For the situation of Andhra, see Waheeduddin Khan, "Problems in the Management of Minor Irrigation Schemes", Lead Paper No. 6, Proceedings of the Commonwealth Workshop on Irrigation Management, Hyderabad, India, October 1978, pp. 224-233.

normal conditions. Shanmugarajah notes that there were no past records of water issues or cultivated areas, there were few control gates and no measuring devices. 1/

In India, the tendency of government to neglect both the technical and management aspects of minor irrigation schemes has been strongly criticised by Vohra. He points out that minor irrigation is usually the responsibility of State Agricultural Departments and suffers from the lack of technical supervision which could be provided by the Irrigation Departments. Minor irrigation organizations build tanks 'only to see them silted up within a matter of years because no care is taken to see that soil conservation measures are initiated simultaneously in catchment areas'. 2/

The incorporation of small indigenous tanks into larger publicly-operated irrigation systems, using the tanks as local storage points which are fed by new canals, has been carried out with apparent success in both Taiwan and China. 3/ Similar success is unlikely to be achieved on schemes in South India and Sri Lanka (under the Mahaweli project) unless present standards of main system water distribution are radically improved.

Conclusions. Although many indigenous systems, particularly those in hill-stream areas, are remarkable for the quality of their social cohesion, nearly all of them could benefit greatly from better advisory and supporting services from government. The same goes for small schemes constructed by government, which frequently experience the same neglect with regard to supporting services and tend to suffer still more as a result, owing to their relatively poor internal organization. It appears to be true of most developing countries that outside the larger command areas resources for the development of irrigated agriculture - both finance and personnel - are spread particularly thinly. One of the reasons for this is no doubt that it is more difficult to organise services to a number of scattered small irrigation schemes than to a single large one, though the greater political attractiveness of large schemes is also a major contributory factor. It seems probable that in many cases very high returns could be obtained from improving the administrative support to these small schemes, often much higher than from constructing new large projects. Such a strategy would also very often be likely to deserve further support on grounds of regional equity.

To make the strategy effective, substantial increases in staff numbers, both on the agriculture and irrigation side, would be needed.

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- 1/ K. Shanmugarajah and S. C. Atukorale, "Rajengane Scheme - Lessons from 1976 Yala cultivation", Case study paper to Commonwealth Workshop on Irrigation Management, Hyderabad, India, October 1978.
 - 2/ B. B. Vohra, Integrated Management of Land and Water Resources, Paper for ESCAP/ACDA/IIPA Regional Programme on Management of Agriculture, New Delhi, September 1976, p. 10.
 - 3/ E.G. in Taoyuan, Taiwan. J. Nickum refers in a paper on irrigation in China to the use of a 'melon-vine' system - i.e. one in which small storage tanks are fed by canals.

Changes in the organization of local administrative staff would also often need to be considered. The provision of specialist advice on operation, maintenance and repairs might be best provided through the establishment of a rural engineering service, with junior field staff based at local offices in the same way as agricultural extension staff, perhaps at a multi-purpose Farmers' Service Centre. They would need to be in regular contact with senior engineers for advice on design work. Most of their work would be concerned with low-cost improvements in design - e.g. for masonry diversion structures, weirs, measuring structures - and with the development and implementation of improved procedures for water distribution. It is extremely important in the latter case that a clear division of responsibility be established, with the farmers' organization being encouraged to undertake all functions except those that require specialist knowledge. ^{1/}

12.2 Groundwater schemes

Groundwater systems have two obvious advantages over surface water systems. They lend themselves much more easily to divisible investment and they are capable of being much more flexibly operated. However, the use of groundwater is possible only under certain aquifer conditions; and, despite the scope for greatly reduced water losses because of short distances between well and field, it is usually significantly more expensive than surface water.

Three of the most important issues affecting the quality of groundwater are ones of policy: the choice between public and private ownership; the choice of appropriate well and pump technologies; and the establishment of effective controls over groundwater extraction. Where ownership of a well is public or communal the same kind of water distribution problems are apt to arise as on surface systems, though not on the same scale. The typical problems of management associated with large scale organizations do not arise except where public tubewells are being operated over a large area, either on their own or, more commonly, in conjunction with large canals (as in the case of study areas one and four).

How choices should be made between public and private ownership and among different technologies depends largely on the following factors:

- (a) groundwater depth;
- (b) abundance or scarcity of groundwater supplies;
- (c) the need for drainage (against waterlogging);
- (d) water quality;
- (e) opportunities for conjunctive use with surface water;
- (f) size of land holdings;

^{1/} Cf. Recommendations of Commonwealth Workshop on Irrigation Management, Hyderabad, India, Proceedings, pp. 15-16.

- (g) density of watercourse and field channel network;
- (h) social structure of the farming community; and
- (i) the quality of public sector management.

The importance of establishing controls over groundwater extraction increases with the scarcity of the water supply and the intensity of the demands being made upon it. Responsibility for overall control is inevitably government's though the choice of mechanisms for applying it will vary depending on the nature of well ownership.

The other essential functions of government, irrespective of ownership patterns, are the organization of comprehensive water balance studies and detailed hydro-geological surveys in advance of any major groundwater development; and continuous monitoring of groundwater conditions as extraction proceeds, with checks on trends in aquifer characteristics, drawdown and salinity lines. Under conditions of private well development, additional government responsibilities include the organization of credit, assistance in drilling and the supply of construction materials, the provision of insurance against dry wells in hard-rock areas, the establishment of servicing workshops, the provision of extension advice on pump operation and maintenance, and assistance in the construction of watercourse channels where these are found to be inadequate. The extent to which government needs to involve itself in some of these services, especially in relation to larger farmers, will depend on the availability of private businesses which can also undertake construction and repair work.

Questions about ownership and technology can sometimes be answered in a fairly clearcut fashion. Under certain aquifer conditions, there is an incontestable case for groundwater management by a public agency, using deep tubewells with large discharge capacities: for example, when the watertable is very high and the main purpose of pumping is for drainage, not irrigation; or when the quality of the groundwater is too poor to be used for irrigation except after careful mixing with surface supplies. On the other hand, where the watertable is high (but not too high) and supplies abundant, there would seem to be a strong case for encouraging private exploitation through shallow wells.

The arguments in favour of private wells using small-scale technology are particularly persuasive in conditions such as those prevailing in areas like Bangladesh, West Bengal and Bihar where, in addition to high watertables, farm holdings are highly fragmented, watercourse channels are poorly developed and farmers' propensity to cooperate is low. There has been criticism recently in Bangladesh of the emphasis which the government, with the backing of external donor agencies, has given to the promotion of publicly-operated deep tubewells rather than to the support of highly divisible low-cost technologies (shallow wells, low-lift surface pumps, etc) already being widely used by private operators in various parts of the country. Biggs, Edwards and Griffith maintain that this has been a case of particularly inappropriate technology transfer, not only because high watertables in many parts of Bangladesh make deep tubewells costly and unnecessary but because the very numerous small, fragmented

landholdings within each tubewell command create unusual difficulties for water distribution. This is reflected in the fact that the actual area irrigated by these wells is generally much smaller than the planned area. Similar mistakes were also made earlier in Bihar, where the government persisted with attempts to promote deep tubewells for a long time after the vast majority of farmers had opted for small bamboo tubewells designed and produced within the private sector (with installation costs of under \$30, or less than the interest payments on large wells). Biggs *et al.* argue that the objectives of productivity and equity would both be best served by a government programme which concentrated on the improvement and development of existing small-scale technologies and on ensuring their availability to all farmers, however, small: despite their relatively low cost, this would entail introducing selective subsidies and special credit programmes, for the poorest farmers, in place of the present subsidy and credit policies which favour the larger landholders. ^{1/}

There is a very substantial area of uncertainty with regard to appropriateness of policy in those conditions which fall between the two extremes discussed above. In certain circumstances there may often seem to be strong arguments, on technical and economic grounds, for installing large public tubewells: for example, where the watertable is too deep to be easily exploited by lower capacity private wells or, particularly, where there are opportunities for developing a comprehensive programme for the conjunctive use of surface and groundwater supplies, in which careful aquifer control (to secure an optimal balance between pumping and recharge) is a central feature. However, the case for public sector operation usually rests on the assumption that the wells and pumps will be managed at least as efficiently as they would be under alternative (lower capacity, private ownership) conditions. Unfortunately, this rarely happens in practice. Where pumping is mainly a drainage exercise the problems of management are relatively limited; but when its purpose is to provide water for irrigation major opportunities for corruption and bad management occur, as the Area One case study has shown. In areas where both private and public wells are in operation, the evidence generally points towards higher levels of efficiency in water use under private wells. ^{2/}

This is not altogether surprising. Wells are likely to be operated most flexibly when they are in private hands: in contrast to the public tubewell operator, private well-owners have to bear most of the costs of construction, operation, and maintenance (apart from any government subsidies) and are therefore careful to reduce wastage to a minimum by pumping

^{1/} S. D. Biggs, C. Edwards and J. Griffith, Irrigation in Bangladesh, IDS Discussion Paper No. 126, University of Sussex, 1978. On the bamboo tubewells of Bihar, see E. Clay, "Planners' preferences and local innovations in tubewell irrigation technology in N.E. India", IDS Discussion Paper No. 40, 1974; and A. J. Dommen, "The bamboo tubewell: a note on an example of indigenous technology", Economic Development and Cultural Change, 33, 3.

^{2/} For example, in a sample survey in Pakistan, average water application efficiencies on farms with canal water supplies plus private tubewell water were 59%, against 44% on farms whose supplementary water came from public tubewells.

only when their crops require water. 1/ On the grounds of efficiency alone, therefore, it might appear preferable in societies where the level of public sector management is poor to go for private development in nearly all circumstances. An alternative to this, of course, would be to try to improve the quality of public sector management through the kind of measures advocated elsewhere in this report; or possibly to dispense with publicly-employed tubewell operators altogether and replace them with people chosen by, and accountable to, local watercourse groups. 2/ Meanwhile arguments about efficiency have to be balanced against others about equity. It is very clear that the more unequal the pattern of a country's rural income distribution is, the more inequitable will be the pattern of groundwater development if it is left in private hands, unless government takes specific steps to provide special assistance to smaller farmers. In areas of relatively abundant groundwater this implies, at the very least, a heavy government commitment to R & D programmes concerned with the promotion of well technologies which are particularly suitable for smaller farmers and to the supply of credit on special terms which will ensure that they have access to such technologies. However, where there is greater pressure on groundwater supplies and a danger of a steady decline in watertable levels, it also becomes essential for government to limit private exploitation of the aquifer through legislation. In such circumstances, well development can be prohibited except under government licence, with restrictions being placed not only on well locations but also on pump capacities. Without such controls, the inevitable pattern of development is a free-for-all, in which larger farmers - often assisted by subsidies - take the lead and then, as the watertable begins to decline, maintain their advantage by moving onto increasingly sophisticated technologies which their poorer neighbours cannot afford. The effects of inadequate public control have been well documented in the case of the Wadi Dhuleil project in Jordan, where a rapid decline in water levels occurred owing to the restricted nature of the aquifer, and also in North Arcot District, Tamil Nadu. 3/ But many other examples can be found. The ultimate effects are disastrous, not only in terms of equity but of the long-term economic prospects of the whole of the over-exploited area. Some of the most poignant examples of what the future will have in store for many other areas if they allow competitive exploitation to continue unchecked are to be found in the hard-rock region of Coimbatore District, Tamil Nadu; here many open

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- 1/ They will also often sell water to their neighbours on demand.
- 2/ An example of successful well management by a cooperative is described by E. W. Coward and Badaruddin Ahmed, "Village Technology and Development: Patterns of Irrigation Organization in Comilla District, Bangladesh", Cornell University, 1977 (mimeo).
- 3/ I. Carruthers, E. Clayton and F. Hamawi, Wadi Dhuleil, Jordan: an ex-post evaluation, Wye College, University of London, 1974; and C.M. Madduma Bandara, "Hydrological consequences of agrarian change", in B. Farmer (ed), Green Revolution?, pp. 323-339.

wells have been dug to a depth of 150 metres or more and it is no longer economic even for large farmers to continue deepening their wells or to pay the additional pumping costs. 1/

Despite the obviously undesirable social and economic consequences of a laissez-faire approach to private groundwater development, very few developing country governments have in fact introduced or applied the necessary legislative controls. Nor indeed has much attempt been made to seek ways of redressing the inequality balance through rather general subsidies on pump-sets. 2/ The main reason for this faint-heartedness on the part of governments is that it would bring them into conflict with often powerful larger farmer interests. Given their reluctance to do so, it might appear that a policy of public well ownership and operation, though likely to be less efficient in the short-term, would provide a better chance of achieving greater equity and long-term stability. Almost no comparative research appears to have been done on this subject (though comparisons of the economic and financial benefits of private and public wells have been numerous); but observations made in Area One were not encouraging, at least with regard to equity (serious declines in groundwater levels had not yet occurred). Not only were the tubewells being inefficiently operated, but there was considerable evidence that the largest farmers were profiting most from the arbitrary behaviour of the tubewell operators.

The most obvious general conclusion to be drawn from this brief survey is that, like good surface water management, good groundwater management (whether in private or public hands) is impossible unless there is commitment at the highest political level to serve the interests of all water users and not only minority pressure groups. This point can be further underlined by reference to the positive example of Area Four, where public tubewell development has been planned specifically with a view to promoting greater equity of water distribution. The deep tubewells are pumped directly into the canal system (in contrast to Area One where they are pumped into watercourses) and are operated in conjunction with the pattern of surface supplies, under the close supervision of senior project management. Most of the wells are concentrated towards the tails of the canals, so that the area most vulnerable to deficiencies in surface supplies can have access to supplementary groundwater when required. The pump capacities of private wells are strictly controlled, so that the restricted deep aquifer is tapped only by the public tubewells. On the other hand there are abundant small shallow private wells which provide farmers with the additional flexibility of operation which cannot be obtained through the public system.

1/ R. Sivanappan and P. K. Aiyasamy, Water Resources of Coimbatore District, Tamil Nadu Agricultural University, Coimbatore 1978.

2/ For a discussion of possible alternative future technologies, see R. Chambers, et. al, "The crisis and the Future", in B. Farmer (ed), Green Revolution?, pp. 386-7, 392-6.

V. RECOMMENDATIONS

13. Evaluating Organization and Management

13.1 The Need for Comprehensive Evaluation

Although there is still room for argument about finer points of methodology we believe that this report (together with the others carried out in the course of the study) has demonstrated the need for a comprehensive approach to the evaluation of irrigation projects - an approach which goes well beyond the conventional analyses of project performance and attempts to explain in detail the causes of performance. We believe that this report will also provide support to the more general view that a similar approach is equally needed with regard to other kinds of agricultural projects or programs, and as much in their ex-ante appraisal as in their ex-post evaluation. An essential element in the appraisal of new projects should in any case be the evaluation of the past performance and management of existing projects: without the information provided by such studies it is most unlikely that planners will be able to propose organizational structures and management methods which will be appropriate to local needs and capacities.

Conventional project evaluations are usually very limited in scope (where they are carried out at all) and so too is their value for the purposes of causal diagnosis and policy prescription. They are generally restricted to technical and economic/financial analysis: present performance is measured against past performance or against targeted goals, in terms of input:output and cost:benefit ratios. They may often contain some general - largely descriptive - observations on the social characteristics of the farming community and on the organization of government services, but their central focus is on the results of management, not on the management process which has contributed to the achievement of these results. In other words, they record what has happened, but provide only limited evidence as to how it happened and why it happened in that way. These essentially retrospective evaluations may of course be valuable for certain purposes, for example as a means whereby governments or aid agencies can audit the economic and financial progress of projects they have invested in and assess their repayment capacities. They are quite inadequate, however, for the purposes of evaluating and appraising projects whose principal purpose is to promote rural development policies specifically intended to assist the rural poor. Such projects in particular cannot be effectively designed without an intimate understanding of the social and political contexts in which they are to be implemented and of the administrative and institutional measures likely to be most appropriate in those contexts.

The deficiencies of conventional evaluation methods are reflected in the common biases and gaps which are regularly observable in the improvement programmes devised by governments and aid agencies for existing irrigation schemes - even the very best of them. During the past decade a far greater general awareness has developed than before of the need for improvements to be made not only in the physical infrastructure of many irrigation schemes but

also in their organization and management. Nevertheless, in the absence of comprehensive analyses, certain assumptions have tended to be made about the reasons for poor project performance which have led to the recommendations of sub-optimal programs of remedial action. The most comprehensive 'package' program of the kind currently most favored would probably contain the following elements:

- (a) amalgamation of Irrigation and Agriculture Ministries at national levels;
- (b) formation of unified project agency at command area level;
- (c) strengthened agricultural extension;
- (d) larger budget allocations for operation and maintenance;
- (e) higher water charges;
- (f) remodelling/rehabilitation of main water delivery system;
- (g) technical and institutional changes at the watercourse and farm levels ('on-farm development', organization of water users' groups, etc.). 1/

Despite the great potential importance of all the components of this package, there is one central aspect of management which has been universally neglected; and, very largely because of this, there are inevitably serious imbalances in all the remedial programs currently being recommended.

What is conspicuously missing from this list of improvements is any set of measures specifically directed at reforming water distribution practices within the publicly-operated section of the canal (or canal-cum-tubewell) system. Yet it is clear from this study as well as those conducted by several other independent researchers that this is one of the areas of greatest weakness on large irrigation schemes. The evidence is presented in detail in the field study reports; and further evidence, of which the most telling comes from IRRI's controlled field experiments in the Philippines, has been cited earlier in this report. 2/

By contrast there is no good evidence at all to support the belief, still apparently held by some planners, that most of the problems on the main

1/ Most governments have adopted only parts of this package so far. The Indian Central government is one of the few so far to have accepted the radical changes implied by (a), (b) and (c), under the Command Area Development program. The main emphasis elsewhere has tended to be on (d), (f) and (g), and sometimes on (c).

2/ Pp 139 ff.

distribution systems are technical ones, soluble by technical means alone, and that all major deficiencies of management are concentrated within the watercourse and on the farm. Evidence which is sometimes cited in support of this belief is that water losses are generally much higher below the watercourse head than above it. This is demonstrably true. ^{1/} But it proves nothing by itself. It is perfectly consistent with poor management higher up the system leading to unpredictable patterns of water supply to farmers and consequently high losses within the watercourse and on the farm.

The object here is not to deny that there are often serious shortcomings to be remedied at the watercourse and farm levels: they were blatantly evident in Area Two, obvious in Area One and detectable (though much less immediately apparent) in Area Three. It is rather to emphasize the point, already made earlier in this report, that until effective reforms are introduced in the field of water distribution, the chances of lasting success in other spheres - particularly on-farm development - must inevitably be greatly reduced. ^{2/} Indeed, one could go further and declare that as long as such a central management issue continues to be ignored in the planning of irrigation improvement programs, the balance of improved investment is bound to be wrong; there will be a continued bias towards bricks-and-mortar and watercourse level solutions as against solutions which involve the improved mobilization of administrative resources; and returns on investment will regularly fall below planners' expectations.

In practice, very few evaluators or planners can be totally unaware of weaknesses in the official management of irrigation projects, particularly with respect to water distribution. However they recognize this as a sensitive 'political' area which is either thought to be outside their terms of reference or is more wisely left alone for fear of offending personal sensibilities and stirring up unpleasant controversy. In such circumstance it is temptingly convenient to put the main blame on "the farmer". If this is commonly the case, it is a further argument in favor of developing a systematic method of evaluating management performance which is able to produce a detailed and objective assessment in place of what could otherwise be represented as a superficial and arbitrary personal impression. In fact, as this study has shown, all the major management weaknesses identified in the field study areas could be traced back to deficiencies in policy, organizational structure and management procedures. There is therefore usually no need, in writing up an evaluation report, to refer to individual personalities unless, perhaps, they have shown outstanding capabilities.

^{1/} See e.g., M. Bos and J. Nugteren, On Irrigation Efficiencies, Wageningen, 1974.

^{2/} Evidence from field experiments in support of this view again comes from the Philippines: "The principal constraint in realizing the full benefits of Improved Irrigation Management on other than a pilot basis will be problems in water distribution within the main system. When that problem is brought under control on-farm water management can also be upgraded". A. Valera and T. Wickham, "Management of Traditional and Improved Irrigation Systems: Some Findings from the Philippines", FAO Farm Management Notes, January 1978.

There is no question in an evaluation of this type of trying to quantify the weights to be assigned to different causal factors by means of some kind of multi-variate analysis. Such an approach would be futile in view of the complexity of the social issues involved and the degree of inter-dependence among variables. The main objective should be to present to policy-makers a comprehensive and objective review of observed weaknesses and potential, with detailed evidence to support the evaluators' assessment of their relative importance. In addition, a sequence of action should be proposed to government which would give priority in time to shorter-term measures requiring fewer major decisions and relatively little capital outlay; e.g. (i) improvement of management procedures, training, incentives; (ii) major changes in organizational structure; and (iii) major capital investment. One of the great merits of a comprehensive evaluation of the kind proposed is that it will draw governments' attention to numerous opportunities for improvement through low-cost investment which are at present being largely overlooked. ^{1/}

The evaluation envisaged here is essentially an identification exercise. It is not itself intended as a means of analysis on which detailed proposals for a new management system could be based. Such analysis would need to be done subsequently as part of the recommended follow-up improvement program, and would make substantially heavier demands on time and specialist personnel.

The resources required for the preliminary evaluation would depend on the amount of recorded information already available on the project; on the extent of the evaluators' knowledge of the local environment; and the depth of the investigation which is contemplated. In most cases the minimum number of people would probably be three - two senior researchers and a field assistant. Most of the field studies (which were not intended as evaluations but rather as a means of testing a methodology) were carried out by a team of three - one social scientist, covering the social, economic and management aspects; one technical consultant, covering the engineering, agricultural and technical management aspects; and a local research assistant. With those resources it was usually possible to obtain sufficient information to identify major constraints after 2-3 weeks in each project area, plus 1-2 weeks' general orientation, including discussions with senior planners and administrators and brief visits to other projects for purposes of comparison and contrast. The time required for report-writing would again depend on the amount of recorded information already available.

The personnel requirements would be somewhat different if the studies were to be carried out as part of a fully-fledged economic appraisal or evaluation. In that case, it would be necessary to ensure that the required management expertise was added to the conventional engineering - agriculture - economics team. The amount of time needed in the field to study management issues would be about the same as indicated above.

^{1/} Cf. Section 9.1.

One obvious implication of the proposal that management should be a subject for regular inclusion of all agricultural project appraisals and evaluations is that people would have to be found to do the job. The development profession is not at present well-endowed with people who are specialists in the analysis of institutions and decision-making processes. However it contains many social scientists, particularly economists, who could be trained for the purpose. It is probably unnecessary for the person undertaking the analysis of management issues to be a management 'expert' - though if non-specialists are to be used, the need for a universally applicable methodology becomes still more important.

13.3 Possible Areas for Further Comparative Research

How much more research would need to be done before the methodology proposed here could be used as the basis for developing a handbook for appraisers and evaluators of irrigation projects is a matter for discussion. There is certainly scope for further revision and refinement but we believe that sufficient analytical progress has already been made for the production of the first edition of such a handbook to be feasible in the near future. Meanwhile, two kinds of possible further research need to be considered. The purpose of the first would be to subject the analytical framework as a whole to further testing, by different people, in environments substantially different from those of the field studies. The object here would be to correct any biases which have been built into the conclusions of the study as a result of its primary focus on large, relatively well-established projects in Asia. Such research might be thought necessary before a definitive handbook could be produced; or it might be used to revise a first edition. The other kind of research would be concerned with improving the state of knowledge about certain particular issues of uncertainty or controversy, some of which appear to require separate in-depth studies of their own. The production of a handbook would not necessarily have to await the completion of these studies in most cases.

Studies in other irrigation environments. Since their problems of organization and management are substantially different, studies of large projects need to be considered separately from those of medium and small projects. In the case of larger projects, little more should be needed than to check the validity of the principal conclusions reached in the present study in the context of substantially different environments and to make any necessary recommendations to the existing analytical framework. For smaller projects more substantial modifications to the framework would be required.

In the selection of further large projects for review, the guiding criterion should be to find environments which contrast as much as possible with the ones already studied. This would suggest a need to concentrate on projects with the following characteristics:

- (a) Projects whose institutions have developed under the influence of cultures so far not encountered (particularly in Francophone Africa, Latin America and the Middle East).

- (b) Projects with institutions which are formally designed to encourage farmers' participation in decision-making (Irrigation Associations).
- (c) Projects with high centralized 'integrated management' systems (settlement schemes of the Gezira or Mwea types, mainly in sub-Saharan Africa). 1/
- (d) Settlement schemes without fully integrated management (i.e. without monopoly market control over farmers' output) but with a need to provide farmers with a wide range of services, including inputs and market facilities, owing to the poor development of infrastructure and services within the project area.
- (e) Post-land reform projects in which redistributed land is purchased by the farmers over a period of time.
- (f) Projects in the very early stages of operation. These have significantly different management requirements from those which are long-established.
- (g) High-technology projects, which have particular implications for the mixture of skills required, especially in the field of maintenance.
- (h) Projects in delta areas, with problems of control over excess water.
- (i) Projects dependent on single- or multi-purpose reservoirs, with wide scope for alternative patterns of water scheduling and crop combinations.
- (j) Projects in which public canal operation is combined with substantial private groundwater extraction.

The unified command area structure which is considered desirable in the case of many large projects is not appropriate on medium or small projects for reasons explained earlier in this paper. Medium-sized projects may be defined as those which are too small to warrant a unified structure but still require a substantial professional staff to operate and maintain them. Public tubewell schemes in areas without canal irrigation may often fall into this category, as well as canal schemes. The main objects of research in the case of medium-sized projects should be to try to establish more precisely the conditions under which a unified structure ceases to be feasible and to identify the best institutional mechanisms and procedures for coordinating the activities of irrigation and agricultural agencies in its absence. Where

1/ But these may already have been studied sufficiently by others.

conditions appear to favor it, the possibilities of adopting a catchment area approach should also be investigated.

Small projects are definable as those on which official staff are either not required or not available to operate and maintain the main water delivery system, except perhaps for the main sluice gates. Abundant research has already been carried out on the organizations of indigenous systems, but there is still more to be learnt about their physical and technical characteristics, which have often been given little attention by anthropologists. There has also been a certain amount of research on the problems of incorporating small indigenous systems into larger projects; the object here should be to maintain the vitality of existing institutions as far as possible so that they are able to take over new tasks as part of the larger project organization. However, there are two areas of research with regard to small projects on which very little work indeed has been done. One is the existing pattern of organization and management on projects constructed by government and not by the farmers themselves. The other is the potential for developing more effective administrative frameworks for assisting and supervising small and scattered irrigation projects of any kind, whether government-initiated or indigenous, surface or groundwater. These are seriously neglected areas and deserve high priority, both in terms of research and of follow-up action.^{1/}

Additional research on particular issues. One issue on which the present study has made less progress than was originally intended has been the development of norms for finance and staffing levels. For reasons already explained, this is not as easy a task as it might appear, especially if the main source of data are projects which are not being operated at a high level of management efficiency. It should, however, be possible in a fairly short period of time to gather information from a much wider range of projects than has been reviewed here and to establish better guidelines with a greater degree of confidence. This could probably be done largely at a desk study.^{2/}

There are three other very important issues on which further research is needed, but all require detailed study in the field. The first concerns the development of improved criteria for the choice of appropriate techniques of water distribution in different agro-climatic regions. This subject could best be studied by regional research centers within developing countries, within the framework of a national research program (which would in turn benefit from information and guidance from international centers such as IRRI). It is of course essential that the research be carried out on large irrigation systems in typical field conditions and not under artificial laboratory conditions.

^{1/} Pp 227 - 228.

^{2/} Cf. Section 9.4.

Another issue on which research is urgently needed is the cost-benefit analysis of 'on-farm development' programmes. As has been argued earlier in this chapter, neglect of the quality of water distribution higher up the system has almost certainly led planners to lay premature emphasis on physical improvements at the watercourse level in many cases and also to exaggerate the amount of infrastructural investment required. In future, recommendations for ofd work should only be made after a thorough analysis of the quality of management at all levels of the irrigation project. The most effective means of testing the need for ofd work on any system would be to experiment first with the extent to which performance can be enhanced by improved main system management alone, on the lines of the research done by the IRRI team in the Philippines. It is recommended that this should be one of the central features of any action program which is adopted as a follow-up to the initial identification of irrigation management problems. Reliable monitoring systems must also be developed for the ex-post evaluation of on-farm development programs, to prevent the emergence of misleading activities of the kind observed in Area Three. 1/

Finally, there appears to be further need for research on optimal sizes of watercourse and well command under different physical and social conditions. Particular attention should be paid here to the implications of different watercourse and well sizes for effective group formation, though other factors (particularly cost) would obviously also have to be taken into account. Some research on this subject could be undertaken on existing irrigation systems, by comparing the quality of management on larger and smaller watercourses, but it should also be possible to introduce more controlled experiments on pilot areas of new projects. 2/

1/ Section 8.4.

2/ Section 10.3.

14. Follow-up action

14.1 The approach required

This study has demonstrated that there are major problems associated with the organisation and management of large irrigation projects in many developing countries and, by analysing the causes of the problems, has made clear the numerous opportunities that exist for greatly increasing productivity and equity on these projects through various kinds of management reform. Although there is still scope for further refinement of the evaluation methodology proposed in this report, enough is already known about how to carry out the evaluations required to make their implementation at the earliest opportunity both feasible and highly desirable. Great interest was shown in this study by senior officials and administrators in the countries where the case material was collected and further evidence (e.g. from rapidly increasing official support for research and training initiatives in the irrigation management field) strongly indicates that developing country governments would be very responsive to constructive advice about management reform.

This implies the need to consider now what kind of action programmes are likely to be required as an immediate follow-up to an initial evaluation. Many common deficiencies in organisation and management have been discussed in this report and a wide range of potential remedies suggested. The chief deficiencies include

- fundamental weaknesses in horizontal coordination at the project level;
- insufficient delegation of authority to project managers;
- lack or inadequacy of O & M Manuals, operational procedures etc;
- insufficient O & M finance;
- methods of water charge payment which (a) fail to make project management accountable to its clients and (b) contribute to the insufficiency of recurrent finance;
- inadequate skills on the part of those responsible for planning and implementing water distribution;
- poorly motivated water distribution staff;
- insufficient numbers, skills and motivation in agricultural extension;
- inadequacy of watercourse management extension work;
- poorly developed group responsibility for watercourse O & M;

- poor data collection and monitoring;
- ineffective legal framework.

Some of the remedies required to deal with these problems involve high-level policy decisions and could not easily be introduced in the short term. These include major changes in horizontal structure; major changes in the responsibilities and status of project managers; large increases in O & M finance; major changes in methods of water charge payment; and major policy changes with regard to salaries, promotions and transfers.

The most effective remedies which could be introduced relatively easily in the short term are improved procedures and training programmes. Their impact would be further enhanced if regulations governing promotion could be somewhat modified, particularly in the case of junior staff, whose motivation is most severely affected by current restrictions. Investigations should also be made into the possibilities of introducing modest changes in the present methods of water charge payment. 1/

The particular activities for which these reforms are most urgently needed are those of water distribution and agricultural extension. The basic requirements for improved agricultural extension in terms of procedural reform, training and, where necessary, structural reforms are already fairly well understood and recognised. The work of Benor and others has ensured that an increasing number of governments are becoming convinced of its need as a result of vivid demonstrations in the field of the high returns obtainable from improved extension methods. As a result, that part of an action programme which is concerned with improving agricultural extension should present relatively few problems to those responsible for planning it. The situation with regard to water distribution is quite different, however, for the following reasons:

- (i) The extent to which present deficiencies in irrigation project performance are the consequence of poor water distribution practices is still not widely understood; this point needs to be proved and demonstrated.
- (ii) The combination of measures required to produce the best results can be expected to vary substantially according to the local technical and social environment; field experiments will therefore be required in different localities before recommendations can be extended through the larger agro-climatic regions of which they are representative.
- (iii) Water distribution is a much more sensitive, politicised activity than agricultural extension, and particularly powerful proof will be needed to overcome the opposition

1/ See Sections 9.1 and 9.2 and pp 120 - 121.

likely to come from those with vested interests in preventing reform.

- (iv) Certain very important general hypotheses about the likely impact of water distribution reform cannot be easily tested or verified except under 'action research' conditions. The logical conclusion to be drawn from this is that by far the best point of entry into new programmes of irrigation management reform will be action research, carried out on selected sections of larger irrigation systems in the manner of the IRRI experiment on 5000 ha in the Philippines. 1/ Its principal objectives would be:
 - (a) To advise new procedures and institutional arrangements which would be tested and modified (under closely monitored but administratively replicable conditions), with a view to identifying the reform measures most likely to succeed in similar environments;
 - (b) To provide a visible and convincing demonstration to politicians, administrators and farmers of the precise benefits - and true administrative and financial costs - of these reforms; and
 - (c) In the interests of advancing general understanding about certain key issues in irrigation management, to test important hypotheses about which present knowledge is limited, e.g.: larger farmers tend to be more dominant where water is scarce/in tail-reaches than where it is abundant/in head-reaches; 'zero-sum' situations are much more likely to arise in arid or semi-arid areas.

A 'package' of measures for improving water distribution would be likely to contain most or all of the following elements, depending on what is required or feasible in particular circumstances:

- the introduction of simple procedures, improved information systems, etc. designed to produce significant short term benefits from predictable and equitable water supplies (on the lines of the Philippines experiment);
- the production of prototype O & M Manuals, job descriptions, etc;

1/ Pp 139 ff.

- experimentation with alternative methods of increasing representative farmer participation in decision-making, both at the local small group (watercourse) level and at the project level;
- research on crop water requirements in farmers' fields, on the basis of which new water distribution methods and alternative cropping patterns would be designed and tested;
- experimentation with new forms of water charge payment. Action research should, as far as possible, form part of a larger and wider-ranging action programme. This would almost certainly need to include a substantial investment in training for senior engineers and the introduction of new university curricula. ^{1/} Improved promotion opportunities for junior staff should be given high priority. Improved agricultural extension would be another probable component. The programme could also embrace longer-term commitments to major changes in organisational structure. And, depending on the needs of the situation, a greater or lesser programme of physical improvements would almost certainly be required to complement the improvements in management.

The time which would need to be devoted to action research before recommendations could be more widely extended is probably in the region of 2-5 years. Where donor agencies are concerned in providing financial support for it, there might often need to be substantial external collaboration with local administrators and academic research institutions for the purposes of planning and overall supervision. Immediate responsibility for day-to-day operations would be in the hands of local institutions. Initially, the formation of teams with appropriate expertise for the work could present difficulties on both the donor agency and host country sides, in which case preparatory training programmes would have to be instituted.

14.2 A note on political will

It is commonplace in writings on rural development to emphasize that "political will" is an essential precondition for any reforms and institutional changes designed to bring a significant redistribution of benefits to the rural poor. The reforms advocated in this report certainly require it: frequent reference has been made to the highly political nature of many aspects of irrigation development, and of the activity of water distribution in particular. In many countries there are powerful groups of people (local politicians, sometimes administrators themselves) who have no interest in the reform of irrigation management, and indeed, may well feel threatened by it.

^{1/} P 188.

If this is so, what reason have we to be optimistic that the reforms proposed here will be widely adopted and applied?

Some social scientists would argue that there is very little reason to be optimistic at all. In their view, in conditions where rural society is dominated by powerful local elites, governments and their administrations are almost bound to be ineffective in opposing the interests of those elites and bringing real benefits to the poorest. There are a number of variants to the argument, but the central burden of them all is that, just like village cooperatives or other would-be 'democratising' local institutions, the bureaucracy itself tends to reflect or take on the character of the surrounding society. Its employees (themselves often products of the same social environment which they have been charged with transforming) are easily 'captured'. The implication of the argument is that there can be no hope of achieving significant social reform through the medium of the existing bureaucracy until substantial changes occur in the underlying power structure.

It is certainly true that bureaucracies do usually reflect the character of the local society within which they operated. But while this analysis may be broadly correct in certain extreme cases, we have no reason to accept it as applying to any of the areas we studied. The weakness of the argument is that all examples of failure on the part of a government and its administration to benefit the poor are taken as proof of 'lack of political will', whereas in practice much of its ineffectiveness may rather be attributable to lack of skill. Detailed analysis of bureaucratic behaviour of the kind undertaken for this study tends to reveal a much more complex picture than the one presented by the conspiracy theorists. Governments and bureaucracies are not monolithic in their interests; as within the farming community, there are many different interest groups; and the objective of the evaluator and the 'action researcher' should be to seek out opportunities for development rather than to use 'lack of political will' as an excuse for doing nothing.

Proposals to reform the management of large-scale irrigation projects and their water distribution should provide a particularly challenging test of political will. Though there have been many criticisms in this report and the case study reports of serious shortcomings in management performance, we believe that many governments will be prepared to accept the challenge.

EVALUATING IRRIGATION MANAGEMENT: GUIDELINES FOR ANALYSIS

PART I - THE RESOURCE BASE

(A) The local environment (the context in which management has to be performed)

1. Physical characteristics of the area

- 1.1 Rainfall
- 1.2 Temperature
- 1.3 Soils
- 1.4 Topography

2. Technical characteristics of the irrigation system

(i) Canals

- 2.1 Size of net command area (NCA)
- 2.2 History of system: date of construction; original objectives; subsequent changes
- 2.3 Storage facilities (million m³ per year)
- 2.4 Maximum design capacities of canals (main canal to watercourse head), in lit/sec/ha.
- 2.5 Number and length of canals (primary, secondary, etc.)
- 2.6 Number, length and average command areas of watercourses
- 2.7 Length of canal and watercourse lining
- 2.8 Number and type of canal regulators and measurement structures (main canal to watercourse head)
- 2.9 Number and type of other structures
- 2.10 Cropping pattern/cropping intensity for which system has been designed
- 2.11 Monthly canal discharges in selected years (m³)
- 2.12 Canal roads (and public roads)
- 2.13 Workshops

(ii) Wells*

(a) Public tubewells

- 2.14 Number of wells
- 2.15 History of well development (as in 2.2 above)
- 2.16 Design characteristics
- 2.17 Average command area per well

* Similar information to be collected in the case of low-lift pumps.

- 2.18 Maximum pumping capacity - total (cumecs) and per well (Lit/sec)
- 2.19 Maximum permitted/planned annual pumpage (million m³)
- 2.20 Maximum permitted/planned water availability per ha (lit/sec)
- 2.21 Actual annual pumpage in selected years (m³)
- 2.22 Watertable depths (pre-project and in selected years since project completion)

(b) Private wells (and low-lift pumps)

- 2.23 Numbers, design characteristics, pumping capacities, actual pumpage, etc.

(iii) Surface drainage

- 2.24 Number and length of channels (primary, secondary, etc.)
- 2.25 Number and type of structures
- 2.26 System capacity (lit/sec/ha of NCA of catchment area)

3. The farming system(s)

- 3.1 Cropping patterns and cropping calendars (in selected years):

<u>Crop</u>	<u>ha cultivated</u>	<u>Irrigation dates</u>	
		from	to
(1)			
(2)			
(3)			

(broken down by localities)

4. Social characteristics of the farming community

- 4.1 History of human settlement in project area
- 4.2 Population:
 - (i) in project area (per ha/male/female/ages)
 - (ii) % of total population engaged in agriculture
 - (iii) distribution of occupation among those engaged in agriculture (farm operators, family labour, landless labourers)
- 4.3 Social structure:
 - (i) Power and characteristics of local leaders
 - (ii) Propensity to collaborate within local communities (cohesive or divisive effects of caste, kinship groups, etc.)
- 4.4 Economic indicators:
 - (i) Farm sizes (% of farms in different size categories)
 - (ii) Land tenure pattern (% of farms in different size categories which are owner-operated, tenant-operated; characteristics of tenancy arrangements)

- (iii) Estimated annual farm incomes and total incomes (by farm size; and by groups - landowners, tenants, landless labourers)
- 4.5 Literacy levels and other social indicators
- 4.6 Length of farmers' experience of:
 - (i) agriculture
 - (ii) irrigated agriculture
- 4.7 Farming practices and levels of technical knowledge (methods of land preparation, sowing/planting and water application; knowledge of crop water requirements, use of improved seeds, fertiliser applications, etc.)
- 4.8 Local organisations and groupings, both 'indigenous' and introduced by government (village councils, cooperatives and, especially, water users' organisations):
 - (i) period of existence
 - (ii) declared functions
 - (iii) average size (membership, area)
 - (iv) linkages, if any, with higher-level (secondary, apex) organizations.

5. Economic environment

- 5.1 Past and present levels of economic development (as indicated by e.g., proportion of total working population engaged in agriculture, proportion of GNP derived from agricultural production)
- 5.2 Past and present policies of government towards agricultural sector (as net contributor to, or net benefactor from, government funds)
- 5.3 Farm-gate or rural market prices of principal inputs (selected years)
- 5.4 Farm-gate or rural prices of principal crops (selected years)
- 5.5 Rates of government taxation and subsidy on items 5.3 and 5.4
- 6.5 Water charges:
 - (i) level of charges (selected years)
 - (ii) method of charging (volumetric, per cropped area, flat rate, etc.)

(B) Administrative and financial resources of project management

6. Administrative resources

- 6.1 Structure of project organisation - horizontal:
 - (i) Agency/agencies principally concerned with development of irrigated agriculture in project area
 - (ii) Their areas of jurisdiction
 - (iii) Means of coordination (e.g. single Area Commissioner, coordinating committees)

- 6.2 Extent of agency/agencies' legal powers to control farmers' decisions, eg:
 - (i) Selection of farmers
 - (ii) Control over farmers' tenure of land
 - (iii) Choice of crops
 - (iv) Timing of cultivation operations
 - (v) Enforcement of rules against misappropriation of water
- 6.3 Organisational linkages between agency/agencies at project level and agencies of Province/State and Central Government levels
- 6.4 Principal activities assigned to each agency
- 6.5 Structure of project organisation - vertical (for each agency);
 - (i) Organisation chart (including indication of points of contact between project staff and farmers)
 - (ii) Numbers of staff in each job category (eg Section Engineer, Agricultural Field Assistant)
 - (iii) Brief description of principal functions of each job category
 - (iv) Salary scales for each job category
 - (v) Qualifications of staff in each job category
 - (vi) Length of experience of staff in each job category (on project concerned; on irrigation projects elsewhere)
 - (vii) Location of offices and residence of staff in each job category (centralized/dispersed)

7. Supporting services

- 7.1 Transport facilities:
 - (i) Number and type of vehicles owned by project agency/agencies
 - (ii) Number and type reserved for use by staff members (by job category)
 - (iii) Number and type of vehicles privately owned by project staff (and contribution made by project agency to their capital and running costs)
 - (iv) Limits on fuel consumption
- 7.2 Telecommunications: Number and location of telephones or other methods of internal/public communication
- 7.3 Maintenance machinery: workshops and equipment

8. Financial resources

- 8.1 Expenditure by project agency/agencies on new capital works (selected years)
- 8.2 Expenditure on reconstruction, major rehabilitation (selected years)
- 8.3 Recurrent expenditure (selected years)
 - (i) operation and maintenance
 - (ii) staff

(In the case of the irrigation wing, to be expressed in terms of cost per ha, per canal km, per control structure; in the case of agricultural and other wings, to be expressed in terms of cost per farmer and cost per ha)
- 8.4 Sources of finance (Central/Provincial government funds; revenue from local taxes, etc.)

PART II - INDICATORS OF PROJECT PERFORMANCE9. Productivity

- 9.1 Changes in crop areas and yields over time
- 9.2 Quantity/economic value/nutritional value of output per units of water delivered (and of other major inputs)
- 9.3 Water losses (overall; main system; watercourse; field)

10. Equity(a) Locational

- 10.1 Variations in cropping patterns/cropping intensities/yields water availability between upstream/downstream commands on same river system
- 10.2 Do. between upstream/downstream sections of a single command
- 10.3 Do. between groundwater/non-groundwater areas
- 10.4 Do. between areas with different water rights
- 10.5 Do. between heads and tails of watercourses

(b) Between richer and poorer groups

- 10.6 Do. between larger and smaller farmers
- 10.7 Employment generation: job creation through increased agricultural production; pattern of in- and out-migration

11. Environmental stability

- 11.1 Area of waterlogging (over time)
- 11.2 Area of salinity, alkalinity (over time)
- 11.3 Water-table levels (over time)
- 11.4 Erosion of upper catchment areas

12. Cost

- 12.1 Capital costs
- 12.2 Annual costs (new construction, rehabilitation, O & M, etc) se 8.1-8.3

13. Cost recovery

- 13.1 Total annual revenue collected from local taxes - water charges, land tax, etc (selected years)
- 13.2 Rate of recovery (% collected : % assessed)
- 13.3 Total revenue recovered as proportion of total project costs
- 13.4 Proportion of total revenue retained by project agency/agencies; proportion passed to Central/Provincial government
- 13.5 Local taxes as proportion of farmers' incomes

14. Other criteria eg:

- 14.1 Level of nutrition: effect of cropping pattern on farm families' diets
- 14.2 Incidence of waterborne diseases
- 14.3 Effects of irrigation on fisheries, wild-life ecology

PART III - IDENTIFICATION OF CAUSES

(A) 'Non-management' factors

15. Limitations in technical design eg: (4.2) 1/

- 15.1 'Planned' limitations
- 15.2 Deficiencies in watercourse layout (eg incapable of conveying water to all parts of watercourse command; channels insufficiently large to convey all water delivered at watercourse head)
- 15.3 Insufficient provision for drainage (reflected in low levels of production attributable to waterlogging)
- 15.4 Absence or shortage of water measuring devices (at all control points down to watercourse head)
- 15.5 Mechanical and other weaknesses in tubewell pump design
- 15.6 NB: Review history of planning and design process

16. Other exogenous factors (4.1)

- 16.1 Climatic and biological hazards
- 16.2 Domestic price policies
- 16.3 International factors (world inflation, shortages of imported materials etc)
- 16.4 Services provided by other enterprises on which project is dependent (eg roads, transport, electricity)

(B) Organisational structure

17. Project level organisational structure - horizontal (6.2)

- 17.1 Is the scheme:
 - (a) a recently-established settlement scheme?
 - (b) a specialised high-value cash crop scheme?
 - (c) a scheme providing water to already settled areas with relatively free-choice cropping?
- if (a) is there a unified project organisation responsible for agriculture and water management activities plus commercial service activities?

1/ Figures to right of headings refer to relevant sections in main report.

- if (b) is there a unified project organisation responsible for agricultural and water management activities plus commercial service activities?
 - if (c) is there a unified project organisation responsible for agricultural and water management activities?
 - if not, are there good reasons?
eg: irrigation staff are 'agriculture-oriented', agricultural extension services are strong, etc; project area too small; irrigated area discontinuous, interspersed with unirrigated land.
- 17.2 Is there a separate section for water distribution, staffed by a cadre of water distribution specialists?
- 17.3 Is responsibility for canal and tubewell operation combined in one section?
- 17.4 Are there separate sections for (a) canal and drainage construction and maintenance; and (b) tubewell construction and maintenance?
18. Project-level organisation structure - vertical (6.3)
- 18.1 Division of responsibilities between officials and farmers:
- Is the farmers' management capacity high or low? (refer to length of experience of irrigated agriculture - 4.6 - and social cohesion - 4.3)
 - If it is low, is the official-farmer relationship one of high supervision/low delegation?
 - If it is high, is the relationship one of low supervision/high delegation?
 - Is the relationship one of low supervision/low delegation?
NB: Are there any purely technical reasons for interventionist policies by officials?
- 18.2 Division of responsibilities among officials:
- Is the proportion of staff falling into different skill categories appropriate to the performance of activity A, B, C, ...?
 - Do junior staff have a high or low level of education and experience?
 - If low, is the senior:junior staff relationship one of high supervision/low delegation?
 - If high, is the relationship one of low supervision/high delegation?
- 18.3 Location of field staff:
- Is the project area small and compact (implying a single headquarters office)?
 - Or widely extended (implying a number of regional offices under headquarters)?

19. Organisational structure - provincial and national levels (6.4)

19.1 Horizontal structure:

- Are there separate planning and policy-making agencies for irrigation and agriculture at provincial/national levels or is there only one agency?
- If there are separate agencies how are their plans coordinated?

19.2 Vertical structure:

- How much budgetary and other responsibility is delegated to managers at the project level?
- Is this amount of responsibility appropriate to those managers' capabilities?

(C) Project management

20. The project management function - scope and limitations (7.1, 7.3)

- 20.1 Are the project manager's powers limited by absence of a unified horizontal structure?
- 20.2 What are his powers to recruit, promote or raise salaries of subordinate staff?
- 20.3 What are his powers to retain revenue from farmers for direct expenditure within the project area?

21. The project management function - assessment (7.2, 9.1)

21.1 Objectives:

- Is there a consistency of objectives at national/provincial and project level?
- Are the project's objectives clearly specified in a manual or similar document?
- Are relative priorities specified?
- Are the project's objectives clearly understood and accepted by staff at various levels?

21.2 Budgeting:

- Is there an annual plan/budget?
- How is it set up? With participation of project personnel? To what level?
- What does it include? Cost targets (eg. cost per km) or merely expenditure limits?

21.3 Programming:

- Is there an (annual) programming meeting?
- Who attends? Participants from all departments/units concerned? Staff to what level?
- Is a work programme drawn up jointly with all participants at the meeting?
- Are there (monthly) review meetings?
- Are (monthly) progress reports prepared and circulated to staff recording who should do what, when and how?
- Are staff at different levels conspicuously over- or under-loaded?

21.4 Job descriptions:

- Are there (written) job descriptions? At all levels?
- When do they date from? What revision/updating procedure exists? When last applied?
- Are the tasks associated with each job accompanied by quantified targets wherever possible? Revised annually or more often?

21.5 Management style:

- Do superior officers tend to behave in an authoritarian manner towards junior staff?
- Is there any evidence that their behaviour is more or less authoritarian than the local norm?

21.6 What information is used at project level to monitor: productivity of water and other inputs; equity of water distribution; environmental stability (waterlogging, salinity, etc);

- How is the information acted upon? Is performance measured against targets? Or is the information merely recorded, filed and/or stored in reports of past performance?

21.7 How is the performance of personnel monitored?

- Are records and reports of junior staff spot-checked by senior officials for accuracy?
- Do senior staff make random spot-check visits to the field?
- Are annual reports prepared on each member of staff? Are they discussed with him?

(D) Performance of specialized activities22. General

22.1 In the case of staff at all levels, in each activity:

- Obtain job description (if available)
- Ask staff to discuss own functions and responsibilities; check their perceptions against job description
- Assess staff satisfaction with present job and future prospects
- Enquire about perceived obstacles to performing job satisfactorily
- Assess frequency of communications with superiors, junior staff and laterally with other agencies or wings
- Ask staff to assess extent to which they are under- or over-loaded with functions and responsibilities; and to suggest alternative solutions
- Ask staff to estimate proportion of total working time spent
 - (i) on different activities; (ii) on planning, executing, monitoring or correcting - in the case of each activity;
 - (iii) in the office/in the field.

23. Water distribution - planning and design (8.1)

- 23.1 Is the water distribution method selected for use on the project appropriate to local conditions?
- 23.2 Has the irrigation system been designed in such a way that this method can be applied without undue difficulty?

24. Water distribution - actual patterns of allocation and farmers' views (8.1, 10.2)

- 24.1 Recorded evidence of water distribution patterns (10.1-10.6 above)
- 24.2 In interviews with sample farmers (large and small farmers; farmers within head-reach and tail-reach watercourses; farmers at the head and tail of the same watercourse) discover their views on:
 - the adequacy, frequency and predictability of water supplies received
 - the reasons for shortcomings (if any).

25. Water distribution - technical dimension (8.1)

25.1 Planning:

- Do detailed written procedures exist for the collection and analysis of expected water supply in the forthcoming season?
- Do detailed written procedures exist for the collection and analysis of expected cropping patterns and cropping calendars?
- Are forms used for data collection and analysis well designed?
- Have assumptions about crop water requirements under different soil conditions been based on tests carried out in farmers' fields?
- Are proposed plans discussed with agriculturalists and farmers' representatives and, after agreement, communicated to farmers?

25.2 Implementation:

- Do detailed written procedures exist for the collection and analysis of continuing information about actual patterns of supply and demand throughout the crop season?
- Are forms used for data collection and analysis well designed?
- Are changes in operating procedures as a result of variations in supply levels clearly specified in manuals?
- Are farmers regularly informed about actual discharges, deviation from planned levels and reasons for deviation (at watercourse outlet/elsewhere in the system)?

25.3 Monitoring:

- Are daily/weekly/10-daily reports of supply patterns compiled which enable senior officials to compare planned and actual patterns?
- Are periodic reports on cropping patterns and intensities compiled, to enable checks to be made on locational equity of water distribution?

- In areas of public tubewell operation, are water quality and groundwater levels regularly monitored?
 - Are forms used for data collection and analysis well designed?
 - Are random spot checks made by senior officials in the field? How often?
 - Are farmers supplied with sufficient information to enable them to do their own monitoring?
 - Do procedures exist for the collection and analysis of data which enable senior officials to monitor performance against objectives at the end of each crop season (with reference to productivity of water, equity of water distribution, environmental stability, cost)?
 - Where there is substantial private extraction of groundwater, is the extent of farmers' dependence on this water source known to senior project officials?
- 25.4 Reasons for levels of performance achieved:
- Quality of procedures and information system (23.1-3 above)
 - Level of skills of senior officials and junior staff in techniques of water distribution
 - Adequacy of resources: manpower, transport and equipment.

26. Social/political dimension - assessment of performance (8.1)

- 26.1 Degree of pressure on irrigation staff to misallocate water:
- Water scarcity
 - Cropping restrictions/differential pattern of water distribution
 - Social structure of farming community
- 26.2 Capacity of staff to resist pressures:
- Quality of system design
 - Quality of procedures
 - Motivation of junior staff (salaries, promotion prospects, status, potential effectiveness of management control procedures); and of senior officials (salaries, promotion prospects, frequency of transfer, external monitoring/evaluation)
 - Existence of effective legislation for punishment of offenders against irrigation rules
 - Accountability of irrigation officials to farmers' representatives (through formal farmers' 'watchdog' organisation and/or through retention of farmers' revenue payments for expenditure within the project)
- 26.3 Evidence of misallocation:
- 'Mistakes' or falsifications in water distribution records (broken electricity meters in tubewell pump-houses, etc)
 - Failure of senior officials to monitor, or act upon, deficient records
 - Evasiveness of staff and officials in answering questions about inequitable water distribution and its reasons, deficiencies in records etc.

- Failure of staff to punish offences against irrigation rules
 - Evidence of 'unofficial income' from farmers to irrigation staff and officials (approximate amounts; principal beneficiaries; main source of pressure - officials or farmers?)
 - Evidence of pressure from local influentials against resistant senior officials - threats of transfer, etc.
- 26.4 Reasons for misallocation:
- See 24.1 and 24.2 above (especially social structure of farming community, motivation of staff and officials, effectiveness of legislation, and officials' accountability to farmers).
27. System maintenance (8.2)
- 27.1 Civil maintenance:
- Objective indicators (eg, actual canal/drainage discharges in relation to design discharges (in past 3 years); technical efficiency of regulation structures; sediment content; floating/fixed weeds content, number and dimensions of breaches)
 - Do detailed written procedures exist for planning, executing and monitoring the maintenance programmes (routine, emergency, etc)?
 - To what extent can quality of performance be attributed to
 - (i) Procedures?
 - (ii) Technical skills (of senior officials and junior staff)?
 - (iii) Motivation (of senior officials and junior staff)?
 - (iv) Resources (manpower; equipment; finance)?
- 27.2 Mechanical and electrical maintenance (tubewell):
- Objective indicators (operating time lost through technical faults; actual discharges in relation to design discharges; physical condition of motors and other parts; frequency of workshop overhaul)
 - Do detailed written procedures exist for planning, executing and monitoring the maintenance programmes (routine, emergency, etc) at tubewell/workshop levels?
 - To what extent can quality of performance be attributed to:
 - (i) Procedures;
 - (ii) Technical skills;
 - (iii) Motivation;
 - (iv) Resources (manpower, equipment, finance)?
28. Agricultural extension (8.3)
- 28.1 Objective indicators of effectiveness:
- Interviews with farmers (especially smaller farmers) to assess frequency of contact with extension staff; level of knowledge of husbandry generally; level of knowledge of methods, crop water requirements, crop root depths etc)
 - Interviews with extension staff at different levels to assess level of knowledge of husbandry generally and of water management in particular

28.2 Procedures:

- Do detailed written procedures exist for planning, executing and monitoring the following activities:
 - (a) identifying farmers' problems and needs
 - (b) advising farmers about production methods
 - (c) providing specialist advice to farmers about water management
 - (d) developing farm plans designed to make more economic use of available water supplies
 - (e) discussing short-term variations in water demand with water distribution agency
 - (f) participating in seasonal and long-term strategic planning for water distribution
 - (g) coordinating with agencies responsible for providing inputs and credit (or directly providing these services themselves)
 - (h) collecting and analysing data for monitoring production performance?

28.3 Equity:

- Do procedures lay special emphasis on support to smaller farmers and/or on the dissemination of techniques which are easily assimilable by smaller farmers

28.3 Reasons for performance:

- To what extent can quality of performance be attributed to:
 - (i) Organisational structure;
 - (ii) Procedures;
 - (iii) Technical skills;
 - (iv) Motivation;
 - (v) Resources (manpower; equipment, especially transport; finance)?

29. Watercourse improvement and advisory services (8.4)

29.1 Improvement ('on-farm development') work - where applicable:

- Has the planning and design of the programme been preceded by a thorough investigation of the management of the main distribution system and the introduction of reforms, wherever possible?
- Has the programme been developed on the basis of experimental pilot projects in localities with different physical/social characteristics?
- Have farmers been offered a range of technological choices (eg with regard to land levelling, channel lining, farm roads)?
- Have farmers been required to make substantial contributions towards costs?
- Once work has been completed, has there been objective monitoring of technical, economic and social factors?
- Has adequate provision been made for follow-up extension work on watercourse O & M?

- To what extent can quality of performance with regard to the planning, execution and/or monitoring of the programme be attributed to:
 - (i) Organisational structure (inter-agency coordination);
 - (ii) Procedures;
 - (iii) Technical skills;
 - (iv) Motivation;
 - (v) Resources (manpower, equipment, finance)?
- 29.2 Watercourse O & M advisory services:
- Do detailed written procedures exist for the provision of any or all of the following services:
 - (a) training and supervision of water distribution within the watercourse;
 - (b) training and supervision of watercourse maintenance;
 - (c) assistance with settlement of water disputes within the watercourse command;
 - (d) development of representative water users' groups at the watercourse command level?
 - How difficult is the task of watercourse extension work in the region concerned as a result of the physical and social characteristics of the watercourse commands (Section 32 below)?
 - Are respective responsibilities of officials and farmers clearly defined?
 - To what extent can quality of performance with regard to the provision of these services be attributed to:
 - (i) Procedures;
 - (ii) Technical skills;
 - (iii) Motivation;
 - (iv) Resources (manpower, equipment, finance)?

30. Management support services (7.3, 8.5)

30.1 Finance and budgeting:

- Is revenue generation an integral part of the planning and budgeting process or are they two separate processes, for which different units/agencies are responsible?
- What are the levels of water charges/membership fees? What are the rates of recovery?
- What are the reasons for quality of performance (procedures/skills/motivation/resources of revenue staff? Quality of water distribution service? Degree of integration between revenue-raising and budgeting processes?)
- Is budgeting a dynamic, participative process (cf Section 21)? Are accounts of expenditure submitted to farmers as well as to government? If not, what are the reasons?

30.2 Personnel management:

- Scope of project management to offer incentives (cf Section 20): Is project management able to recruit own staff on long-term basis, offer periodic bonuses and promote them within the organisation? Or are decisions about recruitment, salaries, promotions and transfers all made externally?

- Are there frequent transfers of senior staff? If so, why? What are the reasons? What are the consequences?
 - Methods of supervision and control: Are there well-designed procedures for monitoring staff performance (cf Section 21.7)? Are these applied firmly but sensitively? If not, why not?
- 30.3 Planning, research and monitoring:
- is there a multi-disciplinary unit with any or all of the following functions:
 - (a) assisting management in planning work programmes;
 - (b) monitoring project performance against objectives;
 - (c) doing specialized research or monitoring in particular subject areas, eg water distribution;
 - (d) testing and modifying management procedures and developing improved information systems?
 - If so, how well has it performed and why? If not, is such a unit needed?
 - Project's information systems: Is enough data collected? Is it the kind of data required for management purposes? Is it accurate? Is it analysed in a way which makes it an effective management tool?

(E) The farmers' role in management

31. At the farm level (10.2)

- 31.1 Objective indicators (for selected sample of large/small; owner/tenant; upstream/downstream farmers); eg estimated timing and volume of irrigation (and other inputs) in relation to volume of production; method of water application (basin, furrow, border strip, sprinkler, etc.); precision of field-leveilling; timeliness of cultivation practices; degree of compatibility between farm plan/cropping pattern adopted and water supply pattern.
- 31.2 To what extent can quality of performance be attributed to:
- farmers' knowledge of farm and water management practices
 - their capacity to apply that knowledge within constraints of resource endowments
 - effectiveness of agricultural extension service (Section 28)
 - adequacy and predictability of water deliveries to the farm (Sections 23-26, 29 and 32)
 - Effectiveness of agencies supplying inputs other than water
 - Availability, and ease of access to, profitable outlets for marketable surplus?

32. At the watercourse level (10.3, 11.1-2)

- 32.1 Objective indicators (for selected sample of upstream and downstream watercourses); eg knowledge of, and adherence to, prescribed water distribution procedures; physical condition of communal irrigation and drainage channels and structures; frequency of internal water disputes; frequency of meetings held by informal/formal water users' group

32.2 To what extent can quality of performance be attributed to:

- Average farm size (number of farmers per watercourse)
- Social characteristics: stratification/cohesion
- Farmers' education and experience of irrigated agriculture
- Technical characteristics of watercourse command
- Size of watercourse command
- Village- or channel-based organisation
- Closeness of official advice and supervision (Section 39)
- Adequacy and predictability of water deliveries to watercourse outlet (Sections 23-26)?

33. At the project level (10.4)

33.1 Representation:

- Are farmers formally represented at the project level by a committee?
- If so, how has it been formed (by direct election or by federal representation from watercourse groups)?
- What are its functions?
- If there is no committee, are farmers in any way, formally or informally, able to participate in decision-making at the project level (eg in planning seasonal water distribution plans, monitoring actual water deliveries, planning or monitoring annual budgets)?
- Is the level of responsibility given to farmers appropriate to their capacities (cf Section 18.1)?

33.2 To what extent can quality of performance be attributed to:

- Representative/unrepresentative character of farmers principally involved in decision-making
- Level of representatives' education and experience
- Any other factors?

FORMS OF ORGANISATION STRUCTURE: Examples

Diagram 1: Functional

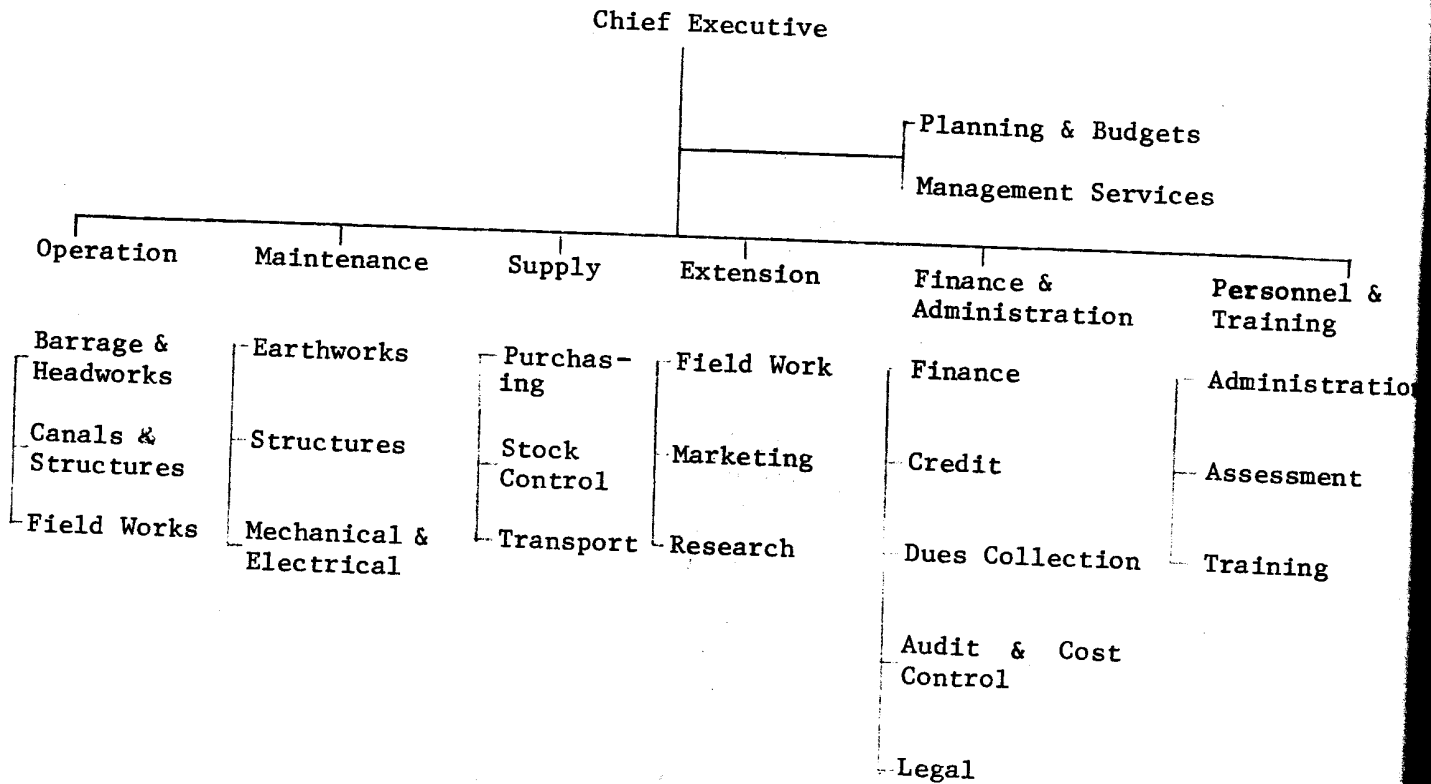


Diagram 2: Geographical

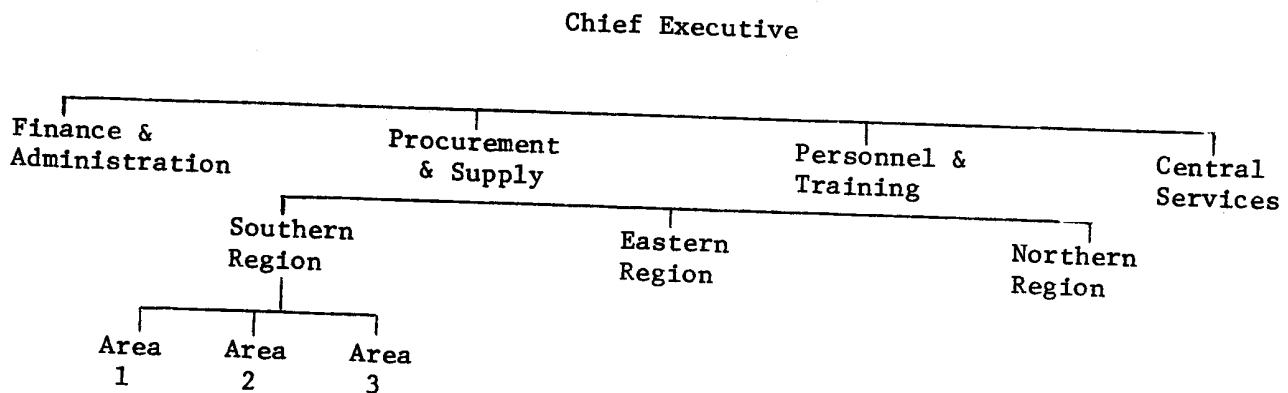
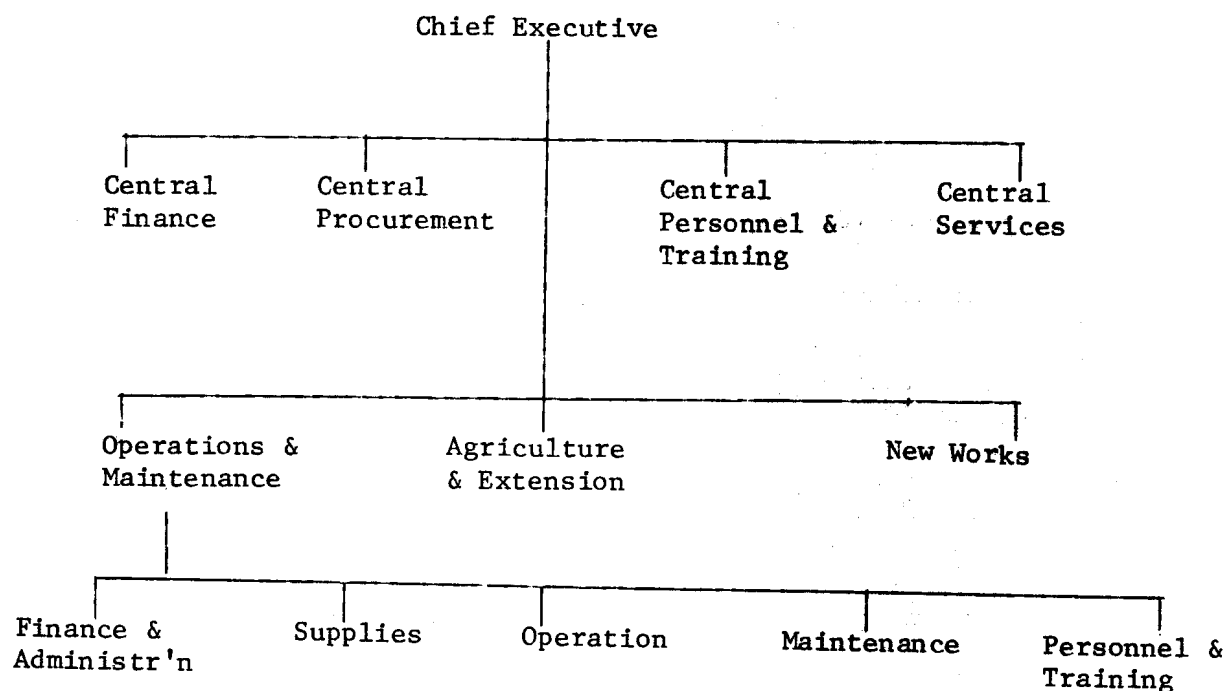


Diagram 3 : Divisional

- Notes.
1. The examples are purely illustrative and make no claim to completeness in any case. Nor is any preference necessarily shown for a single Chief Executive - although the problem of span of control is well illustrated.
 2. As can be seen, the distinction between 'staff' and 'line' is of varying importance in the different solutions.
 3. The 'divisional' solution is shown as an example of this structure, although in view of the fairly unified function of irrigation management, it seems unlikely to be appropriate.

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