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PROJECT ON AGRARIAN CHANGE IN RICE-GROWING AREAS OF TAMIL NADU AND SRI LANKA

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The Organisation and Operation of Irrigation: An Analysis of Evidence from South India and Sri Lanka

by
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1. Introduction

The purpose of this paper is to present and open up some of the questions and issues raised through comparing irrigation systems in parts of North Arcot District in South India and parts of Hambantota and Moneragala Districts in the Southeast Dry Zone of Sri Lanka. The fieldwork during which much of the evidence was collected was carried out in Sri Lanka in 1973 and in India in the first half of 1974. It was extensive rather than intensive, involving day visits[1] to a fairly wide variety of irrigation systems, most of them in the Indian villages and Sri Lanka Cultivation Committee areas which were simultaneously being surveyed as part of the Project. In Sri Lanka, in addition, visits were made to two major irrigation systems - Gal Oya and Uda Walawe - and discussions were held with government officials both there and in Colombo. The method of short visits unavoidably required reliance on informants' statements of irrigation practices rather than observation of their being carried out. There are thus a number of "facts" reported in this paper which should be, but are not, heavily qualified with cautious and tentative footnotes. The reader is asked to bear in mind this limitation. Moreover, the villages and Cultivation Committees were selected according to criteria which were not related to types of irrigation system (see Chinnappa 1974). Argument and analysis referring to major irrigation in the Dry Zone of Sri Lanka have been presented in two previous papers (Chambers 1974a and b) which will not be repeated in this paper. The approach here is more comparative, considering both Indian and Sri Lankan irrigation, on both large and small scales, and with particular attention to the rather neglected aspects of the organisation, operation and political economy of irrigation. The aim is to see whether such analysis can make progress in developing theoretical-cum-practical ideas about these subjects.

A basic premise is that water is a scarce resource, the benefits from which should be optimised in relation to other scarce resources. In the Dry Zone of Sri Lanka there is much evidence that water is more limiting than land (Chambers 1974a: 19ff) although scarcities of draught power and labour are also constraining (Harriss 1974) and may in some senses and in some situations be more constraining than water. In parts of North Arcot District the scarcity of water is even clearer and more acute than in Sri Lanka. Surface irrigation water from tanks is often inadequate for a second crop and the groundwater level appears to be subject to a secular decline of increasing seriousness as groundwater extractions increase, wells are increased in numbers, and pumpsets are installed (see Bandara 1974a: and b). The distribution of water between irrigators and the productivity of water must therefore be matters of concern, increasingly so as population presses more and more on the resource combinations available for food production.

Irrigation No Man's Lands

The literature on irrigation which has been scanned, and the preoccupations and perceptions of those most concerned with irrigation - engineers and agriculturalists - are remarkable for the extent to which they not only ignore but even appear to be unaware of several interlinked aspects of irrigation. It is rare indeed to find any serious consideration of the middle and lower levels of irrigation organisation and operation, of the detailed procedures for irrigation control, of the actual behaviour of the actors at those levels, of, in short, management aspects of irrigation, referring to the management of men - of those who manage the water. Of this neglect there may even be as many examples as there are reports on irrigation. Some recent

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[1] I am very grateful to those, notably Madduma Bandara, Nanjamma Chinnappa, John Harriss, K. Ramachandram, V. Rengarajan and B.W.E. Wickremanayake whose collaboration, local knowledge, linguistic skills and patience made these investigations and visits possible, besides enjoyable.

instances can be cited by way of illustration. These are four reports selected from those listed under "irrigation" in a library as being among those most likely to include consideration of these management aspects.' First, the report of the working group for the formulation of Fourth Five Year Plan proposals on soil and water management under irrigated conditions in India (ICAR 1966) is entirely technically oriented, has no place for any social scientist on any research station and proposes no research on organisational aspects of irrigation or on the management of the staff who manage the water. Second, a report of an irrigation programme review in Ceylon (part of an IBRD/FAO co-operative programme) (MPEA Colombo 1968) is overwhelmingly oriented towards capital works and the planning and execution of capital projects, and while recommending that there should be many more extension staff and stating the need for co-ordination at the field level, does not go into any detail about the procedures for achieving this. This, be it noted, was in spite of terms of reference which included to "review and recommend on institutional, organisational, managerial and technical measures required to ensure successful execution and operation of existing and future projects" (my underlining). Nor were the operational and organisational aspects of water management and their economic and social implications a concern of an international seminar on "Economic and Social Aspects of Agricultural Development in Irrigated Areas" held in Berlin in 1967 (German Foundation for Developing Countries 1967). Finally a recent publication of the National Commission on Agriculture in India dealing with modernising irrigation systems and integrated development of commanded areas, shows much the same blind spot: it embodies a top-down view of irrigation and does not deal with operational detail (Government of India, 1973).

There are several reasons for this neglect (see also Chambers 1974a: 2-8 for a fuller discussion). First, the common preoccupation with capital investment, construction and settlement processes at the cost of the vital operating processes which follow. Second, cramped vision from within narrow disciplinary boundaries, mutual ignorance between the social scientists and the technologists and a reluctance to explore a no man's land between disciplines. Third, the intensity of research required to explore what happens at the lower levels of administration and difficulties in generalising from one or a few cases, which are all that one researcher can perhaps hope to examine in realistic detail. Fourth, the maddening nature of water itself, with its tendency to flow, seep, evaporate, condense, and transpire, and the problems it presents in measurement. These tie down natural and physical scientists to research-intensive tasks, denying them time, even if they had inclination, to branch out and examine wider aspects such as the people who manage the water and how they behave.

There are, in fact, several gaps in knowledge. Geographically, there is a gap between the last point at which water is measured or officially controlled and the point at which it enters a farmer's field. Organisationally, there is a gap in knowledge between what happens at the level of senior officials and what happens in the community which receives the water. Politically, there is ignorance of the processes of decision-making and allocation which influence the timing and quantity of water which a farmer receives. From the point of view of political economy, there has not been much analysis of who gets what, how, when and why, and with what costs and benefits. From a human management point of view, there is a gap in perception, a blindness to the problems and opportunities of managing those who manage the water, the people in organisations and communities.

This paper will not fill these gaps. Rather it represents some rather nervous, short-sighted and uncertain steps among the minefields of the inter-disciplinary no man's land which these gaps represent. But it will serve its purpose if it encourages others to explore further and better.

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Typologies of irrigation

It seems sensible to begin by trying to map out the land and identify useful features and categories.

The descriptive terms used by engineers and to a lesser extent by agriculturalists tend to dominate discussion of irrigation systems. This is partly because they themselves have such key roles in irrigation. Partly too it is because their categories refer to physically observable phenomena such as structures, field layouts, and methods of water application. It is by no means a foregone conclusion that these categories will be the most useful ones for an analysis of the organisation and operation of irrigation. Initially, however, by way of exposition and description, we can start by classifying the irrigation systems encountered in Sri Lanka and India in terms of their more obvious physical characteristics.

In that part of the Southeast Dry Zone of Sri Lanka (Hambantota District and part of Moneragala District) with which we are concerned, almost all irrigation is by surface gravity flow, most of it from storage tanks. Tank water is received from various combinations of catchment runoff and river diversion. Scarcely any wells are used for irrigation. The commonly used classification of gravity flow irrigation into "major" and "minor" corresponds with differences in scale and organisation, not with differences in physical type of source, conveyance or storage of water. The management of water under major irrigation is the responsibility of the Territorial Civil Engineering Organisation (TCEO) which distributes it down to the field channel level. Water management on minor irrigation is the responsibility of village communities which organise their own distribution systems. Under a major irrigation project there are usually several Cultivation Committees of cultivators (roughly corresponding to Indian villages), whereas under minor irrigation there is usually only one.

Using the more obvious characteristics of scale and type of water source and storage, the Cultivation Committees in our sample can be classified as follows:

Cultivation Committee	Minor/ Major	Water source	Storage system
Kachchigala	Minor	Small catchment run-off	Small tanks
Methigatwala	Minor	Small catchment run-off (now supplemented by major irrigation)	Small tanks
Kataragama	Minor	Small catchment run-off	Small tank
Tenagama	Minor	Small catchment run-off and spills of higher tanks with small area sometimes supplemented by major irrigation	Small tanks in series, close together
Wellawaya	Minor	Anicut and channel from permanent stream	Nil
Hanganwagura) Jansagama) Rotawala)	Major (WRB)	Anicut and long channel from Walawe river with perennial flow	Nil
Jayawickremayaya	Major (KOLB)	Anicut and channel to tank from Kirindi river (water not always available)	Tank (Debarawewa)

Cultivation Committee	Minor/ Major	Water source	Storage system
Kachcherigama	Major (KOLB)	Anicut and channel to tank from Kirindi river (water not always available)	Tank (Tissawewa)
Udasgama	Major (KOLB)	Anicut and channel to tank from Kirindi river (water not always available)	Tank (Tissawewa)
Companniwatta	Major (KORB)	Anicut and channel to tank from Kirindi river (water not always available)	Tank (Wirawila)

WRB = Walawe Right Bank

KOLB = Kirindi Oya Left Bank

KORB = Kirindi Oya Right Bank

In all these cases distribution from the tank or from the main canal is by gravity through channels of diminishing size to farmers' fields. There is only one well and pump known under any of these systems (under Tissawewa tank) and that is not in one of the survey Cultivation Committee areas.

In that part of North Arcot District in India which we are examining there is a greater variety and a greater mixture of irrigation systems. The most common form of gravity irrigation consists of canals from anicuts from rivers which are dry for most of the year, and which supply chains of village tanks in series. In our sample, large tanks are represented only by Dusi, which is one of 18 villages served by the large Dusi-Mamandur tank. In addition, in all villages there are wells used for lift irrigation. Three forms of lift are used - etram (human power); kavalai (ox power); and pumpsets (oil, or much more commonly electric power). These wells are usually found both on the dry land (land which is not under command for tank or channel irrigation) and on the wet land (land which is under command for tank or channel irrigation). The villages in the sample can be classified as follows:

Village	Non-well water source	Tank Storage	Wells in wetland	Wells in dryland
Kalpattu	Nil	Nil	No wetland	Yes
Vegamangalam	Excavated springs near river, permanent flow	Nil	Nil	Yes
Dusi	Channels leading from large seasonal rivers	Large tank serving 18 villages	Negligible	Few
Meppathurai Vinayagapuram	Channel leading from seasonal large river direct to village tank	Village tank	Yes	Yes
Amudur, Duli, Randam, Sirungathur, Vayalur, Veerasambanur, Vengodu	Combinations of natural drainage lines and channels from seasonal rivers leading through chains of tanks to village tank	Village tank	Yes	Yes

Note: some villages have additional small tanks which are fed by catchment run-off. All tanks receive some water from their catchments in addition to whatever may be received from the source named.

The categories used above follow the useful and necessary but well-worn and discipline-bound criteria of the engineers and hydrologists who have dominated so much of the thinking about irrigation. They are much concerned with the acquisition, transport and storage of water and perhaps rather less with its distribution. An engineer can be expected to talk and think in terms of diversion channel, tank, dam, gravity, well, pump, major and minor irrigation, with type of structure and scale of operation as his main criteria. A hydrologist for his part is most likely to think and talk in terms of water cycles and sources of water - shallow or deep well, spring, surface run-off storage, and river diversion irrigation for example. But other disciplines would classify irrigation systems quite differently: for an agriculturalist for example, the method of field application of water is the central concern, and we have flood, border strip, check basin, furrow, underground, and sprinkler irrigation to mention but some. But when we come to the social sciences we find something of a void. In the past, the only serious and large-scale attempt to analyse the organisational and operational aspects of irrigation from the point of view of a social science has, to the best of my knowledge, been Wittfogel's massive polemic (1957). Recently, however, Thornton has made a useful start by classifying some aspects of the organisation of irrigation in Sudan, India and elsewhere. He points out, after considering the physical acquisition and transport of water, that it is with distribution that "the largest number of organisational alternatives occur" (1974:2). It may be added that distribution corresponds with much of the unexplored no man's land in irrigation, and is also where most actors are involved and where most of the not inconsiderable drama is to be found.

The categories which are used in classification depend not only on the objective nature of the subject matter but also on the points of departure in the thinking of the observer. Some possible classifications of systems of irrigation organisation might themselves be classified as top-down, bottom-up, and middle-outwards, depending on the stance of the observer. Thus Thornton's typology is based upon a top-down view, concerned with the formal organisation and

distribution of responsibilities within the organisation and makes its major division into private and public systems, with subdivisions according to the locus of responsibility for organising the system. A bottom-up view of irrigation, starting with the farmer and his preoccupations, would look very different. It might differentiate between irrigation systems according to the cost, adequacy, convenience and reliability of the supply of irrigation water to his farm. A middle-outwards view of irrigation organisation would start geographically and organisationally in the middle of the distribution system. It would differentiate systems, perhaps according to the decisions, communication and allocations which affect distribution, looking both upwards towards the source from which the water derives and downwards to the farmer. All three views - top-down, bottom-up, and middle-outwards - deserve to be developed. For the purposes of this paper, however, we will start in the relatively unexplored middle ground and move outwards from there, paying particular attention to the organisation and operation of communities and bureaucracies in the distribution of water.

A central and universal issue in the distribution of irrigation water is who gets what, when and where. This is the very stuff of politics and it is surprising that political scientists, political anthropologists, and those who study political economy have not devoted more attention to it. In circumstances in which water is a scarce and often constraining resource and in which individual farmers and communities of farmers are competing for it, the attention of the actors focuses on the processes of allocation and acquisition which determine the access of users to water. These processes can be classified as:

1.	Direct appropriation.	The user acquires water directly from a natural source such as a private dam or well.
2.	Acquisition through contract.	The user acquires water through agreement with a supplier in exchange for goods or services.
3.	Community allocation.	A communal source of water is allocated among a community of users.
4.	Bureaucratic allocation.	Water is allocated by bureaucratic organisation direct to individual users.
5.	Bureaucratic-communal allocation.	Water is allocated by a bureaucratic organisation to one or more communities of users, each of which manages distribution to its members.

These types are represented in the examples available as follows:

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Type of allocation/ acquisition	Sri Lanka	India
Direct	Negligible	Very common (individual wells)
Contract	Negligible (except where tenancy carries water rights)	Negligible (except where tenancy carries water rights)
Community	All minor irrigation (Kataragama, Wellawaya, Tenagama, Methigatwala, Kachchigala)	Amudur, Duli, Meppathurai, Randam, Sirungathur, Vayalur, Veerasambanur, Vinayagapuram, Vengodu, Vegamangalam
Bureaucratic	Uda Walawe	Nil
Bureaucratic-communal	All major irrigation (Hanganwagura, Jansigama, Rotawala, Jayawick-remayaya, Kachcherigama, Udasgama, Companniwatta)	Dusi

In order to narrow the field, I shall ignore those types which are weakly represented - contract and bureaucratic. We are left then with direct acquisition, almost entirely through wells in India; community allocation, well represented in both Sri Lanka and India; and bureaucratic-communal allocation, mainly in Sri Lanka but also represented by Dusi in India.

We can further narrow the field by considering the level at which decisions and actions affecting allocation and acquisition are taken. For the three types, these are

	farmer level -within fields	community level -within community area	system level -within irrigation system area
Direct	Yes	No	No
Community	Yes	Yes	No
Bureaucratic-communal	Yes	Yes	Yes

In this paper, in trying to explore the middle ground or no man's land, I shall not consider allocation and appropriation in any detail at the farmer's level. The main attention will be at the community and system levels. "Community" here and elsewhere in this paper refers to users with an interest in a common source of supply, the water from which is distributed among themselves. This usually refers to what in Sri Lanka is called minor irrigation, to what in India is village tank irrigation, and in both countries to groups of users on larger irrigation projects who depend upon the same feeder. "System" refers to whatever organisation or arrangement exists above the community level for the management and allocation of water.

Before proceeding, however, a word of warning is in order. The categories adopted must be treated warily. They are designed for convenience without necessarily implying that they have some enduring validity or some great explanatory power. As with many other distinctions in the social sciences, the edges blur and overlap in practice and at an early stage one is liable to be confronted with an uncompromising duck-billed platypus which does not properly fit into any class. Thus Dusi is immediately a bad fit in bureaucratic-communal irrigation, since the size of the paddy tracts under the large Dusi-Mamandur tank would lead

anyone familiar with irrigation in Sri Lanka to look for a bureaucracy which distributes the water; but in the strict sense of bureaucracy - an organisation with its own norms, rules, terms of service, and so on - there is none. The PWD only controls issues from the sluices, leaving the rest to the traditional officers of the villages. Again, Amudur in India, though it has a community system of allocation and acquisition, has something verging on its own "bureaucracy", in the form of three harijan thoddis who distribute the water to individual farmers. These two examples are cited not to destroy the usefulness of the classification, but merely to discourage any tendency to think that words refer to classes of entities which are more consistent and distinct than they really are.

Indeed, irrigation presents social scientists with tantalising invitations to speculate. Expressions like "irrigation societies" and "hydraulic organisation" hint that there may be strong causal links between irrigation systems and social and economic relations. Irrigation has an appearance of inevitability which lends itself to deterministic interpretations. Wittfogel succumbed to the temptations presented by the apparent imperatives of large-scale irrigation, requiring, as he saw it, totalitarian organisation in order to muster the labour forces necessary for the maintenance of huge flood control works and irrigation systems. This is not the place to discuss the validity of his thesis, except to observe that in modern conditions it has lost a good deal of its persuasiveness because so much of the work supposedly[2] carried out by direct labour in the past is now carried out by machinery. The importance of Wittfogel here is that he demonstrates the tendency to see the forms of irrigation organisation as unavoidable, as generated and required by imperatives of the physical system. There may be two main reasons for this tendency. First, on all irrigation systems which are larger than "community" and in which water is controlled and allocated by a bureaucracy, that bureaucracy has to be fitted geographically to the irrigation network. Certain tasks have to be carried out and staff are needed to perform them. Second, many of the discussions of irrigation are based on detailed analysis of only one example, with perhaps some side glances at others. The superficial and not entirely reliable information gained in South India and Sri Lanka in field visits provides an opportunity (full also of dangers) to see what variations in forms of organisation there may be over a wider range of examples than is often available. At the same time, a few glances at comparative literature on the subject can also be used to provide further possibilities of contrast.

The discussion which follows is in two sections, dealing with selected aspects of the organisation and operation first of community irrigation, and second of bureaucratic-communal irrigation.

Community Organisation and Operation

(1) The allocation and appropriation of water

For convenience the allocation and appropriation of water can be described in terms of two stages: decisions about areas to be irrigated and about timing; and actual allocations and appropriations.

In the first stage a decision may have to be taken as to which areas under command to irrigate. Leach has described for

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2 I have not yet found any discussion of the possible role of elephants in the construction of the large ancient tanks of the Dry Zone of Sri Lanka; but if they were widely used, then the form of organisation might well have been closer to a modern PWD or military engineering unit than to a totalitarian bureaucracy exacting forced labour from peasants.

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Pul Eliya in Ceylon the nice decision which has to be taken with a village tank

> "The issue is a subtle problem of economic choice since, if the water resources of the irrigation system are over-extended the outcome may be total crop failure. The village meeting makes its collective decision on the basis of the level of water in the tank and a gambling estimate of rain in the weeks to come." (1961:53)

This type of decision is not limited to village tanks. Wellawaya depends on diversion from a small perennial stream which is not always sufficient for all of its six blocks of asweddumized land: similar decisions have to be taken about which and how many of the blocks to cultivate in the yala season. The only Indian village in the sample known to have a similar system is Duli where, when water is short, a decision is taken to allow the same fixed acreage to each holder of wetland and to supply water only for that. Under the other Indian villages with tanks there appears to be no formal decision about the acreage to be cultivated: the decision is left to individuals who must rely on their own judgement of the water likely to be available and their chances of obtaining enough of it, through whatever system of allocation and appropriation operates and subject to the physical layout of the irrigation system and their fields. Where, as in Vegamangalam, there is a perennial supply of water adequate for more or less continuous cropping, the question of which land to irrigate or not to irrigate does not arise in the same form but depends upon the timing and phasing of cultivation operations.

The second stage of decision is the allocation and appropriation of water within an irrigation community, affecting those areas which it has been decided to irrigate. There are at least four forms this can take:

(i) a physical division of water flows between channels. The karahankota described by Leach for Pul Eliya (1961:160-5) is an example. Water was divided by a wooden weir into which flat-bottomed grooves of various widths had been cut, the water allocations being the amounts of water which flowed through different grooves into different channels. The physical system (though not the proportional allocations) had fallen into disuse in Pul Eliya even in 1954 and no case of any similar system was found in our survey either in Sri Lanka or in India;

(ii) rotational rationing on a roster basis. This is widespread throughout the world. The warabandi system in Haryana (Vander Velde 1971:132) and the waqt (sunrise to sunset or sunset to sunrise) system in Iraq (Fernea 1970: 124-5) are examples. In our survey we found that time had been estimated in various ways in the past including judging by the sun during the day and by the stars by night, measuring the lengthening shadow of a stick either in fingerbreadths or paces (Amudur), and taking the time a leaking pot took to empty (the murai palla system in Vengodu). These methods have, however, fallen into disuse and have been replaced by the wristwatch, sometimes in Sri Lanka combined with paper chits (tundu) as in Companniwatta (where four-hour spells have been used in periods of scarcity) and in Wellawaya. In several Indian villages in the sample there was a karai system in which a sequence of turns was taken by family groups, the duration of the turns being a matter of tradition. But given the dispersal of family lands and the complication of pumpsets, it must be an open question to what extent in practice such a system is followed. A principle often stated, however, was that the duration of water was related to the acreage owned or to the acreage actually cultivated in the season in question.

(iii) allocation by restricted acreage. The rationing system at Duli is based on the principle that each cultivator should restrict his acreage to a fixed amount and then, in rotation, be supplied with the water needed. This has some similarities with the bethma system in some purana villages in Sri Lanka (Farmer 1957, Leach 1961) in which, in a season when acreage had to be restricted, all holders of wetland were able to cultivate a portion of the irrigated field;

(iv) "anarchy". Water may be not so much allocated as appropriated, as described by John Harriss for part of Kirindi Oya Right Bank: "I have found ... the suggestion of a kind of anarchy in which in time of scarcity water supplies depend upon the strength of a man's right arm" (1974:16). The apparent disintegration of traditional allocation systems under Indian village tanks may also sometimes verge on this situation.

(2) Equity and productivity

These two sets of actions - deciding which land should be irrigated and the timing of irrigation, and then the allocation and appropriation of that water to those lands which are being cultivated - raise acute questions of equity. Rural inequity is often associated with differing sizes of landholdings. But this can be misleading when, for example, a man with a secure water supply can crop his land three times a year while a man who has to rely on only one irrigation can take but one crop. The physical position of fields relative to channels is critical here. Those near the top of channels have an immense physical advantage in their access which it can be very difficult for those further down to control. In the absence of countervailing custom, social sanction or physical force, it cannot be a matter for surprise that the privileged top-enders satisfy their own needs first before allowing water to flow on down a channel to their less fortunate neighbours below. The tail-enders thus often receive less water, less reliably, and in a less timely fashion, than those near the top. There is a striking variation in the extent to which the communities studied in India and Sri Lanka moderate these inequities and in the methods they use.

In India the most common systems for distribution under tanks are inequitable in that they favour those at the topend. In Meppathurai, Randam, Sirungathur, Vayalur and Veerasambanur, top-enders are said to take water first. Moreover the karai system, and any other system of time-rationing, is liable to deliver less water to tail-enders because of seepage and evaporation losses en route (see Vander Velde 1971, passim). However, informants from Vinayagapuram, Amudur and Vengodu all claimed to have systems which were fairer to tail-enders in time of water scarcity: in Vinayagapuram, the first issue is said to be from the top downwards with the second issue in reverse from the tailend upwards back towards the top; in Amudur since about 1955 it is said that water has been issued to tail-enders first (this was part of a major reform in which the supervision of water allocation was also changed); and in Vengodu, where tail-enders had been suffering, a partially effective convention was said to discourage those with pump-sets in the wetland from using tank water so that it could be supplied to those less fortunate cultivators who did not have pumpsets. It is, however, Duli's system, allowing adequate water to equal plots of land which scores highest for equality. In Sri Lanka the systems also vary but information on them is incomplete. On major irrigation, however, the practices appear to follow the principle of "the devil take the hindmost".

Questions of equity are linked with questions of productivity. With food production a major objective and water a critically scarce resource, measures which might be more equitable have to be weighed also in terms of productivity. The central issue here is that the conveyance of water involves losses through

percolation and evaporation. Duli scores highly for equity but the water losses in distributing water as in Navavai 1972 to small plots of 30 cents each scattered over the ayacut must have been substantial. Had it been possible to adopt an equivalent of the bethma system in which all cultivators participated but in which the water was applied to one block of land near the tank, then the productivity of water and the total output of the land should have been higher. Similarly, the supply of water to tail-enders first is wasteful, not only in conveyance losses but also in the loss of opportunity to re-use drainage water and to raise the water table: for when top-enders in an ayacut take water first, seepage in their fields may raise the water table lower down and thereby reduce subsequent water duties there, and surface run-off into drains may be re-used by cultivators nearer the tail-end, as occurs in Sri Lanka at Kataragama on minor irrigation and under Tissawewa on major irrigation.

The questions are complex and interlinked with the patterns of wealth and power in irrigation communities. Any government may hesitate to intervene in such a difficult policy area. All the same it is worth noting that several of the Indian villages had themselves within living memory changed their water allocation systems, in one case at least (Amudur) in the direction of greater equity in distribution. The systems used are by no means a sacred part of the social fabric that can be tampered with only with the risk of severe disruption. The evidence suggests that water distribution under tanks is at present usually both inequitable and inefficient in terms of productivity. A particular example is the tendency for those with water available from wells and pumpsets nonetheless to take tank water (since they do not have to pay for it), denying it to their less fortunate neighbours who may not have wells. The result may often be that a village cultivates a much smaller area than it could if the pumpset owners were to cultivate only using well water. The question can be asked whether those with pumpsets could be persuaded or forced to forego tank water. The suggestion was greeted with laughter in Randam and Vayalur, but informants in Vengodu suggested that some such idea was at large there and might even be partially implemented. If it is true that with the introduction of pumpsets in wetland and with the progressive fragmentation and dispersal of family lands, the distribution systems under tanks in North Arcot are looser and less effective than in the past, this may be a time when an official initiative to increase both equity and productivity is feasible. A system of differential taxation to provide an incentive to pumpset owners in the wetland to abstain from using tank water might be considered. (See the paper, Water and the Future, to this seminar, for an elaboration of this proposal).

(3) Enforcement and arbitration

An intriguing set of questions arises over infringements and disputes, and their adjudication. There is a sharp contrast here between Sri Lanka and India. Under the colonial regime in Sri Lanka a local official, the vel vidane, appointed by government and responsible to the Government Agent, was in charge of allocation of water, supervision of its distribution and adjudication of disputes. After independence and under the Paddy Lands Act of 1958 he was replaced by the Cultivation Committee and its officer, the administrative secretary or govimandala sevaka. Whereas the vel vidane had been armed with near-dictatorial powers and was remunerated with a share of the crop (which gave him a productivity incentive), the administrative secretary was remunerated on a tax farming basis, receiving 40 per cent of an acreage tax which he was meant to collect from paddy cultivators. It seems to be widely accepted that the vel vidane system was often exploitative but usually quick-acting and technically efficient, whereas the Cultivation Committee system has been slow-acting and permissive. Cultivators canvassed in the UCARTI survey, gave responses which can be interpreted as preference for a system, whether vel vidane or other,

which was authoritative, quick and effective (Chambers 1974b: 9 and appendix A). It would be very easy, if no other system were known, to conclude from this that a more authoritative and more efficient system is needed at the irrigation community level; that a committee cannot perform this function; and that a man whose reward is unrelated to the value of the crop is unlikely to perform it well.

The contrast with the Indian villages is then striking. Under the South Indian tanks there is no equivalent of the vel vidane. There is no tradition of a government servant being concerned with allocations within the paddy tract under small tanks. The system is radically different. Whereas the vel vidane was usually an influential and prosperous local person, those responsible for the execution of water control in the South Indian villages are harijans, the thoddis or neer thoddis. Their responsibilities vary considerably as does their remuneration. In some villages they are responsible only for closing and opening the sluice. In Amudur, however, they have extensive responsibilities in executing the allocations in the paddy tract. One of the three Amudur thoddis said (1974) that he would never allow anyone else to move water and if they did there would be an ur panchayat meeting and the miscreant would be fined; but this had never happened. Evidently, if our informants were correct, rights and allocations in Amudur are clearly understood and the thoddis have clear guidelines to follow. One Amudur farmer went as far as to say that under the system practised before 1955 there were many disputes, but now he did not even bother to go to his fields when water was due as he had complete trust in the fairness of the system and its operation by the thoddis.

The extent to which an arbitration role is demanded must depend on the extent to which there are infringements or, in the absence of clear rules, the extent to which there are acts which cause serious resentment. Obviously, cultural differences and different developmental experiences must profoundly influence attitudes towards different forms of arbitration. But it is worth noting that appeals to outside authorities are common. On the basis of a comparison of fifteen irrigation systems in the Philippines, Ongkingco has written that

> "It is striking to note the satisfaction of farmers when somebody in authority, like a policeman or a mayor, attends to water distribution problems. Under these circumstances, farmers even seem to be satisfied with reduced water supplies". (1973:242)

In Sri Lanka, one administrator has lamented the volume of cases and appeals presented to him over water matters, deflecting him from the main task of stimulating agricultural production (Weerakoon 1973:7). Performing these arbitration functions, whether the arbitrator is a government servant or a local person, is not easy. Administrative secretaries interviewed in Sri Lanka were generally unenthusiastic about their work, several of them complaining about the arduous duties involved. In the Philippines again, Ongkingco found one hereditary water master (whose duties were roughly similar to those of an administrative secretary) who wanted to relinquish his position because he got no benefit from it, but who felt he could not do so because of community tradition (1973:240).

In terms of government policy one objective may be to improve equality and productivity while avoiding involvement in administrative costs. Once government intervenes, there is a danger of an endless series of cases and appeals, and of a need to provide more staff at more cost to deal with them. There is also a danger of inducing attitudes of dependence among communities. To secure a "fair" distribution of water within irrigation communities may often be difficult (and in any case there are problems with the connotations and interpretations of "fair"). But cultivators do appear generally to agree that they value quick action and quick decisions. And even where governments cannot institute "fairer" distribution of water, there may be

opportunities for them to enable crucial decisions and judgements to be made more promptly.

(4) Action by irrigation communities

A question of some importance to governments is the extent to which they can rely on action by irrigation communities for the operation and maintenance of irrigation works. The survey villages are of interest because they present at least four cases in India where considerable communal labour is called for to maintain an irrigation system, one of which has collapsed; and one case in Sri Lanka of partial collapse.

The four cases in India all involve work required to acquire and transport a communal water supply. They are Dusi, Vegamangalam, Meppathurai and Vinayagapuram. Communal labour is also used to maintain the channels between tanks where there are chains of tanks, but information has not been collected on these.

The Dusi case involved collaboration between the 18 villages served by the Dusi-Mamandur tank. On 16 August 1971 the Dusi-Mamandur Irrigation Board, consisting of one representative of each of the villages, a secretary and a president, met to decide how to secure the flow in the channel from the anicut to the tank. This, they maintained, was the responsibility of the PWD, but as the PWD could not be relied on to act swiftly enough, the villages themselves had to take action. They decided that each village should send labour at the rate of one man to every ten acres irrigated in order to divert the Palar river into the channel. The work was apparently successful.

The Vegamangalam case is a continuing and customary activity. When the long channel bringing the spring water to the shared pangu lands of the village requires cleaning out, every family with a share of the pangu provides labour at the rate of one man per anna of land (1.6 acres of wet plus 0.74 of dry). The system apparently works well.

The Meppathurai case is an example of a practice abandoned. Several attempts to find out what happened have elicited differing accounts and explanations. What is agreed, however, is that the catchment run-off flow into the Meppathurai tank had for many years been supplemented by a channel from the Cheyyar river. When the river flooded, villagers dug in the river and in the channel to divert water into the channel and along it to the tank. Much work was involved in removing silt from the channel. In about 1967 there was a heavy flood and the channel was seriously silted up. According to accounts the task of clearing was too great for the village and appeals for government assistance failed; others state that there were political differences between the larger, older farmers (who were Congress supporters and who stood to benefit more from clearing) and the smaller, younger farmers (who were DMK supporters and who stood to benefit less). Yet another possible contributory factor may have been a high degree of absentee ownership of wetland in Meppathurai. It is also possible that the larger farmers were not unduly concerned because they could anyway rely on their pumpsets in the wetland. But whatever the cause, Meppathurai failed either to obtain government assistance or to carry out the clearing itself. In 1974, some six years later the situation was even less remediable than it had been at first. The two miles of channel were heavily overgrown with bush and the poorer people who used it as a source of firewood for sale were said to be opposed to any clearing being done.

The Vinayagapuram case is an interesting contrast. The main water supply for the Periya Eri, the large tank, comes from a 5-mile channel taking off from the Cheyyar river. This requires extensive and heavy work to clear off sand during the period from the beginning of January until the end of April. All those cultivators who benefit

from the channel have an obligation to clear 3 feet per day for every acre of wetland they hold. The work is closely administered and arduous, but the second (Navarai) crop depends upon it. There is a long history of conflict with Konaiyur, a village above Vinayagapuram which lies astride the channel but which has no rights to the water in it. Twenty years ago when the channel silted very badly and Vinayagapuram was appealing for government help to clear it, Konaiyur people said they would clear it and take it over. However, Vinayagapuram obtained government assistance and managed to continue maintenance. More recently theft of water by people from Konaiyur has led to violence and court cases. When the channel is running, Vinayagapuram posts night guards over it where it runs through Konaiyur. Since the main crisis twenty years ago the system of communal labour appears to have been continuously effective.

The final case is from Sri Lanka. It raises the issue of the division of maintenance responsibilities between cultivators and bureaucracy. In one instance a long canal is heavily silted and overgrown. Partly as a result of this, but also because of high rates of extraction at the upper end, water only reaches the lower end four to six weeks after it begins to flow at the top. It is in the interests of the tailenders, but not of the top-enders, that the canal should be cleaned and maintained. The maintenance responsibility officially lies with the Territorial Civil Engineering Organisation (TCEO) which, when it is unable for various reasons to maintain the channel, suggests that the farmers themselves should take action. This is, however, liable to be at a time when there is already a demand for water to flow for cultivation, and the result, in one instance, was no maintenance and a continuation of the unsatisfactory situation. In addition, the TCEO was instructed to take over the maintenance of all field channels which were over half a mile long or which supplied more than 50 acres, but this instruction met with lack of official enthusiasm at the local level and a reluctance to inform cultivators in the hope that they would continue to accept the responsibility.

Although these are few examples, they do support what are really commonsense conclusions about communal labour. First, it is most likely to be effective where the community will benefit directly and where labour obligations are proportional to expected benefits. Thus Dusi and the other 17 villages could mobilise labour to divert the river into the tank, and Vegamangalam and Vinayagapuram can maintain their channels. In all these cases the labour obligation is related to irrigated acreage. Conversely, where there is no direct link between the work done and the benefits gained, communal maintenance will be much more difficult. One of the reasons given for the abandonment of the Meppathurai channel was that the young men and small farmers felt that they were being required to do more than their share in relation to the benefits they might expect. Even more so, it is unrealistic to expect maintenance to be undertaken by people who will not benefit at all, as with clearing of silt at the top of channels by top-enders, which helps not them but only those further down.

A second conclusion concerns the role of the bureaucracy. Intervention to help a community may be critical in sustaining a system of communal maintenance when it is subject to exceptional stress. One of the differences between Vinayagapuram and Meppathurai is that when Vinayagapuram appealed to government for help in a crisis it was successful whereas in similar circumstances Meppathurai was unsuccessful. One of the difficulties about maintenance in Sri Lanka is the susceptibility of the TCEO to political pressures and the uncertainty about the boundary of responsibilities between groups of cultivators on the one hand and the TCEO on the other. In order that a government may benefit from communal work in maintaining irrigation systems, clear and sensible decisions have to be taken about the boundaries of responsibility and then those decisions have to be sustained. The only exceptions should be, and these are nice judgements, special assistance to communities which are facing exceptional problems which it is beyond their power to [illegible] on their own.

A third suggestion is that where the choice presents itself those who design irrigation systems in countries where labour is abundant and government poor should consider incorporating into the design whatever features will encourage community action. These require that the maintenance work shall be within the capacity of the numbers of cultivators anticipated, and that it shall be they who benefit from the work being done. The recurrent costs to government of the irrigation system should then be less than if government itself were obliged to provide it. Higher capital costs, for example with more separate channels to communities which would then maintain them, might be justified by reducing the recurrent costs of maintenance at government expense.

Bureaucratic-communal Organisation and Operation

Perhaps the most interesting, important and difficult questions concern the organisation and operation of bureaucratic-communal irrigation, that is, of those irrigation systems in which water is controlled first by a bureaucracy and then by a community or communities. The questions which arise within irrigation communities also arise now within the bureaucracy, between the bureaucracy and the communities, and between communities. Thus the problems of water allocations between competitors (now communities instead of individual farmers), the questions of productivity and equity, and the difficulties over enforcement and adjudication which are all found within communities are now replicated but on a bigger, more visible and sometimes more dangerous scale on the larger irrigation system.

Although the variations are legion, a recurrent concern and source of inter-community conflict on bureaucratic-communal irrigation arises over the allocation and appropriation of water. With community irrigation, without a bureaucracy, we have already seen how the poaching of Vinayagapuram's water by farmers from Konaiyur, higher up the channel, led to violence and litigation. Similar incidents are common on bureaucratic-communal irrigation, with the difference that there is a mediating bureaucracy. Common practices include constructing illegal outlets, breaking padlocks, drawing off water at night, and bribing, threatening or otherwise in some way inducing officials to issue more water. Typically those at the top-end get their water first and get most of it, while those at the tail-end suffer. Many examples could be given. On Kirindi Oya Right Bank canal in Sri Lanka, there are several extra pipes off the main canal which were not part of the original irrigation design (personal communication, John Harriss) extracting water higher up often to the detriment of those lower down. In North India, the tension between villages may erupt into serious threats to law and order. Vander Velde reports an intervillage dispute in which ten cuts were made in an embankment in less than 24 hours and major violence between villages threatened (1971:154). Both in the allocation of water and in the execution of the allocations the competition between communities is an inescapable parameter of importance.

Questions of productivity and equity are involved here as they are in intra-community distribution. Other things being equal, water is less productive after conveyance losses to the tail-end of a channel than if it can be applied at the top-end. Moreover, when a canal is long, conveyance losses high, and delays in the arrival of water at the tail-end run into weeks or even months, as they do with the 17 miles of the Walawe Right Bank in Sri Lanka, then planting at the tail-end is liable to become untimely, either forcing cultivators to grow lower-yielding, shorter-duration varieties, or involving them in risks of inadequate water at critical periods in the growth of the crop, or condemning the crop to climatically suboptimal conditions, or some combination of these. A common contributing factor in these delays and inadequacies of supply to the tail-end is excessive extractions higher up. On major irrigation in Sri Lanka it is notorious under a permissive regime of water issues that top-end farmers flood their fields in a manner which is unnecessary for the growth of paddy and that they substitute water for labour in weeding with little or no regard for

their neighbours waiting dry further down the channel. Their behaviour is perfectly rational, given their interests; but it is also antisocial, both in denying their less fortunate neighbours timely and adequate water, and in denying the country the additional paddy which their neighbours might be producing. The same is true with water issues on the two largest schemes in Sri Lanka - Gal Oya and Uda Walawe - where the acreage cultivated is less than it might be because of permissive and excessive water issues. In the one Indian example of bureaucratic-communal irrigation (Dusi-Mamandur) the problem may be less acute, but even there tail-enders complained that they could grow fewer crops in the year than top-enders.

The challenge here is to be inventive in devising institutions and relationships which will moderate inter-community strife and be both equitable and productive in the allocation and application of irrigation water. It may help here to suggest that there are four clusters of functions which have to be performed:

(i) strategic decisions about water use, including timing, amounts, allocations to communities, which lands to be irrigated, what crops to grow and the maintenance of channels;

(ii) the execution of those decisions;

(iii) allocation of water and arbitration within communities;

(iv) policing, and prosecution of infringements.

Since we are considering bureaucratic-communal irrigation in which the actors are officials on the one hand and communities of users or their representatives on the other, the question is how they should be combined or separated in order best to perform the functions. A problem here is the word "best". The criteria for evaluating solutions already include the productivity of water and the equity of its distribution. To this some, democrats, would add maximising participation by the users; while others, technocrats, would add its antithesis, maximising the decision-making and control by technical staff.

In deciding what balance to strike between these two views it is chastening to reflect on the wide differences which can be observed. At one extreme is the system operated under the Dusi-Mamandur tank in India with its ayacut supporting 18 villages. Inter-community water allocation decisions are made by the President of the Irrigation Board elected by the villages. Villages send their traditional functionaries to him with requests for water which he then forwards, after whatever amendment he judges necessary, to the Section Officer of the PWD who instructs one of his staff to open or close the sluice from the dam accordingly, In Sri Lanka, on this size of irrigation system, the distribution from the channels below the tank would be the responsibility of government staff, but according to the evidence given, all water movement below the Dusi-Mamandur tank is the responsibility of an Irrigation Board of village representatives. Among the examples available, this is an extreme version of the user participation in strategic decisions and their execution. At the other extreme are projects where the bureaucracy controls water issues right down to the level of the farmer (as on Uda Walawe in Sri Lanka) or even to his individual field (as on the Mwea Irrigation Settlement in Kenya (Chambers and Moris 1973).

Both extremes have disadvantages. The Dusi-Mamandur

system is probably inefficient in water use:[3] certainly there is an irrigation engineering opinion that water use would be much less wasteful if the bureaucracy controlled water issues from the main canals to the irrigation communities; certainly, too, the tail-enders only manage one or at best two crops a year while those at the top-end regularly have two or even three. It must at least be asked whether with tighter management the distribution of water might not be both more productive and more equitable. On the other hand, the bureaucratic extreme, as on the Mwea Irrigation Settlement, is very expensive in government staff and in the associated loss of community self-management and communal labour for maintenance. Government is liable to be doing for communities what they could and would otherwise do for themselves without any cost to the tax-payer. Some middle course between these two extremes may perhaps combine greater productivity and equity without foregoing communal labour and without the need to maintain a large bureaucracy.

Taking this point of view, we can examine the four clusters of functions and see how they might be allocated.

First, there is a good case for strategic decisions being taken jointly by representatives of users and by government officials. Where representatives of users take decisions alone, they are likely to lack some of the technical knowledge needed, as probably on Dusi-Mamandur. Where administrators or technocrats take decisions on their own they are liable to ignore some particular needs of users, leading them into difficulties later on. Moreover, as the Assistant Government Agent, Hambantota, wrote in 1922 when the Director of Irrigation had suggested that the Irrigation Department should fix cultivation and irrigation dates:

> "In policy I think that this would be a mistake, since the proprietors are more likely to adhere to dates which they have agreed to than to regulations imposed from without, and in practice I doubt whether it would result in any material difference in the dates fixed ..." (Letter to Government Agent, Southern Province, 8 November 1922 - Hambantota Kachcheri file E 85)

Better decisions are likely where they result from discussion which benefits from an engineer's knowledge of water availability, an agriculturalist's appreciation of the cropping position, farmers' own knowledge of their resources and problems, and a presiding administrator's appreciation of all of these. This is, indeed, very much the system practised in water meetings in Sri Lanka, presided over by Government Agents. In that form it has both strength and weakness in the openness of the meeting to all farmers affected and who may not fairly represent all the interests involved. Given the large attendances, it is not surprising that they decide on dates for operations (such as opening the sluices from a tank, starting cultivation, completing water issues, etc.) but do not decide on the detail of rotational issues. Were there a more representative but smaller body, elected by "irrigation constituencies" which would ensure that tail-enders were included, then it might be possible for such meetings or a succession of them to decide in more detail what system of water issues to communities, with

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3 The evidence from the Project survey is suggestive but not conclusive on this point. Dusi stands alone among all the villages in the degree of dissatisfaction shown with tank irrigation in the samba season. No respondent considered that the supply of tank water had been satisfactory; but the reasons given were that there had been inadequate water in the tank and that the monsoon had failed. It is quite possible that the water allocation and distribution system was partly responsible for the degree of dissatisfaction expressed.

what volumes of water, should be adopted.

Second, with the execution of these decisions the question is how far the bureaucracy should extend down the irrigation system. On Dusi-Mamandur it is restricted to the sluice itself. On major irrigation in the Dry Zone of Sri Lanka it extends down the main channels to the points at which water is issued into field channels to communities. Without ruling out the possibility that communities may be able so to agree among themselves that those higher up will take less than they want in order that those lower down may benefit, this is scarcely likely to be the common rule. More usually, an independent and impartial organisation is needed, and this can only be some form of bureaucracy. The need for such bureaucracy is underlined by the experience of the elected Thannimurrippu Paripalana Sabai, reported by Ellman and Ratnaweera who state that while strategic decisions were satisfactorily taken, the problem was implementation and enforcement in which the TPS was not interested (1973:10,15). There were difficulties over the blurred division of responsibilities between the elected body and the government officers, and a need for "depersonalising the process of rule enforcement" (ibid: 8-9, 27). A crucial link is, it seems, between the strategic decisions and those who implement them. And it is here that a degree of impartial independence is required, with willingness and ability to carry out instructions earlier arrived at without bowing to particularistic local pressures. For this, a bureaucracy loyal to the decisions, but with its discipline partly deriving from a larger national or regional department, seems to be the most promising solution.

Third, allocation and arbitration within communities can usually be left to those communities, with perhaps some provision for appeal and for intervention by the bureaucracy in emergency. If water has to be rationed on a rotational basis, the difficulties of allocation within the community irrigation tract may be lessened if, as suggested by Levine and others (1973:11), the intermittent issues of water are large.

Fourth, there is a persistent need for policing and the prosecution of infringements above the community level. These are sometimes carried out by communities themselves. Vinayagapuram's night guards on its canal where it passes through Konaiyur and the observation of the Dusi-Mamandur President (interview May 1974) that if government were to be responsible for distribution below the tank, it would be continuously necessary to call in the Police, are salutary reminders of the versatility of community organisation. But it is also noteworthy that under Dusi-Mamandur there was ten years of conflict between two villages, Pallavaram and Kanikillupai, over the height of a weir alleged to be diverting too much water to one village to the detriment of the other, a dispute which provoked intermittent damage and repair to the offending structure. It is common wherever water is scarce for communities to resent extraction of water from higher up on their own supplies, whether apparently legal (as with a rubber company upstream from Wellawaya and with two pumps in the Cheyyar river above Vinayagapuram) or evidently illegal, as with the surreptitious raising of diversion weirs, the use of pumps at night to lift water from channels, the digging of breaching of canal banks, and the like. For these, if not a police force, then something like one is needed.

Police are quite often called in to intervene both with allocation and enforcement. During the crisis of water shortage on Kirindi Oya Right Bank in yala 1922, police helped with the allocation of water (manuscript letter, Divisional Engineer S.D. to the Director of Irrigation, 25 August 1922, Hambantota Kachcheri file E85). In the inter-village conflict in Haryana cited by Vander Velde "The resulting inter-village acrimony required the intervention of the police on a major scale to prevent serious violence" (1971:154). In India the Irrigation Commission of 1972 drew attention to the need for efficient policing and prosecution and to

> "the success which has been achieved in Haryana through extensive patrolling and inspection of canals and channels by flying-squads of officers, adequately armed. These flying squads carry out surprise night inspections and whenever offenders are caught, heavy penalties are imposed on them. The essence of the system is surprise, and prompt and condign punishment. A similar system of inspection by flying-squads could be adopted with advantage elsewhere". (MIP 1972:300)

A widespread complaint in Sri Lanka was precisely the lack of "prompt and condign punishment". Within communities, administrative secretaries rarely bothered to file cases which they knew would be subject to long delays; and at a higher level of irrigation organisation many cases filed by government servants were not heard for matters of months or even years.

The conclusion seems to be that a careful mix of relationships may be best: with user participation in strategic decisions and with management by communities of their own water supplies once allocated, but with a disciplined organisation responsible for executing decisions, policing the system, and prosecuting delinquencies. As I have argued elsewhere (1974a, b and c), it has to be made rational for the staff involved to deny resources to people who want them, in particular to issue less water to top-enders than they would like to receive. To achieve this, the bureaucracy needs first, high-level political support, and second, an internal style and supervision and incentive system which supports and rewards such unpopular actions.

Comparisons, Theory and Practice

The comparison of the organisation and operation of irrigation in parts of Sri Lanka and India has had the surprising effect of weakening the analytically attractive, even seductive, idea that there are powerful imperatives operating on irrigation systems which through their own logic force a convergence of organisation towards certain forms. In the past, largely in the work of Wittfogel, it has been thought that these would be authoritarian, disciplinary and totalitarian in style. What the evidence of the comparisons made in this paper suggests is a wider range of possibilities. It is sobering to think how much simpler the conclusions would have been if it had been only Sri Lanka's irrigation systems which had been under review. It is also important to bear in mind that further research may well show that the evidence gathered is inaccurate and that important corrections should be made. But a preliminary conclusion is that the culture in which an irrigation system is found may be a major determinant of the form of organisation found: thus in the Sri Lanka examples, where the society is more egalitarian and more anarchic, the case for tighter bureaucratic controls in irrigation seems clear; in India, where the controls already exist in the hierarchical structure of the society, their imposition seems less necessary at this time.

The comparison opens up exciting possibilities for developing a practically-oriented theory of irrigation societies and organisation. But for this, more empirical work and more comparative analysis are needed. One opportunity for this is the research project of the Tamil Nadu Agricultural University on the Kaveripakkam tank. Others are provided by the field research of individual physical, biological and social scientists if they are alerted to the concerns discussed in this paper. But the subject is exceptionally inter-disciplinary and demands that those who try to work on it should either be members of multi-disciplinary teams or, perhaps better, should be polymath and versatile in their interests. The practical value of such work might be substantial. Much more attention is being paid to the management of water and of irrigation in South Asia and elsewhere than

was the case a few years ago. The seminars on water management held recently by FAO in Southeast Asia and the major initiative of the Command Areas Development Programme in India are examples. But there has been a neglect of human management aspects, an ignorance of the operation of distribution systems, and a lack of good data and analysis to provide a basis for the design of irrigation organisations and procedures. What is needed now is more empirical understanding, more comparative analysis, and a practical framework on which to arrange new information. This should make it easier to identify and present the lessons of experience for the benefit of the practical men faced with the day-to-day and strategic problems and opportunities of managing irrigation systems.

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