Agricultural Administration Unit
Occasional Paper 5

Managing Large Irrigation Schemes: a Problem of Political Economy

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Preface

The papers brought together here were first published 3-4 years ago and all relate to the management of established large irrigation schemes. Most of them are not widely available in their original form. I hope that their republication now will prove useful to those with an interest in the practical and theoretical aspects of irrigation management. They are intended to be of general relevance to Third World conditions, though they contain something of an Asian bias: papers 2 and 3 were written for a meeting in Pakistan, paper 4 for a meeting in India. People concerned with significantly different social and administrative contexts — for example the development of irrigation in newly settled areas in Africa or Latin America — will need to make certain adjustments and amendments to the text if its more detailed arguments are to become precisely relevant; but they will, I hope, agree that the overall analytical framework, with its emphasis on the need to look at issues from the standpoint of political economy, is immediately applicable in their own circumstances.

Since writing these papers, I have collaborated with Ir. Rien Jurriens of the International Institute for Land Reclamation and Improvement, Wageningen, Netherlands, in editing a paper on the planning and design of (predominantly large) irrigation systems, which should be read in conjunction with this collection.[1] I have also moved from ODI to Bangladesh, where local priorities have caused me to shift my attention from large-scale irrigation by gravity to small (½-2 cusec) lift irrigation systems and to large, medium and small-scale flood control and drainage projects. In the case of small lift irrigation systems (which in Bangladesh are nearly all privately or co-operatively owned and managed), a concern for political economy leads one to a primary focus on who has access to the lift devices in the first place (the process of allocation of pumps and engines) rather than on the subsequent allocation of water, which I have argued should be the primary focus on established large irrigation systems. On flood control and drainage systems, the same problems of planning and management arise as on irrigation systems but to a still greater degree;

and 'participative' solutions are likely to be still more difficult to devise for a number of reasons, including even greater conflicts of interest among the different parties affected (not only upstream v. downstream and large v. small farmers, but also upland v. lowland v. fishermen). I hope to be able to write more soon on these two issues, to supplement the increasingly substantial literature available on the planning and management of large and small gravity irrigation systems.[2]

In the meantime, I find I have not changed my mind greatly about what I wrote earlier about large-scale irrigation, except that I would now (in the light of the Bangladesh experience) want to say more about the employment effects of improved design and management. These relate not only to increased employment as a result of increased agricultural productivity per unit of land and/or water (something which I have always assumed to follow from better irrigation management); but also to the potential for involving members of the poorest landless classes in the operation and maintenance of the irrigation systems themselves. Experimental projects are already under way in Bangladesh whereby groups of landless people have been enabled to purchase low-lift pumps and tubewells and earn a living through the provision of irrigation services to farmers on payment.[3] Proposals have also been made for experiments on large irrigation, flood control and drainage projects under which landless groups would contract with the government agencies concerned to help operate and maintain the systems in return for rights to make productive use of 'waste' or underutilised public land — embankments, borrow-pits, etc., through activities such as social forestry and pond fisheries. These experiments — unique, as far as I know — should be closely watched. Until now, the literature on irrigation management — this collection included — has tended to assume that there are only two main parties involved: the water users (farmers) and the service agencies (bureaucracy). The Bangladesh experiments suggest that, especially in countries where population pressure on land is very acute and significant land reform measures are for various reasons unlikely to occur, increasing thought should be given to ways of giving a third party — the landless — an important stake in the ownership and/or management of water.

Anthony Bottrall
Ford Foundation
Dhaka
September 1984

Notes

1. R. Jurriens *et al.*, 'Evaluation of Irrigation Design — a Debate', Agricultural Administration Unit Irrigation Management Network Paper 9b, ODI, April 1984.
2. I have already prepared a substantial *Review of Irrigation Management Practices in Bangladesh* for the Bangladesh Ministry of Agriculture (Centre for Development Science, Dhaka 1983) but it is not easily available; and much of it is too location-specific to be of wide interest to readers in other countries.
3. See, e.g., G. Wood (ed.) 'The Socialisation of Minor Irrigation in Bangladesh' *ADAB News* (Dhaka) Vol. X, No.1, January-February 1983, pp.2-20 and 'Provision of Irrigation Services by the Landless — an Approach to Agrarian Reform in Bangladesh', *Agricultural Administration* Vol. 17, 1984, pp.55-80.

1

Water, Land and Conflict Management*

Recent years have witnessed a marked increase in concern at both national and international levels about the poor performance of irrigation schemes in many developing countries: rapid population growth is intensifying mankind's demands on an increasingly scarce resource which is essential to its livelihood; there are high energy costs associated with extending its exploitation; yet efficiency of water use on many existing systems continues to be very low. At the same time, there has been a growing realisation that much of the poor performance stems from fundamental weaknesses in the human processes of planning and management, which no amount of investment in technological hardware is going to overcome on its own.[1]

Although there is an evident need for radical changes in the way decisions are made within the field of water resource development (domestic water supplies as well as irrigation), it is equally apparent that it is a field whose very nature makes such changes particularly difficult to bring about. On the one hand, there are heavy pressures on governments and donor agencies to increase the availability of water resources quickly. Water is recognised as vital for development, particularly for drinking and sanitation (the UN has proclaimed the 1980s the International Drinking Water Supply and Sanitation Decade) and for irrigation; and the easiest and most obvious way for development agencies to respond quickly to the demands for new investment is to put their money into hardware — dams, canals, pumps and pipes. On the other hand, it is unfortunately the case that the software part of water development, particularly the management of water distribution, bristles with problems. Precisely because water is such a scarce and vital resource in poor societies, it inevitably

*Extract from an article under the same title which originally appeared in *ODI Review* 1-1981.

becomes a focus of competition and potential conflict among its users; on larger distribution systems the staff employed to manage them usually come under intense pressure to misallocate water and to allow private interests to override, and play havoc with, public welfare; while on smaller systems and at the lower end of large systems, scarcity of administrative resources nearly always demands that substantial management responsibilities should somehow be delegated to the competing water users themselves.

Almost invariably the very urgency with which a typical water programme is pursued automatically works against its own chances of success by helping to reinforce administrative structures and procedures which are singularly unsuited to promoting proclaimed development objectives. It strengthens the already over-dominant role of design and construction engineers in the decision-making process, at the expense of other groups of people (such as local government organisations and, in the case of irrigation, agricultural staff and farmers) whose collaboration is essential to good system management. It diverts resources away from the tedious and time-consuming task of improving management capabilities and performance through field training and procedural and organisational reforms. And, by encouraging heavy reliance on central government and donor agency funding, it further inhibits the scope for local participation in planning and construction, thereby compounding the difficulties of promoting communal responsibility during the subsequent stage of operation and maintenance.

Other factors besides the desire for speed often combine to push the process of water resource development further in the same unfortunate direction. These include the short-term political attractions of investing in visually impressive constructions; the much higher status accorded in most developing countries to 'modern' professions such as engineering than to 'traditional' professions such as farming and agricultural extension; the propensity of many governments to try to win popular favour by adopting a 'handout' approach to development and offering water as a free good (usually the kiss of death to the furtherance of local management responsibility); the opportunity for private gain arising out of major planning and construction contracts; the frequent tendency for aid agencies' performance to be judged more by the quantity than the quality of their lending; and the associated preference of many aid agencies for large capital loans rather than for cheaper but administratively complex technical assistance programmes.

Given the cumulative force of these pressures towards a capital-intensive approach to water resource development, it should not be a matter for surprise that most of the governments and aid agencies which are now looking with increasing anxiety for ways to improve performance and management have been finding progress slow and difficult. Among the essential ingredients for substantial success are more participative planning; the delegation of greater responsibility to local communities for day-to-day management; and the creation of support organisations capable of combining responsiveness to community needs with the exercise of sufficient impartial authority to minimise inter-community conflict. But it is inherently improbable that any of these things would be realisable on a significant scale without a reversal of certain deep-seated attitudes, assumptions and practices within the development agencies themselves. Only now (1981) are some of these agencies beginning to comprehend the full dimensions of the problem that faces them. Their most common first reaction to a realisation that there is a serious 'management problem' has been to identify it as being largely located at the water users' level; hence the recent upsurge of enthusiasm for officially-sponsored water users' organisations. Their next step has been to observe that the formation of such organisations tends to achieve little in the absence of changes in the surrounding planning and administrative framework. At this point even the least introspective of agencies have been obliged to start asking whether there might be some fundamental weaknesses and contradictions in their own methods of operation.

Some credit for hastening this slow but perceptible movement in attitudes must go to the small body of researchers, mainly but not exclusively social scientists, whose work during the 1970s has helped to underline two important messages to policy-makers: first, that provided conditions exist or can be created which are conducive to local initiative, water users often organise themselves remarkably well and are capable of assuming substantial responsibilities (including the management of local conflicts); and secondly, that most of the weaknesses of officially-sponsored projects are not primarily attributable to the water users but to deficiencies in planning, design and project management (including the management of larger inter-community conflicts). Before this recent period there was little significant communication between the worlds of research and action, despite a long tradition of social science research on the management of water, especially irrigation water. This was very largely because of the development agencies' overriding preoccupation with large-scale

construction, but there were problems on the other side too. Anthropologists and sociologists were producing micro-studies of small indigenous irrigation systems which, viewed individually, appeared to have little to say of immediate relevance to development agencies; they often had a profound distaste for the ways of planners, engineers and governments which would have made productive dialogue difficult even if the other side had sought it; many of their studies, while describing the social organisation of water users in admirable detail, were vague about important physical and technological factors (such as soils, topography and water availability); and many of their forays into comparative analysis were for the purpose of private, exclusive and often sadly ill-focused debate about subjects like Wittfogel's theory of oriental despotism.[2]

Economists meanwhile were much more closely in touch with what development agencies were doing, and many worked in collaboration with them. They were among the first to bring home to the agencies, through detailed evaluations, just how badly many public sector irrigation and water supply projects were working. With a few exceptions, however, economists have contributed relatively little to our understanding of why performance has been so bad; nor, despite their general contribution to improved techniques of project planning and evaluation, have they been able to offer any very specific practical suggestions as to how the process of management — and particularly conflict management — could be strengthened. Much of their effort has been wasted on elaborate proposals for changes in water pricing policy which have done little except reveal the authors' failure to comprehend the political and social environments in which decisions about water have to be made. To many economists the processes of management and decision-making appear to remain a mysterious black box — clearly important but maddeningly unquantifiable; yet development agencies, despite their growing recognition of the importance of management issues, continue to rely far more heavily on economists for guidance in project planning than on social scientists from other fields.

Notes

1. See my article, 'Technology and Management in Irrigated Agriculture', *ODI Review*, 2-1978.
2. Karl A. Wittfogel, *Oriental Despotism: A Comparative Study of Total Power*, New Haven: Yale University Press, 1957.

2

Irrigation Management and the Organisation of Support Services*

Introduction

This paper is concerned with the broader physical, social and organisational framework within which water is managed on large irrigation schemes, with special reference to experience in Pakistan and its current on-farm management programme. Special consideration will be given to the function of water distribution.

An irrigation scheme is an administrative concept, in contrast to an irrigation system, which is a physical one. In Pakistan the administrative unit of the irrigation scheme is usually based on a very large canal system and is therefore itself very large. (For example, the Lower Jhelum Canal Circle, which is responsible for a single canal system, covers a command area of about 628,400 ha; by contrast, a comparable administrative unit in South-East Asia might cover an area of c. 30,000 ha, comprising a large number of relatively small systems, averaging 1,500-2,000 ha each. Such small surface systems may also be found in hilly areas of Pakistan. There are also many small well units in the plains; of these, each private tubewell may be regarded as an administratively independent 'scheme'; but the public tubewells, though also relatively small systems with commands of 200-300 ha, are administered as part of a larger scheme.) The largeness of most jointly-managed irrigation schemes in Pakistan[1] has important administrative implications — for the staff of government departments, for farmers, and for relations between staff and farmers. In particular, it complicates the transmission of accurate and trustworthy information about water supply and demand. (Contrast the relative ease with which water users from all parts of a small diversion or reservoir system can find out for themselves about total

*Paper presented to the National Workshop on Water Management at the Farm Level, University of Agriculture, Faisalabad, Pakistan, 18-23 April 1982.

water availability and the pattern of water extraction by fellow users.) It also complicates the process of allocating available water supplies in such a way as to achieve an optimal 'fit' with farmers' demands.

Irrigation development is as much a social and political activity as a technical one. This applies at all stages of the development process (from planning and design, through construction, to operation and maintenance) and at the river basin and irrigation project levels as well as at the watercourse level. The reason lies in the fact that irrigation water is a scarce and valuable resource to which a multiplicity of private users have common access. Conflicts of interest are therefore bound to arise at all levels of an irrigation system, increasing with the scarcity of water available. Good irrigation design and management must take this uncomfortable fact into account (see previous paper).

The importance of main system management

I recently completed a comparative study of the organisation and management of large irrigation projects for the World Bank, in which I focused particularly on the usually neglected area of water management in the main (primary and secondary canal) system, *above* the watercourse outlet.[2] I found that in three of the four case studies[3] where performance was relatively poor — in terms of productivity of water use and equity of water distribution — a major contributory cause was deficient main system management. My evidence was largely qualitative, but it strongly indicated that in all three cases a significant proportion of the water losses observed at the watercourse and field levels could be attributed to poor water distribution on the main system. The precise significance of this factor could only be determined by controlled experiments in improved main system management, which few countries have so far attempted. But in the Philippines, where such an attempt has been made, some remarkable results were achieved. Researchers from the International Rice Research Institute (IRRI), working on one canal command area of 5,700 ha, found that quite modest changes in water distribution procedures, combined with minor technical improvements, were associated with an overall increase in dry season production of 39% over one year, including a 137% increase in the tail section.[4] In a later experiment, in 1981, production was affected by pest damage and typhoons but dry season utilisation efficiency was increased from about 50% to 70%.

These comments are not intended to suggest that Pakistan's on-

farm water management programme is wrongly directed. There is ample evidence of the urgent need to improve the physical and organisational aspects of water management at the watercourse and field levels. I am suggesting, however, that the full potential benefits of the programme cannot be realised until similar attention is also given to the improved management of the main irrigation system, and of other closely associated support services. Experience elsewhere suggests that it would by no means be an easy programme to implement. Governments and aid agencies (or at least some of their members) tend to be unenthusiastic about improvement programmes which cast doubt on the management capabilities not only of farmers but also of their own technical experts. However, if systematically undertaken, the investigations required to determine an appropriate programme of administrative change need not be particularly embarrassing. It is the management *system* which is likely to come under criticism, not individual managers or staff members.

Analysing management problems and identifying remedies

The four major factors most likely to have a significant influence on the quality of irrigation management, in all its aspects, are:

(i) organisational structure (the differentiation and coordination of functions and responsibilities);

(ii) technical skills (of officials and farmers);

(iii) motivation (of officials and farmers); and

(iv) financial resources (especially for recurrent costs).

(i) Organisational structure

There is no 'ideal' organisation form for all irrigation schemes. Appropriateness of form depends on many local factors (e.g. size of irrigation system, technology, technical skills, social structure, political feasibility). Although an inappropriate organisational structure will guarantee poor management, an appropriate structure is not in itself a guarantee of good management. Much will also depend on how people behave within that structure.[5] However, we can begin to get a broad idea of what an appropriate structure in a particular context might involve if we list the most important functions which need to be carried out and then ask some questions about the allocation of responsibilities in each case. A fairly comprehensive list of functions would look like this:

a) Planning and design

b) Construction

c) On-going management
   — main system operation (canals, tubewells)
   — main system maintenance (canals, tubewells)
   — watercourse improvement
   — watercourse management (operation and maintenance)
   — farm level water management
   — agricultural extension
   — financing recurrent costs
   — commercial services (credit, purchased inputs, marketing).

For each of these functions, one can ask the questions:
   — How is responsibility for this function currently allocated?
   — How could it be better allocated?

And in relation to some of them, it is necessary to add:
   — How is responsibility for these related functions currently coordinated?
   — How could it be better coordinated?

Three clusters of functions call particularly for close *coordination* in some form (though not necessarily in one single 'integrated' organisation): main system operation and maintenance, agricultural extension (with close links to input supplies, etc.), and watercourse improvement and management. In many countries, responsibilities for the first two have been separated between Irrigation and Agriculture Departments, and the third has been no one's responsibility. Various attempts to overcome these problems have been made in several countries, for example,

— The Command Area Development Programme in a few states of India, notably Rajasthan (in many of the others, CAD has not had the effect of better coordination, being largely confined to 'on-farm development' only[6])

— The programme of the National Irrigation Administration of the Philippines, whereby on its larger projects agricultural staff have been taken on as direct employees of the NIA, to help promote improved water distribution and application.

In Pakistan, a greater degree of interdisciplinary coordination is apparent at the planning stage of irrigation projects (through the Water and Power Development Authority WAPDA) than in their subsequent implementation. In addition to the split of responsibilities

between Irrigation and Agriculture (with each department being organised on a different geographical basis)[7] there is a further split within Irrigation between canal and tubewell circles. These too are organised on a different geographical basis — quite illogically, since the objective of conjunctive water distribution and use clearly demands that they are operated in as integrated a manner as possible. A partial exception can be found on the Salinity Control and Reclamation Project (SCARP), Khairpur, where responsibility for tubewell management and agricultural extension is combined in a single project organisation — but responsibility for canal management still rests with another agency.

A case for greater *differentiation* of functions can be made in the case of main system operation and maintenance — usually the combined responsibility of the same sets of people. Taiwan is one of the few countries which recognises that the skills required for operation (water scheduling and distribution, watercourse extension, etc.) are quite different from those required for maintenance. It consequently has two separate cadres within its Irrigation Associations, one specialised in Operation (with training in irrigation engineering and agriculture), and the other specialised in minor design and maintenance (with training in civil and mechanical engineering). Elsewhere, both the operation and maintenance functions are customarily entrusted to civil engineers, who have rarely been given any specialist training in the former.[8]

(ii) Technical skills

As is implied by the preceding paragraph, skills in water distribution (at both system and watercourse levels) are often deficient in many countries, even where considerable thought may have been given to the development of detailed operating procedures in the past, for example on the canal systems of Pakistan and North West India. (These procedures were designed for canal systems whose flows were largely conditioned by the pattern of water supply and had little scope for responsiveness to local variations in demand, but with the introduction of much greater scope for flexible operation from tubewells the need now is for much more demand-responsive procedures). Where water distribution skills are weak, the quality of irrigation system design is also likely to be adversely affected.[9]

Other areas of common weakness in skills are water management extension at the field level — an almost universal lacuna in Agriculture Departments; and watercourse improvement, both in its technical and

organisational aspects (but a problem which is beginning to be confronted in several countries, including Pakistan).

(iii) Motivation

The problem of motivation has generally been much more emphasised and studied in relation to farmers than in relation to government staff. But it is a key factor affecting their performance, especially in the case of water distribution staff. These people are frequently under intense pressure from powerful farmers to misallocate water. If they do so, the private benefits to the farmers who receive additional water are greatly outweighed by the public losses to the nation and to the farmers who receive reduced supplies at unpredictable times — usually tail-enders.[10] But how can irrigation staff, who (like other public servants) are often poorly paid and have limited promotion prospects, be motivated to do an unpopular and apparently unrewarding job?

The problem cannot be overcome by technical training alone (though specialist training in water distribution methods should have some beneficial effects, by raising professional pride and job satisfaction). In crude terms, the most effective way of increasing staff motivation is, usually, through a judicious combination of 'stick and carrot'. On the carrot side, the scope for increasing material incentives tends unfortunately to be very limited in public enterprises, at least in the short run; nevertheless some effective methods of assessing performance by merit and rewarding it accordingly (if only in an honorary way) should be possible to identify. When it comes to the stick — discouraging the misallocation of water through fear of retribution — there are two contrasting approaches to management which have proved effective in different circumstances. One involves reliance on a strict 'top down' benevolent paternalism, with just senior adminstrators acting in the interest of the farmers in their charge (especially small farmers and tail-enders); here the degree of direct participation in decision-making by the farmers themselves may often be minimal.[11] The second approach requires the delegation of substantial responsibility to farmers, to the extent that they are enabled to put pressure on irrigation staff 'from below' to allocate water fairly. This 'participatory' management approach would require the building up of farmers' representation at levels above the watercourse — to the distributory and scheme levels — so that they are in a position to oversee and monitor the irrigation staff's performance and make them accountable to them. Such a relationship has to some extent been established in Taiwan's Irrigation

Associations.[12]

(iv) Recurrent finance

Success in persuading farmers to contribute significantly to the recurrent costs of irrigation seems to be closely related to the ultimate destination of their payments. In most cases, they are required to pay water charges which are absorbed into general government revenue. In that case, farmers — seeing no direct link between what they pay and what comes back to their project for operation and maintenance services — regard the charges as just another tax and will do their best to keep it low or avoid paying it. However, their attitude may be very different if their payment (or a significant part of it) goes to the project agency for direct reinvestment in their own irrigation system. In Taiwan, where the latter method is used, farmers see a direct link between the money they pay and the services they receive in return and they are consequently often willing to pay remarkably large sums to their Irrigation Associations. This method also has an important impact on staff motivation, since higher farmer payments imply the possibility of extra bonuses to staff. The following self-sustaining sequence can then be established: good service — client satisfaction — higher payment — more money for reinvestment — better service. Such a system could clearly not be introduced into Pakistan tomorrow, but its principles may be worth considering with a view to making certain adaptations, at least, to the present method of charging for water.[13]

These are the principle issues one is likely to find oneself addressing if one adopts a 'whole system' approach to the problems of irrigation management.

The adoption of such a perspective in Pakistan would, I believe, do much to strengthen and enhance the work which is already being done to improve management performance below the outlet. In particular, I would expect a significant increase in farmers' motivation to manage their watercourses better on a sustained basis if they were to observe commensurate efforts being made on the part of irrigation staff to improve services above the outlet.

The need for improved management is particularly urgent in those SCARP areas where public tubewells have been installed with the twin objectives of lowering the water-table and providing additional irrigation water in conjunction with canal supplies. In a recent study of an area in Punjab with a combination of canals and public tubewells, it was found that although canal water distribution was

fairly equitable, the tubewells were being operated at a very low level of efficiency and with marked inequity, both between heads and tails of tubewell commands and between larger and smaller farmers. With responsibility for canal and tubewell operation split between different Circles of the Irrigation Department, there was no coherent approach to the conjunctive operation of canals and tubewells. In contrast to the detailed and long-established procedures for canal operation and maintenance, there were no tubewell manuals of any kind available. Shortage of recurrent finance was a major factor contributing to the poor level of tubewell management, but others were the limited skills and poor motivation of tubewell operators and the generally low morale of Tubewell Circle staff.[14]

Notes

1. Jointly-managed schemes are those which are administered by a government bureaucracy above the watercourse or tertiary canal outlet, and by farmers below it. Schemes may also be managed wholly bureaucratically, communally (by groups of farmers) or privately (cf. E.W. Coward Jr. (ed.), *Irrigation and Agricultural Development in Asia*, Ithaca and London, Cornell University Press, 1980, pp.24-5).
2. See Anthony Bottrall, *Comparative Study of Management and Organisation of Irrigation Projects,* World Bank Staff Working Paper No.458, May 1981.
3. In Pakistan, India, Indonesia and Taiwan.
4. A.C. Earley, 'Lessons from system management research in Central Luzon', paper to Workshop on Investment Decisions in S.E. Asian Irrigation, ADC/Kasetsart University, Bangkok, August 1981. cf. A. Valera and T. Wickham, 'Management of traditional and improved irrigation systems: some findings from the Philippines', *FAO Farm Management Notes,* 5, January, 1978.
5. P. Drucker, *Management*, London, Heinemann 1974, p.519.
6. See, for example, K.K. Singh, 'Alternative organisational strategies for Command Area Development', *Proceedings of the Commonwealth Workshop on Irrigation Management,* Hyderabad, Commonwealth Secretariat, 1978.
7. i.e. Irrigation on a hydrological (command area) basis; agriculture on a local government basis. This creates particular problems for trying to assess the performance of irrigation projects in terms of agricultural production (Bottrall, *Comparative Study*, *op.cit.*, pp.77-87).
8. Bottrall, *Comparative Study*, *op.cit.*, pp.84-6.
9. *Ibid.*, pp.123-32.
10. *Ibid.* pp.132-8.

11. A statement of intent to apply such an approach is quoted in the following excerpt from a report in *Dawn* (Karachi) of 17 April 1982: 'The Senior Minister (of Sind) referred to complaints about shortage of irrigation water at the tail-ends and said that to cope with this problem he had conducted the desilting of canals operation through machines under his personal supervision. He said if there was any shortage of water at the tail-ends that would be only artificial. He warned the irrigation officials to ensure that proper irrigation supplies were made to the tail-enders. The Minister cautioned that he will undertake surprise tours and those found violating his instructions would be taken to task.'
12. M. Abel, 'Irrigation Systems in Taiwan: management of decentralised public enterprise', *Water Resources Research*, 12, 1976.
13. Bottrall, *Comparative Study*, *op.cit.*, pp.118-211.
14. See references to 'Area One', *ibid.*

3

Farmer Motivation and Co-operation*

Introduction

We can start by asking: motivation and co-operation for what? This paper has been written for a workshop, which is primarily concerned with two sets of activities:

a) Water management at the individual farm level (as a component of farm management); and
b) Watercourse improvement and subsequent operation and maintenance.

The first of these requires motivation, but not co-operation. The second requires both, since it is concerned with the management of a shared resource for which all farmers on a watercourse have joint responsibility.

The motivation of individual farmers (which may of course be achieved through the medium of a group) is the central function of agricultural extension work. This task is difficult enough. It is not just a question of prescribing an undifferentiated package; it involves finding out about each farmer's problems and constraints and adapting proposals to his particular requirements — for example, there will often be a need to adapt to local variations in soils, water supply and demand patterns, and farmers' financial conditions. Such a task ideally requires a large force of well-trained Field Assistants, acting as contacts with farmers, who can refer back for technical guidance, whenever necessary, to a corps of Subject Matter Specialists. This is the kind of structure envisaged under the Training and Visit system of extension, which has been introduced into certain parts of Pakistan.[1]

*Paper presented to the National Workshop on Water Management at the Farm Level, University of Agriculture, Faisalabad, Pakistan, 18-23 April 1982.

Still more difficult is the task of motivating groups of farmers to co-operate in watercourse development and operation and maintenance. This is the principal challenge facing Pakistan's new On-Farm Water Management (OFWM) programme and will be the main theme of this paper.

Factors influencing ease of co-operation

It is easy to say that water users' associations (w.u.as) should be created, but to get them to work well on a sustained basis is a very different matter. Experience elsewhere makes it clear that *major* administrative effort will be needed if the institutional side of the OFWM programme is to be a success. It will require a lot of hard work — and hard thinking — by those responsible for the programme's planning and execution.

The following factors seem to have a particular bearing on the relative ease or difficulty of co-operative action under different conditions:

a) the objectives of the co-operative enterprise;

b) the social structure;

c) voluntariness of membership;

d) the size of the area and group membership to be organised; and

e) the technology to be managed.

The principal reasons for expecting the establishment of w.u.as in Pakistan to be difficult are these:

1. The country's history of co-operation with regard to other agricultural activities has not so far been too encouraging (especially in the field of co-operative credit). One important reason has been the nature of the *social structure*. The literature on the social aspects of irrigation abounds with references to factionalism, conflicts between *biradaris* or kinship groups and *izzat* or 'honour'.[2] (It should however be noted that the principal objectives for which co-operatives have been customarily set up — subsidised credit in particular — have not provided a favourable basis for group action. One should therefore guard against assuming that social structure must always be the dominant factor, irrespective of context: certain functions and objectives offer better opportunities for co-operation than others.)

2. Water-related co-operative activity cannot be developed on a purely *voluntary* basis. For effective co-operation *all* farmers on a particular watercourse must be members of their channel-based

association and abide by its rules — no one can opt out. As in all forms of co-operative organisation, failure by any individual to co-operate with his neighbours will have the effect of undermining the discipline and morale on which the association's development depends. However, in contrast to savings, credit or marketing co-operatives, which are usually voluntary associations and therefore offer members a measure of choice as to who they will work with and who they will not, w.u.as have their membership determined for them by the location of each person's landholding. W.u.a. members may therefore have no other common bond of interest apart from their need to share the same source of water — and this can be a very fragile bond since, especially in times of water scarcity, individual interests are bound to be conflicting.

3. Another complicating factor is the large average *size* of watercourses in Pakistan and the large number of farmers on each channel who have to reach common decisions. (This should not be an insuperable problem: the possibility of forming smaller sub-units of the main group — perhaps along watercourse branches or sections — is referred to later in this paper.)

4. Finally, and most important, there is the question of the precise *objectives*, scope and responsibilities which are foreseen for Pakistan's w.u.as.

Government's objectives, farmers' incentives

What, first of all, are the government's objectives? There is no doubt that government strongly favours the formation of w.u.as. There seem to be two main reasons for this: a) it wants farmers to take full responsibility for watercourse operation and maintenance — something which government staff cannot possibly do by themselves; and b) it wants the organisations concerned, through their registration under the Water Users' Association Act of 1981, to be held accountable for the recovery of loans for improvement work and to be liable to disciplinary action in the event of poor watercourse management.

One should not necessarily expect all the farmers to look on these objectives with the same degree of enthusiasm as the government. It is true that many farmers do appear to favour w.u.as *at present* — forming a w.u.a. involves no great difficulty and it gives them access to a subsidised programme of watercourse improvement for which they expect significant benefits. However, some important questions may

need to be asked about the future. For example:

a) Do they all realise that they are expected to repay their often substantial loans?

b) What incentives do they have to co-operate in operation and maintenance in the longer term? Do they expect these tasks to be exclusively theirs or do they expect the government to help them again?

At this point, a fundamental principle of successful co-operation should be noted. All members of the association must expect to obtain a private benefit from co-operating which they could not get from not co-operating. Co-operation has its costs — no one does it for fun. Moreover, especially in a non-voluntary organisation, motivation to co-operate must be reinforced by effective sanctions against anti-social activity.[3]

With regard to the two questions raised above, it may be too early to do more than speculate about the likely future repayment of the loans. I will only repeat that credit — especially subsidised and/or loosely supervised credit — has proved a poor basis for co-operation; it can too easily be used as a means for private gain alone and tends not to instil the necessary discipline for lasting co-operation.

With respect to incentives to co-operate in watercourse operation and maintenance, one can say that farmers *ought* to perceive the long-term benefits which all of them should reap from such action. However, past experience (from Mona/Colorado State University studies) and present experience (since the start of the OFWM programme) make it clear that farmers often fail to co-operate well in operation and maintenance. There may be numerous reasons for this, including factionalism, the conflicting interests of head- and tail-enders, uncertainty of water supplies to the watercourse outlet and — particularly after the OFWM programme — lack of clarity as to the future division of responsibilities between government and farmers.

The need for strong external support

For all the reasons put forward above, it would seem rash to assume that many w.u.as set up under the OFWM programme have good prospects of lasting success in the absence of strong outside support from government extension agencies, especially in their formative stages. Outside support is needed particularly for the following tasks:

a) To provide regular demonstrations and reminders to farmers of the benefits obtainable from good watercourse operation and

maintenance (for example, by comparing the time spent on irrigating the same unit area on well-managed and badly-managed watercourses).

b) To work out in detail (with *all* the farmers in each w.u.a.) appropriate organisational structures and procedures which are acceptable to, and understood by, the farmers concerned (for example, decision-making through formal voting may often be inadvisable[5]).

c) To exercise effective sanctions against poor management and provide rewards for good management (for example, awards and prizes to the best w.u.as, as in Taiwan[6]).

All this implies a substantial cadre of trained watercourse management extension staff. In practice, there is no such cadre at present in Pakistan. The Agricultural Officers appointed under the OFWM programme were originally envisaged as supervising work of this kind, but the demands of the physical improvement programme have been such that they have had little time to devote to institution building; and in any case they have no field staff of their own to use for the purpose. The regular field staff of the Agricultural Extension service have been engaged on other tasks; and, while the provision of advice to farmers about field level water management should clearly be part of their regular extension duties, it is very questionable whether they should be asked to take on watercourse management extension as well. The principle functions of watercourse management are water distribution, channel maintenance and conflict resolution. None of these is closely related to the central farm management concerns of agricultural extension staff; and the function of conflict resolution calls for an arbitrating role which is not easily compatible with the requirement that extensionists should maintain good relations with all their clients.[7]

The case for a new and separate watercourse management extension service seems very strong. Indeed, there is little doubt that it should have been in existence right from the beginning of the OFWM programme. Given the scale of the programme on the physical improvement side and the speed at which it is being currently expanded, there is clearly an urgent need to provide it with an effective institution-building capacity if much of the potential benefit of the investment is not to be lost. Though impressive in its scope, the programme has become dangerously unbalanced. The formal establishment of w.u.as is unlikely to achieve much without regular

extension back-up. It is to be hoped that the publicity which the physical programme has attracted will itself help to increase public awareness of the need to make substantial additional investments on the institutional side.

Possible enlargement of group responsibilities

One conclusion to be drawn from the argument so far is that the functions of watercourse operation and maintenance on their own are likely to offer a fragile basis for sustained co-operation among farmers, particularly under the physical and social conditions prevailing in Pakistan. This raises two further questions: a) whether formal w.u.as are needed at all for these limited functions, and b) whether additional functions might not be identified which would provide farmers with stronger incentives to co-operate, thereby reducing the intensity of external supervision needed to ensure the w.u.as' success.

The first question will not be pursued here, though it should not be lightly dismissed. There are those who argue, with reference to the large irrigation systems of the Indo-Gangetic plains[8] that, providing irrigation staff abide by and enforce the existing rules of operation and maintenance efficiently and fairly, effective watercourse management should require no more than informal co-operation among farmers. However, it is clear from Pakistan's water management legislation of 1981, with its provisions for establishing w.u.as, that this 'traditionalist' view — which implies heavy reliance on an efficient, benevolently paternalist Irrigation Department — is no longer officially subscribed to. Now that the government has committed itself to the formation of w.u.as, the second question becomes the more pertinent. Is it possible to consider extending the responsibilities of the w.u.as in such a way as to enhance their capacity for sustained development?

One idea along these lines, which is being investigated by the Faisalabad University OFWM research team as part of their programme of field experiments near Shahkot, involves using w.u.as as a basis for multi-purpose co-operation. With assistance and advice from the University team, some w.u.as have been encouraged to form themselves into co-operative societies (under the Co-operative Act of 1925) with the object of enabling their members to purchase farm inputs on credit in addition to their water management functions. Initial evidence from this pilot action research programme indicates

an enthusiastic response from farmers and the level of loan repayments has been remarkably high.

Whether this approach is capable of being extended successfully on a larger scale remains to be seen. The experiment deserves to be closely watched. Evidence from other countries of irrigation water management groups with additional business functions appears to be limited, though there may be some relevant experience in Bangladesh, where the Comilla programme originally required that tubewells and low-lift pumps be allocated to well-established savings and credit co-operatives.[9] A general point to be noted about multi-purpose co-operatives of any kind is that they tend to make higher demands on management skills than single-purpose co-operatives and are likely to require a greater degree of initial supervision (a requirement which the Faisalabad University team is able to fulfil at present, with only a few watercourses to cover). On the other hand, if such an approach can be made to work well, it could have interesting policy implications; in particular it might show that a 'non-voluntary' channel-based co-operative could be a more effective means of providing smaller farmers with access to much needed credit than the traditional voluntary co-operative, from whose benefits many small farmers have often been effectively excluded.

Another possible way of strengthening the w.u.as would be to give them additional responsibilities *above* the watercourse outlet. In particular, through the establishment of representative committees at the distributory and/or canal system level, they could be enabled to help plan and monitor water distribution and maintenance activities on the main system. This could provide farmers with a strong incentive to participate in w.u.a. affairs, particularly those towards the tail-end of the main system.[10] Though I know of no examples of this kind of farmer representation on canal systems as large as Pakistan's, it is significant that the most successful w.u.as elsewhere tend to exercise substantial, if not total, control over main system operations. Examples on medium-to-large systems are the Irrigation Associations in Taiwan (with command areas of often over 50,000 ha), where farmers' representatives had substantial powers at the project level until 1975[11]; and IAs in Spain and the USA.[12]

There are also many examples of relatively small indigenous communally-operated systems over which farmers have total control, especially in East and South-East Asia.[13] Farmers' roles and responsibilities on these systems are entirely different from those assigned to the users of single watercourses on a large canal system,

and their motivation to co-operate is very different too. Their future depends very largely on the quality of their own decisions. By contrast, a w.u.a. with responsibilities confined to within the watercourse command is expected to be a passive recipient of whatever services the Irrigation Department chooses to give it: its scope for independent action is relatively very circumscribed.[14]

It is difficult to see such an extension of farmers' responsibilities being made in Pakistan in the near future, as far as canal operation is concerned. (Though it should be noted, with regard to the longer term, that the present relatively participative style of irrigation management employed in Taiwan has developed over a span of less than 50 years from one which was highly authoritarian.)[15] However management of public tubewells is another matter. A serious proposal has already been made to government that responsibility for their operation and maintenance should be transferred from the Irrigation Department to farmers themselves. Official reactions to the proposal have so far been cautious, and rightly so, since the administrative difficulties of effecting such a radical change in management responsibilities would be very great. Some of the principal problems affecting the transfer of public tubewell management to farmers' groups would be the size of the tubewell commands (often at least twice the size of an average watercourse command); the much higher degree of technical skill called for in the operation and maintenance of tubewells as compared to watercourses;[16] and the question of how to finance the high costs of tubewell operation and maintenance. Nevertheless, the present method of public tubewell management has run into such difficulties that the option of group management by farmers must be given careful consideration. The best way of testing the feasibility of such an approach would be to establish an action research programme, under which the administrative implications for both farmers and government service agencies would be closely monitored.

What can be learnt from elsewhere?

Leaving aside the possible enlargement of w.u.as' responsibilities in the future, let us now return to the present situation. Let us assume that the OFWM programme has been provided with the support staff it needs in order to get to work on the detailed planning of organisational structures and procedures of w.u.as within its areas of operation. What useful lessons can be learnt from the experience of irrigation groups elsewhere which could be drawn upon in establishing

guidelines for field staff?

The first point which needs underlining is that the range of physical and cultural differences encountered in all parts of the world is such that there can be no question of trying to prescribe a general blueprint for w.u.a. organisation in Pakistan or anywhere else. Even within Pakistan conditions vary enormously, both between provinces and between different areas of the same province. There must be room for local flexibility in the application of the provisions of the Water Management Act of 1981 if w.u.as are to work effectively; and certain provisions, if they are too inflexible, may need to be modified in the light of field experience.

However, despite the great variety of circumstances to be found in irrigated areas everywhere, farmers in Pakistan can be helped to develop institutional frameworks appropriate to their own conditions by reference to certain apparently common organisational *principles*. Six such principles are presented for consideration here. Some of them have been derived from observation of the way in which farmers have organised themselves spontaneously on indigenous irrigation schemes; others are derived from cases where — as in Pakistan — government agencies have been assigned the task of helping farmers to build their own institutions.

1. A water users' association tends to be much stronger if it is formed *before* planning, design and construction work has taken place. It acquires strength and cohesiveness from being required to take joint decisions — and risks — at those stages, before entering the operation and maintenance phase. In a pilot programme to support communal management of small irrigation schemes in the Philippines, government-employed Community Organisers would work with one group of 150-200 farmers for at least 6 months on initial group formation and project planning alone.[17] Though the same intensity of supervision would not be necessary or appropriate in the very different context of Pakistan's watercourse improvement programme, the same general principle does apply.[18]

2. Where a farmers' organisation is formed with government assistance, the respective roles and responsibilities of each party must be clearly defined and mutually agreed by both sides — and the view expressed on the farmers' side must be based on a consensus of all those affected by the agreement. There must be no ambiguity. Moreover, where there is a division of responsibilities between government and farmers, there should be a balance of obligations on both sides, so that their relationship acquires a reciprocal, bargaining

quality from the start. In other words, there should be clear conditions attached to each side's co-operation with the other: 'we will carry out our side of the bargain if you carry out yours'. This relationship characterised the most successful periods of the co-operative action at Comilla and later at Daudzai in Pakistan's North West Frontier Province and inspired farmers with sufficient trust to accept the discipline of 'savings before credit'.[19] This reciprocal relationship is not one which comes easily or naturally to most government officials, who are more accustomed to dispensing patronage (subsidised credit and other 'handouts') and issuing orders.

3. With respect to the internal organisation of irrigation groups, it has been observed that a common characteristic of indigenous systems is their 'accountable leadership'[20]. Leaders of each group are selected by the members of that group; their performance is reviewed regularly by them; and they are rewarded (or sometimes punished) in accordance with the services they provide to the group.

4. The organisation of indigenous systems is also characterised by a high degree of 'management intensity'.[21] Even small irrigation systems are divided into several management sub-units, each with its own local leader and its own delegated operation and maintenance responsibilities.

5. On indigenous systems, the unit on which internal organisation is most commonly based is the channel command, not the village.[22]

6. Wherever there is scope for external agencies to engage in 'social engineering', efforts should be made to ensure strong representation by tail-enders within the w.u.a's leadership, as a means of encouraging more equitable water distribution. The same principle applies to all w.u.as, whether they exist at the watercourse level only or at higher levels of the irrigation system as well.[23]

These principles suggest a number of pertinent questions to be asked about Pakistan's OFWM programme. The answers to them will indicate the directions in which the institution-building side of the programme needs to be developed. For example, considering each of the six principles in sequence, we can ask:

1. How far are farmers consulted about the planning and design of watercourse rehabilitation work under the OFWM programme? Could more be done without a counterproductive loss of time? How far are farmers involved in construction work (through labour and financial contributions)? Do farmers realise what the full costs of construction are? Do they perceive themselves as having contributed to the planning and construction of 'their own'

watercourse or one which 'belongs to government'?

2. Do all farmers clearly understand the division of responsibility between themselves and government agencies with respect to payment of capital costs, operation, maintenance? Does the government have the powers (and administrative capacity) to implement sanctions against w.u.as which fail to repay loans or maintain watercourses properly? Are these powers known to w.u.a. members and, if so, do they believe they will be applied?

3. To what extent have the w.u.as' Executive Committees been selected by their members? What has been the role of government agencies in their appointment, if any? Are the Committees in practice accountable to members?

4. Given the large size of most watercourses in Pakistan, what steps have been taken to encourage the sub-division of w.u.as into smaller management units, wherever possible, in accordance with natural sub-divisions of the physical layout (for example, branches of the Sarkari Khal)?

5. No problem here.

6. To what extent have w.u.a. members taken up the suggestion made in the Water Users' Association Act of 1981 that their Committees may be 'elected from geographic portions of the watercourses (head, middle and tail)' (para.14(2) of the NWFP Ordinance)?

The importance of action research

The design of the physical components of the OFWM programme has been built up on the basis of hundreds of man-years' experimental work by WAPDA and Colorado State University staff at Mona and elsewhere in Pakistan. The design of the equally important institutional components has been based on virtually *no* experimental work. It is true that WAPDA and CSU carried out some valuable sociological studies of farmers' behaviour on selected watercourses *before* the physical improvement programme started. But there has been no *field testing* of alternative institutional approaches during the process of physical change, to match the earlier field testing of alternative technologies. As a result, there are inevitably many uncertainties as to how the institutional side of the OFWM programme should be pursued in detail. Some broad suggestions have been offered in this paper, but to develop more specific ideas which can be recommended with confidence there would appear to be a

strong case for an extensive programme of action research in different parts of the country.

Action research may be described as experimentation in alternative management methods. A research team helps to design and monitor the pilot experiments, with a view to the subsequent replication of an approach or range of approaches which field tests have shown to be viable. It is a mode of research which has already been adopted by the Faisalabad University OFWM team in its experimental field work in the Shahkot area. But it needs to be expanded further. Moreover to be fully effective it requires the direct involvement of the government's OFWM staff in addition to the independent research team: a hallmark of the most effective action research has been close collaboration between researchers and implementing agencies in the search for solutions to organisation and management problems.[24] Though the design and execution of successful action research is never easy, it could have great potential as a tool for developing a strong institutional base for the OFWM programme. Its further application deserves urgent attention.

Notes

1. Cf. D.D. Benor and J.Q. Harrison, 'Agricultural Extension: The Training and Visit System', Washington DC, World Bank, 1977.
2. For example, A.H. Mirza *et als,* 'Village organizational factors affecting water management decision-making among Punjabi farmers', *Water Management Technical Report*, No.35, Colorado State University, 1975; D.J. Merrey, 'Irrigation and honour: cultural impediments to the improvement of local level water management in Punjab, Pakistan', *Water Management Technical Report*, No.53, Colorado State University, 1979.
3. Cf. V.S. Doherty and N.S. Jodha, 'Conditions for group action among farmers', Occasional Paper 19, Economics Program, ICRISAT, Hyderabad, India, 1977; M. Olson, *The Logic of Collective Action*, Cambridge, Mass., Harvard University Press, 1971.
4. Doherty and Jodha, *op.cit.*, p.16; A.F. Bottrall and J. Howell, 'Small farmer credit delivery and institutional choice' in J. Howell (ed.), *Borrowers and Lenders*, London, ODI, 1980, p.158.
5. See Merrey, *op.cit.*, p.40.
6. See A.F. Bottrall, *Comparative Study of the Management and Organisation of Irrigation Projects*, World Bank Staff Working Paper No.458, May 1981, p.173.
7. *Ibid.*, p.174.

8. For example, D. Seckler, 'The new era of irrigation management in India', New Delhi, Ford Foundation, draft, 1981.
9. A.F. Bottrall, 'Review of Irrigation Management Practices in Bangladesh', Dhaka, Centre of Development Science, 1983, pp.120-7.
10. Cf. D.W. Bromley, D.C. Taylor and D.E. Parker, 'Water reform and economic development: institutional aspects of water management in the developing countries', *Economic Development and Cultural Change*, 28, 2, January, 1980.
11. M. Abel, 'Irrigation Systems in Taiwan: Management of a decentralised public enterprise', *Water Resources Research*, 12, 1976.
12. A. Maass and R.L. Anderson, . . . *and the Desert Shall Rejoice: Conflict, Growth and Justice in Arid Environments*, Cambridge, Mass., MIT Press, 1978.
13. See, for example, E.W. Coward Jr. (ed.), *Irrigation and Agricultural Development in Asia: Perspectives from the Social Sciences*, Ithaca and London, Cornell University Press, 1980; B. Bagadion, F. Korten, D. Korten *et al.* 'Promoting participatory management on small irrigation schemes: an experiment from the Philippines', Agricultural Administration Unit, Irrigation Management Network Paper 2/80/2, ODI, 1980.
14. Bottrall, *Comparative Study*, *op.cit.* There are some examples of successful group activity at the watercourse level only, for example in Taiwan and Indonesia (the Dharma Tirta programme in Central Java; see J. Duewel, 'The Dharma Tirta programme in Central Java', paper to Workshop on Investment Decisions in S.E. Asian Irrigation, ADC/Kasetsart University, Bangkok, August 1981). But the irrigation systems of which they form part are often relatively small: social structure is more cohesive; and their responsibilities are greater than those of Pakistan's w.u.as (e.g. in the Dharma Tirta progamme, there is intensive farmer involvement in the planning and construction of watercourse improvement as well as in operation and maintenance).
15. Abel, *op.cit.*, p.344.
16. *Technology* has been cited earlier in this paper as one of the key factors influencing the ease or difficulty of co-operative action.
17. Bagadion, *et al.*, *op.cit.*
18. T.B Moya, 'Water distribution within the Lower Talavera River Irrigation System tertiaries' and Y. Othman, 'Farmer participation in terminal irrigation development — the case of Muda II Project, West Malaysia' both papers to Workshop on Investment Decisions in S.E. Asian Irrigation, ADC/Kasetsart University, Bangkok, August 1981. Published as Agricultural Administration Unit Network Paper 2/81/1, ODI, 1981.
19. A.F. Raper, *Development in Action*, Ithaca, Cornell University Press, 1970; S.S. Khan, *Rural Development in Pakistan*, Ghaziabad, Vikas Publishing House, 1980.

20. Coward, *op.cit.*, p.205.
21. *Ibid.*
22. *Ibid.*
23. Cf. R. Chambers, 'Questions for managing canal irrigation in the 1980s' in *Report of a Planning Workshop on Irrigation Water Management*, IRRI, 1980, p.31.
24. A.F. Bottrall, 'Action research towards improved water distribution', AAU Irrigation Management Network Paper 1/81/2, ODI, 1981.

4

An Approach to Evaluating the Organisation and Management of Large Irrigation Schemes*

This paper discusses the methods of research used and developed in the course of a comparative cross-country study of the organisation and management of large-scale jointly-operated irrigation schemes, which I undertook for the World Bank between 1975 and 1979. The final report, which draws on field studies in Pakistan, N.W. India, Indonesia and Taiwan has been published as a Bank Staff Working Paper.[1] The main purpose of this paper is to point to certain key features of the research approach adopted in the study which tend to be absent from much social science research on irrigation (and indeed on agricultural and rural development more generally); to explain why these features are thought to be important; to consider the principal difficulties which others might have in trying to apply the same approach; and to discuss how these difficulties could be overcome.

Objectives, focus and main hypotheses

The principal objective was to develop a generally applicable analytical framework which could subsequently be employed to evaluate the management of large-scale irrigation over a wide range of different physical, technical, economic and social conditions. It was central to this main purpose that the method of research should be comparative and that the case study areas should be diverse in their characteristics. Few valid and useful generalisations can be made about organisation and management which do not need to be qualified in some way to take account of particular local circumstances. The case studies, by enabling the performance of the same activities to be examined in significantly different environments, were essential to the process of distinguishing between those principles

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of irrigation management which appear to be universally true irrespective of cultural or technological context and those which are contingent on local factors or combinations of factors.

The search for a coherent and systematic analytical framework for evaluating irrigation management was born out of an increasing concern in the early 1970s, on the part of the World Bank and others[2] at the poor performance and management of large irrigation schemes in many countries, combined with an often reluctant realisation that there were unlikely to be any simple universal 'blue-print' answers. The framework which was eventually developed is designed to be capable of incorporation into more conventional project planning-appraisal-evaluation exercises, with the object of persuading planners to base their decisions on an adequate analysis of management and institutional factors as well as technical and economic ones, instead of (as so often) treating them as residual or peripheral. The proposed approach could be used not only to identify specific measures for improving management on the particular irrigation system subjected to evaluation, but also to indicate the shape of reforms likely to be required on existing systems with similar characteristics, and to provide an important input into the planning and design of new systems in the same agro-climatic region.

Irrigation schemes can be classified as large or small by virtue of their physical characteristics (command area, length of canals, etc.) and their organisational complexity. The same applies to irrigation systems. Schemes as large as those included in the comparative study (with command areas ranging from 33,000 to 628,000 ha) generally have bureaucratically or jointly managed irrigation systems, irrespective of the size of those systems — though some remarkable examples of large communally managed schemes and systems can also be found.[3]

An organisational question of importance for regions with a large proportion of long-established medium and small-scale irrigation is whether it may be better for small irrigation systems dependent on the same water source to be managed jointly as part of a single large scheme or communally as independent administrative units — or whether some intermediate administrative arrangements should be developed which would be able to reconcile the potentially conflicting objectives of (a) preserving the independence and integrity of communal systems' internal organisation, and (b) controlling extractions from the common water source in the interests of efficient and equitable distribution of water to users on all systems dependent

on that source.

Within the irrigation schemes studied, priority was given to the analysis of main system management. This is because there were both *a priori* and empirically-based reasons to expect that major management weaknesses would be widespread at this level, especially in water distribution; far less research had been done on management on the main system level than at water course and farm levels; and government and development agencies appeared to have a blind spot about the subject, preferring to confine their concern about water management to the tertiary and farm levels.[4]

It was hypothesised that if the expectations about weaknesses in main system water distribution proved correct, many of the water management 'problems' below the watercourse outlet, attributed by official agencies solely to deficiencies in farmers' organisation, could be shown to have their origins higher up the system. This would imply that the agencies' conventional diagnosis of water management problems was faulty; that they should adopt a 'whole system' approach to the analysis of irrigation management; and that they should be prepared to reconsider their pattern of investment, which on existing irrigation schemes was concentrated almost exclusively on physical infrastructure at the main system level and on a combination of physical infrastructure and reorganisation at the watercourse level.

Field studies: initiation, access to information, and resources used

The selection of countries in which field studies were to be done was largely made by the World Bank. Initial arrangements for setting up the studies and decisions as to their precise locations were made by agreement between the World Bank and the governments concerned. I was therefore unusually fortunate in having the minimum of difficulty in establishing contact with the agencies I wanted to work with and learn about. Access to information, whether through interviews, inspection of records or field visits, was also made relatively easy by the fact that the study was Bank-sponsored[5] and also by senior officials' knowledge that the main purpose of the study was not to evaluate their particular scheme and that detailed conclusions would not be published. This meant that I was usually able to get information on even quite intimate subjects within a fairly short space of time (though reluctance was often expressed over showing financial accounts). Staff were in most cases remarkably co-operative and frank

and were extremely generous with assistance in the use of transport and clerical time.

Each case study was carried out by a team of three people — one social scientist (myself), one engineering consultant, and a local research assistant. Two to three weeks were usually spent in each study area, plus one to two weeks' general orientation, including discussion with planners and administrators at the national level and brief visits to other schemes for comparison and contrast. With the substantial additional contributions of staff time and vehicles provided by the scheme management, the resources we had were generally sufficient for the studies' main methodology-building purposes; but a complete evaluation of a scheme's performance and management, particularly under less favourable circumstances, might often require more.

Where the primary purpose of an evaluation is to influence government policy, a government request for an objective assessment from an independent inter-disciplinary team of this kind would probably represent something close to the ideal arrangement. Whether it can be realistically expected remains to be seen. Though many governments are now becoming openly concerned about main system management, this was not so until very recently; and I still know of no case (except for that of Asopa and his colleagues[6]) in which a systematic and independent whole system evaluation has been undertaken at the request of government for the express purpose of developing an action programme on the basis of its results. In recent years, virtually the only attempts at independent study of main system management have been made by a few exceptional individual social scientists who have developed their research projects on their own initiative.[7] While they have had the advantage of being able to publish their findings openly and have succeeded in influencing policy-makers' thinking by that means (and others), the general disadvantages of such an approach are that access to information tends to be relatively difficult, more time and effort has to be devoted to gaining the confidence and co-operation of staff, and feedback into policy is not guaranteed. These are no doubt the main reasons (besides the need to acquire a technical understanding of irrigation) why so few social scientists have so far ventured into studies of main system management.

Another important source of information and ideas about main system management and a potent influence on policy have been the writings of 'insiders' — irrigation administrators themselves.[8] But not all administrators can be relied on to be as enlightened or articulate as

they; and if the organisation and management of irrigation is to be consistently reviewed on a nationwide basis, an independent cadre of monitors and evaluators will need to be built up for the purpose, together with a common analytical framework.

Methods of information-gathering and analysis

As a result of experience gained in the four field studies, a basic analytical framework has been proposed in my report which contains the following sequential steps.[9]

(a) A descriptive inventory of the local environment (physical, technical, social, economic) and of the administrative and other resources available for use within the scheme.

(b) An evaluation of the scheme's actual performance in relation to potential, in which the leading criteria are productivity (especially of water), equity (especially of water distribution), environmental stability, cost and cost recovery.

(c) A review of the main factors likely to explain the level of performance achieved, including the technical design of the irrigation system; the organisational and administrative framework within which scheme management is expected to operate; the quality of performance of key support service activities within the limitations of that framework; and the quality of farmers' management at the watercourse and field levels.

(d) An assessment of the relative importance of these factors as explanations of scheme performance.

(e) Recommendations for remedial action.

Although this is the logical sequence in which it is suggested that the findings of research should be presented, it does not of course necessarily reflect the order in which information is actually gathered in the field: for example, information on performance and management can be amassed concurrently.

With regard to the first step in the sequence — the inventory of the local environment and the scheme's administrative resources — it may be enough to say here that the collection of information should be relatively straightforward; and if a significant proportion cannot be obtained from official records, this in itself is likely to be an indicator of management weakness. In as much as techniques for appraising and evaluating project performance are relatively well developed and understood, the second step in the analysis should also in theory not present too many difficulties; and because our main concern was to

improve techniques for assessing management, we spent less time on assessing performance than would probably be desirable in a full evaluation. In practice, the main problem here tends to be shortage of reliable information from the records. This can again be taken as a sign of management weakness, since good management depends on an information system which will enable performance in certain key areas to be regularly monitored.

In the four field study areas information on environmental factors (extent of waterlogging and salinity, depth and quality of groundwater, etc.) and on cost and cost recovery was recorded in some form, though not necessarily one that had been well ordered or analysed. On the other hand, the necessary information on which to base an accurate estimate of the productivity of water was not available in any of the four cases, including Taiwan. Unless the evaluation team has the resources to do a lot of extra work on its own measurement of water losses, it will have to fall back on simpler but unsatisfactory proxy indicators of production; but even then the existing information, both on area and yields, is often unreliable and difficult to combine (since it usually comes from at least two different agencies, each with different geographical boundaries).

The criterion of equity, which is of critical importance wherever water supplies are scarce in relation to demand, is very rarely monitored by the irrigation agency itself. However, it should usually be fairly easy for an external evaluator to obtain indicators of equity of water distribution between different parts of a large canal system simply by disaggregating project records. In each of the study areas we made a random selection of watercourses towards the head and the tail of the system and were able to compare the canal flows, cropping intensities and cropping patterns in the different areas. Though the data were not always particularly accurate, major discrepancies between the patterns of water availability at head and tail were always readily apparent. Within the selected watercourses farmers' views were also sought on the quantity and timing of water deliveries. Field inspections and interviews with farmers also gave us some insights into the equity of water distribution at more micro levels (within watercourses or between larger and smaller farmers); but for a well-informed and objective assessment we had to depend, wherever they were available, on more detailed farm surveys already carried out by others.

Most of the time and effort in the field studies was devoted to identifying the principal causes of the levels of performance achieved

and trying to assess their relative importance. Logically, the first important task, which fell to the engineering consultant, was to attempt an assessment of the technical potential of the irrigation system. This was defined as the upper limits of performance of which the system was capable, given its basic design and current physical condition and assuming 'good management'. Not surprisingly, since there was no opportunity to test the system's capacity in practice through experiments in alternative methods of management, the engineers were reluctant to attach figures to their estimates of technical potential. It did however prove relatively easy to identify major design limitations, many of which were readily drawn to the attention of the evaluation team by operating staff. In some cases these limitations were consciously built into the system by its designers (usually for cost-saving reasons) but in others they were clearly the result of unplanned errors.[10]

Having formed an opinion of the limitations imposed on management by a system's technical characteristics, we then sought to analyse the ways in which scheme performance was being further influenced by organisational and management factors. This involved trying to allocate responsibility for the quality of performance achieved to different levels of management. The natural analytical sequence was to start at the top of the management system and work downwards: pre-eminently in the context of canal irrigation, where downstream users usually have very limited room for independent manoeuvre, higher-level decisions critically influence what can be decided lower down the management (and irrigation) system.

We accordingly began with an analysis of the organisational and administrative framework for scheme management, which is essentially the responsibility of senior policy-makers and planners. For an assessment of the quality of 'planning for management', key questions include:

(a) Have clear general objectives been established for scheme management?

(b) Is the scheme's organisational structure appropriate to those objectives?

(c) Are detailed management procedures, information and monitoring systems in existence?

(d) Are policies governing staff's conditions of service (with regard to recruitment, promotion, transfer, salary) conducive to good performance?

(e) Are funds for main system operation and maintenance (whether from government or local sources) adequate?

(f) Is there an effective legal framework for the enforcement of penalties against abuse of water distribution rules?

We found that most of the factual evidence needed to produce answers to these questions could be obtained without great difficulty from a scrutiny of procedural manuals (where these existed), periodic reports and file documents, supplemented by discussions with senior staff at the scheme level. In the case of those questions where value judgements are involved, such as (b), (d) and (e), reaching an answer usually turned out to be more difficult in theory than in practice. Some of the most important judgements about organisational structure, such as those concerned with coordination and specialisation of functions, could be intellectually justified by reference to organisation theory; but in the more extreme cases (for example in the scheme where four separate agencies were responsible for canal management, public tubewell management, drainage, and agricultural extension, each with different geographical boundaries) no more than common sense was required to conclude that the structure was inappropriate. Similarly with conditions of service: wherever staff are rigidly stratified by grades, grades and promotion are decided by formal educational qualification rather than field experience, transfers of senior staff are frequent, differentials between senior and junior staff salaries are high, and junior staff salaries are very low (and all these things tend to go together), there can be little natural expectation of finding high levels of staff motivation. Adequacy of O and M funding can be somewhat more difficult to determine, since it is a function of the skills and motivation of the staff to whom the funds are entrusted, but once again in extreme cases (and many of them are) judgement is not difficult to reach in practice.

The next and most time-consuming part of the management evaluation process was devoted to assessing the way in which key support service activities were actually being performed by scheme staff. Activities reviewed included water distribution, system maintenance, agricultural extension, watercourse improvement services and overall scheme management (including financial and personnel management and monitoring). Most attention was paid to water distribution and to the quality of its peformance at all levels of staff — from the senior engineer responsible for directing operation of the whole main system network down to the junior field staff

members charged with supplying water to the watercourse outlet. In accordance with the same pattern of investigation applied to other activities, answers were sought to the following questions:

—Is a satisfactory service being provided to farmers (i.e., is water being provided to the watercourse outlet adequately, predictably and equitably)? If not, why not?

— Can failure to allocate water satisfactorily be attributed (wholly or partly) to technical deficiencies, e.g. insufficient control structures, lack of measuring devices? (If so, it is not entirely a management problem.)

— Or is it (wholly or partly) a management problem? In which case, is water being allocated unsatisfactorily because system managers and their staff lack the necessary technical skills? And/or because they have insufficient resources (too few people expected to cover too large an area with too little transport)? And/or because, in the absence of sufficient material or other incentives, they lack the motivation to allocate water satisfactorily (and may indeed often have powerful counter-incentives to misallocate it)?

Probing into some of these questions can clearly be a delicate business and calls for a tactful, oblique approach to information-gathering. Methods of building up a picture of staff behaviour and the reasons for it include interviews with farmers; putting the same questions to different staff members and cross-checking their answers; inspecting daily records for errors or falsifications; making unheralded spot checks on what is happening in little-frequented parts of the scheme; and open confessional discussion (if/when time has allowed sufficient familiarity, sympathy and trust to develop between the interviewers and members of staff). In making these investigations the researcher should be trying to put himself into a scheme manager's shoes. His techniques of information-gathering are essentially the same as those of a good manager. Here are some brief examples of the kind of information these probes can yield:

(a) Interviews with farmers:

Although staff were supposed to have informed farmers about the dates of canal closure (for seasonal maintenance) x weeks previously, farmers were very uncertain when the closure would be made. Farmers in a village immediately downstream of a pilot (showpiece) watercourse were receiving very little water because extra supplies were being diverted to the pilot watercourse in order to demonstrate

its 'success'. Farmers did not know the names of local field staff. Field staff accompanying the researcher got involved in heated arguments about the inadequacy of water deliveries.

(b) Cross-checking staff answers:

In a rice-growing area with serious water shortages in the dry season, senior officials insisted that rice areas be restricted and priority given to lightly-irrigated crops, but the majority of field staff believed that priority should be given to rice. Two senior engineers on the same scheme were using different formulas to estimate water requirements. Senior planners had developed one set of operating procedures, but field staff were using an entirely different one. Agricultural extension staff were encouraging the development of different cropping patterns in different zones of a command area in response to local variations in soil conditions and markets, while engineers were redesigning the distribution system on the assumption that water would be distributed on a strictly proportional basis.

(c) Inspecting records:

Daily flow measurements were found filled in in advance. Where an elaborate chart had been prepared to enable the scheme management to monitor the pattern of actual water flows and losses from the headworks to the tail reaches, clerks were taking field staff's reports of discharges at watercourse outlets and working backwards up the system, filling in notional figures for discharges at primary and secondary canal diversion points which had been calculated on the basis of assumed water losses. Obvious errors were found in addition, subtraction and the placing of decimal points, but no corrections had been made by senior staff. Where reported tubewell pump operating time could be checked against electricity meters, the vast majority of meters were broken.

(d) Spot checks:

'Guided tours' should be avoided wherever possible, but on one scheme the management was particularly concerned that I should announce my travel plans in advance. I pointed at a part of the map but my intentions were misunderstood. The next day, when our convoy of vehicles reached a bifurcation and proceeded along the right hand canal, I asked them to stop and explained that I wanted to go along the other one. This led to great confusion, shouting, calling

back of advance vehicles, etc. All along the left hand canal the tubewell operators, unalerted, were either absent, were operating wells when they should not have been, or not operating them when they should have been.

(e) Confessional discussions:

A senior engineer described in some detail the ways in which he had seen standards of supervision over water distribution decline since his youth: since the jeep had replaced the horse, senior staff were now spending far less time in the field, certain time-consuming but critical inspection procedures had been dropped, and the like. A relatively junior engineer, frustrated at being unable to assume initiative and apply his technical knowledge more effectively, asked for a special interview in which he described the demoralised state of his division; the lack of direction, supervision, funds, equipment; and the recent dismissal of three colleagues for corruption and embezzlement.

These are all examples of evidence of poor management, but contrary examples could also of course be given which would represent evidence of good management.

Similarly designed probes into the hows and whys of water distribution could and should be carried out within selected watercourse commands if the evaluation team has sufficient resources for them. If they are carried out as an integral part of a whole system evaluation, there should be no danger that the search for causes of performance at the watercourse level will be restricted to purely internal factors (physical and social) within the watercourse command itself, to the exclusion of probable constraints. This partial or 'closed' perspective has been a weak feature of even some of the best studies of watercourse management — for example, the Colorado State University/WAPDA studies in Pakistan[11] — and tends unfortunately to lead to proposals for wrongly balanced investment programmes, encouraging governments and development agencies in their predilection for 'solutions' to water management problems which point the finger of blame at the water users alone while ignoring the quality of main system management. Where watercourse and main system evaluation are combined, the adequacy and predictability of water supplies to the watercourse outlet is a natural starting point for an analysis of watercourse command management; and wherever there are significant deficiencies in main system management they are likely to be shown up sharply by a selection of watercourse commands

which enables comparisons to be made between water users' problems and practices at the head, middle and tail reaches of the main system.[12]

Field study results

Some approximate indicators of scheme performance were identified.[13] The following résumés indicate what were perceived to be the principal reasons for the performance levels achieved.

Scheme A:

(628,000 ha, 400-450 mm. rainfall, single canal system and public tubewells).

Performance:

Low productivity, especially of tubewells; canal water distribution fairly equitable but marked inequity between heads and tails of tubewell commands and between larger and smaller farmers; very low levels of O and M costs and cost recovery.

Reasons:

(a) *Design:* Old inflexible (but cheap) canal design; very large watercourse and tubewell commands; failure to enlarge watercourse channels to accommodate much increased water flows after tubewell installation.

(b) *Org./admin. framework:* Divided responsibility for water distribution between separate canal and tubewell units, each with different geographical coverage; detailed (but old) manuals for canal management, none for tubewell management; rigidly stratified staffing structure, promotion by academic qualification, senior staff liable to frequent transfer; inadequate O and M funding, farmers' water charge payments (to general revenue) unlinked to allocations for O and M expenditure (from general revenue); adequate canal legislation.

(c) *Performance of key main system activities:* Canal water distribution — straightforward task satisfactorily executed; conjunctive planning and management of canals and tubewells very unsatisfactory; tubewells badly operated and maintained (inadequate procedures; limited skills, poor motivation); little communication with water users about water schedules, little watercourse supervision, no management training.

(d) *Watercourse and field level management:* Little social cohesion, frequent factionalism, no water users' associations but periodic *ad hoc* maintenance arrangements; rotational irrigation schedules set by canal department but often disregarded, specially by larger farmers.

Scheme B:
(229,000 ha, 840 mm. rainfall, single canal system).
Performance:
Low productivity; water distribution very inequitable between head and tail of main canal (with watercourse command cropping intensities varying from 140% to 40%) and within watercourse commands; serious waterlogging and erosion, very low levels of O and M costs and cost recovery.
Reasons:
(a) *Design:* No drainage despite problem soils; watercourses left to farmers to construct despite uneven microtopography; difficulties of conveying water to farm led to numerous illegal outlets in head reaches, reducing flows to tail; crude uncontrolled watercourse pipe outlets; canal system designed for proportional water allocation, with few control structures, when controlled differential or zonal cropping patterns probably were appropriate.
(b) *Org./admin. framework:* Single Command Area Authority, including wings for canals, drainage, watercourse development and agricultural extension; canal staff responsible for major rehabilitation work as well as O and M; crude water distribution procedures; stratified staffing structure, promotion by academic qualifications, seniors liable to frequent transfer; inadequate O and M funding, water charge payments unlinked to O and M expenditure allocations; canal legislation largely unenforceable.
(c) *Performance of key main system activities:* Attempts to improve the canal operation in very difficult circumstances, but inadequate procedures, limited skills and (apart from public complaints by agricultural extension staff) limited motivation; major watercourse rehabilitation programme being initiated; premature (token) creation of formal watercourse rotation groups.
(d) *Watercourse and field level management:* Chaotic, but little scope for formal reorganisation until main system and watercourse rehabilitation completed.

Scheme C:
(33,000 ha, 1940 mm. rainfall, multiple canal system.)
Performance:
Fairly high productivity, but potentially higher; water distribution inequitable between small upstream systems (two rice crops) and larger downstream systems (limited dry-season rice); within downstream systems, great variations in areas of dry-season rice

cultivation and cropping intensities (100% to 51%): rising O and M costs and substantial land tax.

Reasons:

(a) *Design:* No major deficiencies, but some measuring structures inadequate.

(b) *Org./admin. framework:* Unclear objectives regarding priorities of rice versus non-rice crops in dry season; irrigation agency (river catchment-based) independent of agricultural extension agency (local government-based); detailed and complex canal management procedures; stratified staff; O and M funding approaching adequacy, farmers' land tax payments unlinked to O and M expenditure allocations; canal legislation apparently adequate.

(c) *Performance of main system activities:* Canal operation, requiring differential allocations to watercourses according to local variations in cropping pattern, marred by insufficient technical skills (in planning, water measurement, crop area estimation, monitoring) and by users' pressures to misallocate, regular discussions with water users' representatives about water demand and supply; limited, largely informal, water management training.

(d) *Watercourse and field level management:* Strong village organisations with specialised watermasters and staff, whose O and M services are paid for by farmers; water distribution practices sophisticated though not always equitable; minor channels well maintained; field-level water management skills (for rice and non-rice crops) very high.

Scheme D:

(67,670 ha., 1550 mm. rainfall, multiple canal system with some supplementary public tubewells).

Performance:

High productivity; water distribution equitable within differently entitled zones, some of them with prior water rights; high levels of O and M costs and cost recovery.

Reasons:

(a) *Design:* Problems of operating large canal system owing to dependence on temporary diversion structures, but apparently no economic alternative; no major unplanned deficiencies.

(b) *Org./admin. framework:* Irrigation agency (river catchment-based) independent of agricultural services agency (market town-based), but both associations with farmer membership; detailed manuals for operation, maintenance, water management training,

financial management personnel training, etc.; all staff (mostly long-term association employees) offered good opportunities for upward mobility, infrequent transfer, promotion by experience and performance; adequate O and M funding, association's O and M budget directly dependent on farmers' service fee payments; detailed canal legislation.

(c) *Performance of main system activities:* Water distribution, maintenance, watercourse supervision and training very well performed (clear, well researched procedures; appropriate skills acquired on the job and by in-service training; strong motivation, staff salaries and bonuses being dependent on farmers' payments).

(d) *Watercourse and field level management:* Well-organised small groups at the 150 ha level with elected leaders with responsibilities for watercourse O and M; regular meetings with association staff; detailed procedures for water distribution developed with association; water management practices apparently very good at watercourse level, excellent at field level.

Questions answered by the research study

I leave it to others to decide how successful the study has been in its objective of developing a generally applicable method of evaluation; my own hope is that while there is still plenty of room for improvement on points of detail, the proposed approach can be accepted as broadly correct and operationally useful. Meanwhile, I have no doubt that the four case studies provided clear answers to certain more specific questions. Important conclusions to emerge were these:

(a) Deficiencies in main system management were a significant cause of poor performance on schemes A, B and C.

(b) On A and B, deficiencies in system design were also significant causes of poor performance; on A, the deficiencies were largely confined to the watercourse level but on B they extended throughout the system.

(c) On the very large South Asian schemes A and B, communication and co-operation among different service agencies were much superior where their activities were coordinated by a single CAD (Command Area Development) Authority (B) than where they were operating as independent line departments (A).

(d) Comparison with the successful scheme D pointed up numerous other weaknesses on the other three schemes, both in their overall

framework and their management processes, and suggested the directions in which management reform programmes in those cases would need to go.

(e) At the time the studies were carried out (1976 and 1977), official programmes for the development of Schemes A, B and C made no provision at all for improving main system management; the investments associated with these programmes, being based on faulty diagnosis, were therefore wrongly targeted and were in some cases of very doubtful value.

These points are amplified in the paragraphs that follow.

Main system management deficiencies

The presence of significant deficiencies in main system management on Schemes A, B and C implied the need for programmes of management reform. On A there was an obvious case for radical changes in current methods of tubewell management and of conjunctive operation of canals and tubewells as well as for improvements in watercourse layout and organisation. On B the scope for improved main system operation was limited by severe physical and technical problems but it was not negligible; and considerations of system operation should have played an important part in rehabilitation plans, since different assumptions about future cropping patterns and their water requirements had different implications for system re-design. On C it appeared that better main system management should be the key element in any improvement package; there might also be significant benefits from physical and organisational improvements at the watercourse level, but the likely extent of those benefits and the precise kinds of investment required to produce them could only be confidently determined in the context of an integrated whole system programme.

Design deficiencies

The very serious mistakes in planning and design on Scheme A (failure to provide for watercourse enlargement to accommodate increased water supplies from tubewells) and Scheme B (absence of drainage and watercourse development, deficiencies in the main system design assumptions) can be ascribed to the same causes as have been at the root of poor system management. Poor design and poor management are in effect two sides of the same coin. Where major mistakes in design have been made they have nearly always been associated with a

failure to think in detail how the system concerned is going to be operated; good design, on the other hand, has been based on detailed investigations into farm level irrigation practices and water requirements and careful thought about water distribution procedures.[14] A common characteristic of badly planned and designed irrigation schemes is that the decision-making process has been dominated by civil engineers employing crude design criteria, such as the 'duty' concept which has been used for decades in southern and central India;[15] there has been little reference to agriculturists (whose research stations are in turn frequently out of touch with what is happening in the farmers' fields), to economists or to other social scientists.[16] And of course the same political factors which interfere with good water distribution often have still more far-reaching and damaging effects at the project planning and design stage. This interference is commonly manifested in the extension of a canal system 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.[17] Programmes to improve irrigation planning and design should logically be developed hand in hand with programmes to improve irrigation management. On the technical side, key elements required include new structures and procedures for interdisciplinary planning and new training programmes; on the political side, the task must be to provide independent outsiders with better access to information about planners' decision-making processes in the interests of greater public accountability.[18]

Coordination of support service activities

Others[19] have also commended the form of CAD structure adopted in Rajasthan in which a comprehensive range of services (including canal construction/O and M drainage construction/O and M watercourse development, agricultural extension) is coordinated under a single Area Development Commissioner. Although the structure is not yet ideal (for example, staff are seconded, not permanent; operation and construction/maintenance functions are not differentiated; coordination of services is insufficiently decentralised to geographical sub-units within the sub-scheme), the flaws should be remediable. Its two great merits are that the combination of engineers and agriculturalists within a single organisation obliges each group to understand the others' work and, in particular, puts pressure on the water distributors to respond to the demands placed on them by the

agriculturalists on the farmers' behalf; and that the same organisation is responsible for both main system water distribution and watercourse development, i.e. it demands a 'whole-system' perspective. In many other Indian States where CAD organisations have been concerned with the development of only one part of the system — below the watercourse outlet — they have tended either to be ineffective or else to create appalling tensions between themselves and independent irrigation departments with separate responsibility for main system distribution.[20] If there is a tendency in certain parts of India to decry CAD as a failure, it is important that the more radical and well-coordinated variants of CAD should be distinguished from the partial, fragmented variants and not be included in a blanket condemnation. I see CAD as an organisational framework which deserves to be encouraged elsewhere.

Lessons from Scheme D

Though in no way to be regarded as a blueprint model capable of instant transfer elsewhere, Scheme D does have important lessons to offer to the other three and suggests the general direction of change in which jointly managed irrigation schemes in other parts of Asia could be encouraged, step by step, to go.[21]

These have been some of the principal ingredients of its success:

(a) Water distribution has been placed at the centre of irrigation management and is seen as essentially an agricultural, not a civil engineering function (so that there are two distinct and differently trained cadres for water distribution/conflict management/water management extension on the one hand and for construction/maintenance, on the other.[22]

(b) The design of irrigation systems and the procedures for operating them have been built up from detailed empirical observations of farmers' actual water management practices in the field.

(c) The basic framework for management (not only water distribution but all key activities) has been carefully developed by higher-level planners in the form of detailed procedures which can be easily adapted to local circumstances and readily understood and applied by relatively unsophisticated field staff: intelligent central planning has facilitated decentralised management.

(d) While the basic rules of irrigation management developed by the planners impose a wide range of disciplines and constraints on water users, they are at the same time sufficiently flexible to allow

many local variations in practice, especially on formerly 'indigenous' systems which have been incorporated into larger schemes, and traditional water rights are scrupulously respected.

(e) Finally, there is the crucial difference between Scheme D's methods of financing and those of the other three. Under the conventional bureaucratic patterns of financing there is no direct link between the water charges farmers are expected to pay to general revenue and the level of investment which goes back from general revenue into the O and M of the particular irrigation systems they depend on. They therefore have no incentive to pay what is just another tax. This ensures that main system O and M is always chronically underfinanced; and the farmers have no way of making irrigation staff accountable to them. In scheme D, however, farmers pay a service charge to their local association, which retains it for reinvestment in their own system. This leads to a completely different relationship between farmers and staff, in which staff become beholden to the farmers' goodwill for their salaries and bonuses, and farmers have an incentive to pay higher charges in order to get better service. By these means (which are of course the same as farmers themselves employ on communally operated schemes) the problems of underfinancing and lack of accountability are both overcome — or at least greatly mitigated.

Gaps and biases in development programmes

Despite the deficiencies in main system management identified on Schemes A, B and C, development programmes at the time the studies were carried out ignored the problem. Programmes in A and C focused exclusively on rehabilitation and reorganisation at the watercourse level. In B important questions about water distribution were submerged under the mass of other (much needed) physical and organisational changes which were taking place. The exclusive focus on watercourse development in scheme C and on other schemes in the same country was particularly unfortunate since it was far less clear than on A and B that major investment of this kind by government was required, even if it had been accompanied by improvements in main system management. In contrast to A and B, farmers were already well organised for watercourse O and M and networks of tertiary and quaternary channels were relatively well developed in many areas. It was nevertheless assumed that the key to better water utilisation was a nationwide tertiary development programme. This is

a highly centralised government programme carried out on a 100% subsidy basis; design work is done by consultants and construction work by contractors. The centralisation of planning and financing has meant that a standard approach has been applied irrespective of local variations in topography, water scarcity or drainage conditions; and attempts have been made to set up standard water users' associations where traditional institutions already exist. The programme has never been systematically evaluated but the results may be most politely described as mixed, and some areas may even be worse off than before. Farmers in those areas and the government which has had to pay for the programme may both be seen as victims of an international fashion for watercourse (or 'on-farm') developments. Happily, there have recently been signs of change in official perceptions. Main system management has begun to emerge as a subject for discussion in all three countries concerned — particularly India, where a national conference on operation and maintenance of canal systems was held in 1980[23] — and initial action programmes have either started or are being contemplated.

The last paragraph is not meant to imply criticism of watercourse improvement programmes as such. It is, however, a reiteration of the plea for such programmes to be preceded by a whole system evaluation to identify whether there are other activities which need to be undertaken in advance or concurrently. I have no quarrel with research and action programmes which take watercourse problems as their starting-point but at the same time address themselves to main system management issues: e.g. the programme to introduce Warabandi in Sriramasagar Project which has led farmers to put increased pressure on water distribution staff to improve their service.[24] Such programmes fulfil the requirement of being based on a whole system approach. Whether the starting-point is the main system or the watercourse is immaterial.

Unanswered questions: the case for action research

All the main questions which could not be answered were in some way related to problems of quantification. First, we found it impossible with the time and manpower at our disposal to make accurate estimates of the productivity of water in any of the field study areas. We were also unable to attach figures to the estimated technical potential of a given irrigation system. And finally, after identifying the various factors which we judged to be the most important

explanatory causes of scheme performance, we were unable to assign precise weights to each factor.

While it would be helpful to be able to develop better techniques for estimating productivity of water and system potential, provided they are cost-effective, I would strongly urge researchers to resist pressures to include quantitative estimates of the causes of scheme performance in their evaluations. All that is needed at the end of an evaluation of the kind recommended here is a reasoned and detailed argument which reviews the evidence collected (much of it unquantifiable) and draws attention to the most important factors identified under the three main headings of (a) technical design (at both main system and watercourse levels), (b) watercourse management, and (c) main system management. Where the evidence strongly indicates that significant benefits could come from management reform, recommendations for action should be presented in ascending order of political and administrative feasibility, i.e., with priority given to those measures likely to be most easily implementable in the short term. A typical sequence of improvement measures might be:

(a) procedural reforms;
(b) technical and management training;
(c) establishment of representative water users' associations at watercourse levels and above;
(d) changes in practices governing staff promotion, transfer, etc.;
(e) major changes in organisational structure of scheme management;
(f) changes in methods of payment for irrigation services.

Although strongly favouring the measurement of likely benefits of improved system management at a later stage of the research process, there are two main reasons why I believe pressures to quantify causes at the initial evaluation stage should be firmly resisted. The first is that the task is by its nature virtually impossible. As the results of the four case studies show, causes are multiple, complex and interrelated: design and management weaknesses at both main system and watercourse levels often occur together and stem from the same basic causes. Trying to disentangle the web of causation through some kind of multiple regression analysis would be unhelpful to decision-makers and a great waste of valuable research time. The object of an evaluation is, after all, only to identify the likely causes and remedies; the researcher can only make intelligent inferences and, not being omniscient, should not feel obliged to provide irrefutable proof for his

conclusions.

The second reason for resisting pressure is that those trying to apply it — who are most likely to be engineers or planning economists — have no right to place the burden of proof on the researcher or to make him feel defensive about his inability to do the impossible. Rather it is they who should be pressed by the researcher to prove that his evidence of organisational and management weaknesses is not significant. Pressure to quantify the unquantifiable is the result either of ignorance as to what constitutes evidence or else of an unwillingess to accept the implications of the researcher's arguments. If the people concerned don't understand or don't want to understand the validity of qualitative evidence about organisational structure and management processes, they must be made to learn. The researcher should also point out to them the faultiness of conventional arguments which rely on quantification alone and conclude from (precise) water loss measurements that channels must be lined and/or farmers better organised.

The time to start measuring system management and its potential benefits is after an evaluation has been completed and policy-makers have been persuaded by it that there may be something worthwhile to be got out of management reform. In such an event a common scenario is likely to be that some people in government, while intrigued by the possibilities of management reforms, will still be sceptical of the benefits likely to be realisable from them; others with vested interests will be opposed to them; and the research team will also be genuinely uncertain as to the likely benefits (and costs) of reform measures. The needs of such a situation will best be met by a programme of action research. By 'action research' is meant a pilot action programme involving experiments in alternative management methods which a research team helps design and monitor, with a view to the subsequent replication of a particular approach on a larger scale after careful field tests have shown it to be viable. So far very little systematic action research on main system management has been attempted, but the little that has — mainly by IRRI in the Philippines[25] — has produced results which indicate the possibility of very high returns in those conditions from a combination of new operating procedures and minor improvements to control structures. Action research programmes, if successful, can provide excellent contexts for staff training. They are not likely to be easy to design or execute, however, and much of their success will depend on close collaboration between the research team and the action team — the

officials and field staff who are responsible for putting the experimental management methods into operation. Some of the more insidious pitfalls to be avoided are discussed by Lenton[26] and Bottrall[27]. Encouraging signs of interest in action research as a means towards improving management at both main system and watercourse levels have recently been shown by several South and Southeast Asian governments.

Wishes in retrospect

If I had known when starting the study how difficult it would be, I should never have undertaken it. On the other hand, the very fact that irrigation management is such a complex cross-disciplinary subject, combined with my initial ignorance of many aspects of it and the paucity at that time of other research with a similar perspective, had the advantage that I was obliged to work out many problems of analysis and presentation for myself. Though this involved some unnecessary reinventing of wheels, it also meant that I was not exposed to the dangers of too glib acceptance of established methods and theories. However, in retrospect, apart from some differences of opinion between my sponsors and myself (which were themselves not without educational value), the single factor which I regret most is that I did not have a better command of organisation and management theory from the start. This is not because it would have provided blinding insights into aspects of human behaviour which were otherwise denied me but because it would have helped me to organise my evidence more systematically. Two advantages would have followed: I would have spend less time puzzling over the logical connection between different elements of organisational structure and management process; and as a professional rather than an amateur, I should have been more effective in arguing with specialists of other disciplines about methodological and other issues.

The study could also have benefited from the presence of an additional person during the field investigations who would have been responsible for more detailed research at the watercourse and farm levels. There were certain stages in the study when the need to concentrate on the detailed workings of the irrigation bureaucracy produced a tendency to look at problems and solutions too much from the top down, without giving enough attention to the potential for reform through greater farmers' participation in management decisions at both the watercourse and main system levels. This

weakness was, I hope, rectified by the end of the study; but it could have been avoided with extra manpower.

Implications for other researchers

In its objectives, its focus and its methods the approach to research advocated here differs substantially from some of the more orthodox approaches to social science research on irrigation. In arguing that it should be much more widely applied I do not wish to imply that there is not at the same time an important need for more orthodox (and scholarly) research. On the other hand, it may be useful to conclude by considering some of the difficulties likely to be encountered by anyone working for the first time in this mode.

What are the distinctive features of this kind of research? First, its objectives are explicitly policy-oriented: its purpose is to feed directly into government thinking and to influence its decisions in the short term as well as the medium and longer term. Its focus must be the irrigation scheme as a whole (within the still larger context of a nation's political and administrative system) and, in the search for causes of performance, particular attention should be paid to analysing the structure and processes of main system management. Its important features are that it is interdisciplinary, requires close contact with government agencies, and may eventually involve action research.

My expectation is that, during the evaluation stage and still more during the action research stage, the most difficult — or at least unfamiliar — aspects of this approach for many social scientists would be these:

(a) It calls for a different kind of relationship between the researcher, on the one hand, and the government and its field agencies, on the other. Government may often commission the research in the first place; or if the initiative is taken by the researcher, some degree of collaboration must be established if access is to be gained to certain essential information.

(b) Government staff are also the objects of research. This calls for a capacity on the researcher's part both to analyse and try to understand the actions and motives of members of the bureaucracy. This means, on the one hand, a practical knowledge of organisation and management theory (or at least those parts of it which are relevant to irrigation management) and, on the other, a willingness to put oneself in the shoes of those one is studying;

in other words, to adopt the same kind of social anthropological approach which is commonly used to study water users but hardly ever irrigation staff. And when it comes to action research, it is an essential requirement of success that research teams and field staff work together as close associates.[28]

(c) It calls for interdisciplinary thinking, usually as a member of a multidisciplinary team. In many countries, the same over-specialisation which is found within government and is manifested in lack of communication between departments, is reflected in the academic world: civil engineers work in different institutions from agriculturalists, economists, other social scientists. Getting effective research teams together may sometimes be a problem.

(d) And it is not, at least at present, a professionally rewarding form of activity for most kinds of academic social scientist.[29]; PhDs are not usually awarded for relatively rapid evaluations of irrigation management or for participation in action research programmes. The climate may now be already changing, however, particularly now that more institutes of management and public administration are being drawn into the agricultural and irrigation field and have begun to link up with engineers, agriculturalists, economists and other social scientists.

Notes

1. *Comparative Study of the Management and Organisation of Irrigation Project,* World Bank Staff Working Paper No.458, May 1981.
2. See B.B. Vohra, *Land and water management problems in India,* Training Vol. No.8 Training Division, Dept. of Personnel and Administrative Reforms, Cabinet Secretariat, New Delhi, 1975.
3. For example, A. Maass and R.L. Anderson, '. . . *and the Desert Shall Rejoice: Conflict, Growth and Justice in Arid Environments,* Cambridge, Mass., MIT Press, 1978; E.W. Coward Jr. (ed.) *Irrigation and Agricultural Development in Asia: Perspectives from the Social Sciences,* Ithaca and London, Cornell University Press, 1980, pp.31, 147.
4. A.F. Bottrall, 'The management and operation of irrigation schemes in less developed countries', *Water Supply and Management,* 2, 4, 1978, and 'Technology and Management in Irrigated Agriculture', *ODI Review* 2, 1978; R. Wade and R. Chambers, 'Managing the main systems: canal irrigation's blind spot', *Economic and Political Weekly* (Bombay), 15, 37, 1980.

5. I was usually perceived as being 'from the Bank'. In some cases officials clearly believed that co-operation might earn them and their country credit with the Bank which could be drawn on at a later date. In others, field staff (and farmers) linked information about deficiencies in the system with direct requests for financial assistance to remedy them.
6. V.N. Asopa *et al.*, *Irrigation System, On-Farm Development and Extension Service in Chambal Project, Rajasthan*, Ahmedabad, IIM, 1978.
7. For example, in India, R. Wade, 'Water supply as an instrument of agricultural policy', *Economic and Political Weekly*, 13, 12, 25 March 1978; N. Pant, 'Some aspects of irrigation administration (a case study of Kosi Project)', Patna, A.N.S. Institute of Social Studies, 1979; K. Palanisami, 'An economic evaluation of the working of the major surface irrigation systems in Tamil Nadu — a case study of Parambikulam Aliyar Project', Dept. of Agricultural Economics, TNAU, Coimbatore, 1980.
8. Such as Syed Hashim Ali, 'Practical Experience of Irrigation Reform Andhra Pradesh, India', Discussion Paper 153, Institute of Development Studies, University of Sussex, September 1980; Syed Turabul Hassan, 'Farmers' organisation', paper for workshop, IIM, Bangalore, August 1980; T. Jayaraman, 'Implementation of warabandi: a management approach', in *Government of India Report* No. 146, November 1980; A.K. Sinha, 'Formulation and appraisal of agricultural projects: a case study', *Indian Journal of Agricultural Economics*, 33, 4, October-December 1978.
9. Bottrall, *Comparative Study, op.cit.*, pp.236-9, see Appendix for details.
10. For an extended discussion of the relative importance of design and management as factors influencing irrigation system performance see R. Jurriens *et al.*, 'Evaluation of Irrigation Design — A debate', Irrigation Management Network Paper 9b, ODI, April 1984.
11. M. Lowdermilk, A. Early and D. Freeman, 'Farm irrigation constraints and farmers' responses: comprehensive field survey in Pakistan', Water Management Technical Report No.48 (6 vols.), Colorado State University, 1978.
12. R. Wade, 'The social response to irrigation: an Indian case study', *Journal of Development Studies*, 16, 1, 1979; T. Wickham and A. Valera, 'Practices and accountability for better water management', in D. Taylor and T. Wickman (eds.), *Irrigation policy and the management of irrigation systems in Southeast Asia*, ADC, Bangkok, 1979.
13. See Bottrall, *Comparative Study*, *op.cit.*, pp.34-51 for details.
14. G. Levine, 'The management component in irrigation design and operation', *Agricultural Administration*, 4, 1, 1977.
15. S.K.S. Hussain and N. Seetharamaiah, 'Water use concepts as design criteria for irrigation systems: case study of Nagarjunasagar Right Canal', paper for Commonwealth Irrigation Management Workshop,

Hyderabad, October 1978.

16. Cf. Sinha's comments on three schemes developed by the Haryana Irrigation Department in the late 1960s 'though they were primarily agricultural projects', *Indian Journal of Agricultural Economics*, 33, 4, . . . not . . . as inter-disciplinary exercises. No economist, agricultural economist or management expert participated in the process of formulation', Sinha, *op.cit.*, p.241.
17. For a fairly modest example, see Madras Government, Public Works Department, *History of the Lower Bhavani Project*, 1966, pp.14-15, 165-9.
18. A. Vaidyanathan, 'Report on identification, appraisal and evaluation of agricultural projects' *Indian Journal of Agricultural Economics*, 33, 4, October-December 1978, p.284: Jurriens *et al.*, *op.cit.*
19. For example, K.K. Singh, 'Alternative organisational strategies for Command Area Development' in Commonwealth Secretariat, *Proceedings of Commonwealth Workshop on Irrigation Management*, Hyderabad, October 1978.
20. See, for example, Ali, *op.cit.*
21. Cf. M. Abel, 'Irrigation Systems in Taiwan: Management of a Decentralised Public Enterprise', *Water Resources Research*, 12, 1976.
22. Recommendations have recently begun to be made in India for the development of a new cadre with specialised responsibilities for water distribution and management (see Y.K. Murthy, 'The irrigation engineer and the farmer', 5th Bhaikaka Memorial Lecture, Institution of Engineers, Calcutta, February 1980. p.10; and T. Jayaraman, 'Multiple cropping and crop diversification', *Commerce*, Annual Number 1979, p.93).
23. New Delhi Central Board of Irrigation and Power, 'Symposium on operation and maintenance of canal systems', Publication No.144, April 1980.
24. K.K. Singh, 'Warabandi in canal commands: concept and practice', in Central Board of Irrigation and Power, 'Warabandi for irrigated agriculture in India', Publication No.146, November 1980.
25. A. Valera and T. Wickham, 'Management of traditional and improved irrigation systems: some findings from the Philippines', FAO *Farm Management Notes*, 5, 1978; and A. Early, 'An approach to solving irrigation system management problems', paper to Irrigation Water Management Workshop, IRRI, 26-30 March, 1979.
26. R. Lenton, 'Field experimentation and generalisation in irrigation development and management', AAU Irrigation Management Network Paper 2/80/1, ODI, 1980.
27. A. Bottrall, 'Action research towards improved water distribution', AAU Irrigation Management Network Paper, 1/81/2, ODI, 1981.
28. B. Bagadion, F. Korten, D. Korten, *et.al.* 'Promoting participatory management on small irrigation schemes: an experiment from the

Philippines', AAU Irrigation Management Network Paper 2/80/2, ODI, 1980.

29. See, for example, V. Vyas, 'Academics and rural development: lessons from the Dharampur project', Working Paper 286, Indian Institute of Management, Ahmedabad, 1979.

5

Evaluating Irrigation Management: Guidelines for Analysis*

Part I: Inventory of 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 m^3 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

*Originally appeared as Appendix in *Comparative Study of the Management and Organisation of Irrigation Projects*, World Bank Staff Working Paper No.458, 1981.

2.10 Cropping pattern/cropping intensity for which system has been designed)
2.11 Monthly canal discharges in selected years (m^3)
2.12 Canal roads (and public roads)
2.13 Workshops

(ii) Wells/(similar information to be collected for low-lift pumps)

(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
2.18 Maximum pumping capacity — total (cumecs) and per well (lit/sec)
2.19 Maximum permitted/planned annual pumpage (million m^3)
2.20 Maximum permitted/planned water availability per ha (lit/sec)
2.21 Actual annual pumpage in selected years (m^3)
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 categories, 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):

Crop	ha cultivated	Irrigation dates 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, co-operatives 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) organisations.

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
5.6 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 co-ordination (e.g. single Area Commissioner, co-ordinating 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 (centralised/dispersed)

7. Supporting services

7.1 Transport facilities:
(i) Number and type of vehicles owned by project agency/agencies
(ii) Number and type of vehicles 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 Performance

9. 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 Variations 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) see 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 of Performance

(A) 'Non-management' factors

15. Limitations in planning and design process, eg.

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

16. Other exogenous factors

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

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?

— 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 organisational structure — vertical

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

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

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

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 specialised activities

22. 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

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

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

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

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

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

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?

28.4 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

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

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 specialised 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

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-levelling; 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

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 29)

— Adequacy and predictability of water deliveries to watercourse outlet (Sections 23-26)?

33. At the project level

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?

The Agricultural Administration Unit (AAU) was established at ODI in September 1975, with financial support from the Ministry of Overseas Development (now ODA).

The aim of the AAU has been to widen the state of knowledge and the flow of information about the administration of agriculture in developing countries. It does this through a programme of policy-oriented research into selected subject areas and the promotion and exchange of ideas and experience in four international 'Networks' of individuals directly involved in the implementation of agricultural development. The four Networks are concerned with Agricultural Administration, Irrigation Management, Pastoral Development, and Social Forestry. Members are drawn from a wide range of nationalities, professional backgrounds and disciplines.

This is the fifth in a series of Occasional Papers intended to disseminate research findings to a wide audience in an easily accessible format. Occasional Paper 3, *Institutions, Management and Agricultural Development*, and Occasional Paper 4, *Enlisting the Small Farmer* are also available from ODI.

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