SOCIAL SCIENCE RESEARCH ON IRRIGATION: SOME PRIORITIES AND CHALLENGES FOR THE NEXT DECADE

Robert Chambers
Institute of Development Studies
University of Sussex

Paper for Irrigation Water Management Workshop
26-30 March 1979
International Rice Research Institute
Los Banos, Philippines

SOCIAL SCIENCE RESEARCH ON IRRIGATION: SOME PRIORITIES AND CHALLENGES FOR THE NEXT DECADE

The reader should be warned that my experience of irrigation has been in South Asia and not in the humid tropics proper. This, and a personal strategy of trying to survive in the interstices between disciplines, affect the priorities and challenges which I identify. I put them forward in the hope that, if nothing else, they will provoke constructive debate.

In this paper irrigation includes large, medium and community-level surface flow systems. The main attention is given, however, to large and medium systems. The social sciences include economics but there is rather more that is relevant to sociology, broadly defined, than to other social sciences.

Values and Criteria

How should one decide research priorities? There are probably as many answers as there are researchers. What follows is a personal view. It must be clear that at this stage I am discussing what ought to be done; not what is done, either by myself or by others.

The first step is to be clear about objectives and values. The values which underlie this paper are conventional enough in being concerned with the reduction and elimination of poverty on a permanent basis. The relevance and potential benefits of irrigation hardly need spelling out - in increasing food production especially with the new technologies; in stabilising flows of food and income; in its tendency to spread food and income flows more evenly round the year, reducing seasonal shortages and stress; and in its ability to support and retain rural populations and to reduce rural urban migration. In seeking to augment and develop this relevance the approach in this paper is basically utilitarian. Research should be useful in achieving benefits for poorer people. It is true that pursuing exciting ideas, chasing serendipidity, making intriguing comparisons, testing and developing theory - all these may often turn out to have useful applications. But my plea is for a search for practical theory, for understanding which has application, and especially for understanding of those dark areas about which we know rather little and from which the chances of deriving practical theory may be greatest.

The objective of practical theory which will contribute to the reduction and elimination of poverty affects the way one approaches irrigation and thinks about it. A major obstacle, often irreversible, is the intellectual maiming which we have received in our professional training. Irrigation is par excellence a subject involving many disciplines. It is also a difficult subject because of the nature of water, the seasons, and society, and their interactions. Most of the important elements in any comprehensive study of irrigation are difficult to measure. Professionals then often appear to take refuge in gross simplification, or in diligently plodding down a disciplinary rut, or in measuring the measurable, and neglecting the rest. One common error is narrowing the focus to a single objective. It is easy, and unfair to quote out of context authors' single sentence

statements which give the impression that they are more narrow-minded than they really are. But here are three examples:

> "The main objective of management is to ensure a proper return on investment" (Swan 1975:1)

> "High productivity is the key ... to paraphrase Matthew 'Seek ye first production and all these things shall be added on to you'" (Giglioli 1968:9)

> "The purpose of irrigation is to create and maintain the optimum moisture regime for plant growth and in particular to maximise production of that part of the plant which is the harvestable product" (Willens 1975:1)

It is most unlikely that any of these authors would wish to claim exclusiveness for their criterion or that it was more than one of many. But for whatever reasons - whether disciplinary specialisation, personal values, organisational obligations, or sheer preference for the security of closure on a single manageable and measureable concept, single criteria do sometimes tend to be adopted in speech, writing and thought, and are likely to mislead seriously if they lead to neglect of other and wider criteria.

In practice we are faced with multiple criteria for what might constitute improvement in an irrigation system. To suggest what those criteria should be is hazardous but necessary. Not to suggest them is to avoid crucial questions about how we think about irrigation. My own preference for criteria which can be used to interpret the main poverty-reducing objective in relation to irrigation in Asia are the following. The criteria can be applied to water use, to institutions, to other elements in an irrigation system and society, and more particularly for our purposes, to choices between alternative research concerns and research designs. The first two are now a commonplace in the literature; the third is unlikely to be contentious; and the last three are more environment-specific and more debatable.

(i) <u>productivity</u>. This means the ratio of production or of some measure of economic value of production, to scarce resources used or consumed. We may thus have the productivity variously of labour, of land, or of other scarce resources, or of an irrigation system as a whole. For thinking about priorities in research on irrigation, the most useful gauge may often be the productivity of water.

(ii) equity. This refers to a fairer rather than a less fair distribution of resources and livelihoods. In its widest sense it includes opportunities for secondary and tertiary employment generated by irrigation. But in its most common sense it refers to the equitable distribution of water to cultivators. It raises the whole gamut of questions of political economy - who gets what, how much, when, how and why; who gains, and especially, who loses?

(iii) stability. This refers to the capacity for long-term sustained irrigation without environmental depletion, deterioration, or loss of productivity. It refers particularly to avoiding salinity, silting, waterlogging, weed and pest infestation, erosion, or groundwater depletion

(iv) non-seasonality. This refers to the smoothing of seasonal troughs in food and income flows, and to continuity of work, employment and production around the year. This is perhaps much more environment-specific than the first three criteria. Nevertheless, especially with irrigation, it does often appear a desirable objective from the point of view of reducing and eliminating poverty.[1]

(v) population-support. This is often closely connected with non-seasonality. In many environments it is critical to support larger numbers of people at adequate levels of living all round the year. This can lead to thinking about water in terms of the livelihood-intensity of its alternative uses.

(vi) convenience of water supply. The word "convenience" is used here to conflate several criteria which tend to be used a little loosely, though not necessarily by the authors cited.

---

1. See for example the papers of the Conference on "Seasonal Dimensions to Rural Poverty", organised by the Institute of Development Studies, University of Sussex and the Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, held at the IDS, 3-6 July 1978.

Thus we have variously "reliability" (Harriss 1977:373), "predictability" and "appropriateness" (Wade (n.d. 3), and "predictability", "certainty" and "controllability" (Reidinger 1974:81), in all cases referring to the supply of water to cultivators. Perhaps the concept of convenience can be expressed as follows:

convenience = (predictability of water delivery (including reliability and certainty) (plus (appropriateness of water delivery ((including quantity delivered, (place of delivery, timeliness and (controllability)

These criteria are disparate, and even untidy. Other observers may have other, better, criteria. We are searching, however, for what might be described as a cost-effective approach to thinking about priorities, and this entails shortcuts.

Research Biases

The next stage in considering what research priorities ought to be and where challenges lie, is to ask what factors in practice determine choices of research subject concerned with irrigation, especially, but not only, in the social sciences. To do this we have to make ourselves vulnerable to introspection. There may be many reasons why people choose to work on irrigation. At a deep level, a psychologist might speculate whether there was a connection with early toilet training. At a less impenetrable level, (and I cry mea culpa), some of the factors which determine the choice of research topic and research exposure are:

- geographical accessibility. But the poorer people are often remoter from urban centres and tarmac roads, and tailends on large irrigation systems are sometimes (as for example often in the Dry Zone in Sri Lanka) less accessible than the top ends.

- project bias. Research concentrates on new projects and programmes. Certain projects (the Mwea Irrigation Settlement in Kenya, the Muda Project in Malaysia) become visible internationally and receive disproportionate attention.

- prior bias. A tendency to study and concentrate on the earlier stages of a process rather than the later. In irrigation this applies especially to the hypnotic attraction of the design and construction phases with medium and large irrigation projects, to the neglect of subsequent operation.

- quantification bias. The tendency to study what can be measured and to neglect what can not.

- researchability bias. The tendency to pick topics which can be researched with reasonable certainty that a tidy and respectable paper will be the outcome, preferably publishable in a prestigious international journal. This applies also to the choice of subjects for post-graduate theses, where a responsible supervisor tries to help a student identify a subject which is sufficiently researchable using conventionally respectable methods for there to be a good chance of success in obtaining a degree.

- paradigm bias. The tendency to do further research on topics which have already been researched. The existence of a literature attracts attention and provides a springboard, some scope for comparison, some security, and an agenda of questions. A provocative book or article (for example Wittfogel's Oriental Despotism) may so provoke and enrage that whole generations of researchers set out to test and refute it.

- diplomatic bias. Myrdal, in Asian Drama, decried the harmful effects of the diplomacy of research. Research in developing countries, as elsewhere, tends often to concentrate on issues which are not sensitive, to the neglect of the crucial questions of political economy, and to the neglect of a real world in which informal systems of sanction and reward and of political activity are critical to both understanding and prescription. The bias is self-reinforcing since when these aspects are omitted in writing, other researchers tend to neglect them not only for diplomatic reasons, but out of ignorance. In connection with irrigation, Bottrall (1978:45) has recently stressed the way in which the sensitivity of some issues leads to their neglect. Some of the most significant

papers, dealing with the real, messy world of irrigation management, are heavily stamped NOT FOR QUOTATION. Where, as seems extremely common, there are unofficial inducements offered to officials, references are titillating but incomplete. Thus de los Reyes (1978:196)

> "The ... water rotation scheme is further affected by pressure placed by influential persons on the irrigation officials, or imposed by existing or newly developed social relations between farmers and irrigation officials, or between farmers and water tenders"

- professional and disciplinary biases. While all these biases, and others, operate, perhaps the most powerful of all are professional and disciplinary. Each discipline is programmed to focus on certain issues.

> "Hydrologists concern themselves with, for example, the water cycle and the movement of water from one form or location to another. Engineers concentrate on the design and construction of works, using their mathematical skills to calculate stresses, capacities, flows and the like. Soil scientists may try to measure percolation rates in different soils with different water applications. Agronomists investigate crop water requirements. Sociologists study the micro-level village community, the allocation and appropriation of water, the origins and resolution of conflicts. Economists try to calculate the costs and benefits of alternative ways of obtaining or using water, and argue about pricing policies. Medical men estimate levels of pollution, contamination and infection. Each profession and each discipline is pointed towards certain aspects of irrigation such as these, and is programmed with relevant research skills. Moreover, professional prestige and advancement are achieved through work which is highly regarded by fellow professionals. Research tends to use conventional methods and, in Thomas Kuhn's terms (Kuhn 1962) to be designed to refine existing paradigms. Is it sometimes, or even generally, true that research priorities are generated less by the situation of rural people than by the preoccupations of professionals?"
>
> (Chambers 1978:390)

For our purposes there are two respects in which professional and disciplinary biases, combined with others, seem especially serious.

First, research within a discipline may tend to become inbred, with mutual citation exercising a gravitational pull towards certain topics. Papers and journal articles easily take off into self-sustaining growth. Economists and sociologists/social anthropologists may provide examples. Economists tend to be obsessed with water pricing. One of the six sections in the Bibliography on Socio-Economic Aspects of Irrigation in Asia (IRRI and

ADC, 1976) is on water rates. Perhaps this is not surprising: it is something economists can do sums about; the subject lends itself to the exercise of the skills with which their professional training has endowed them. There is now a substantial literature on the subject, and some of it implicitly assumes that individual cultivators actually pay, or could be induced to pay, for the quantity of water they use in irrigation, when this is rarely the case and when water charges are often related to the area of land irrigated or meant to be irrigated and not to the amount of water supplied and used. A second example is the study by sociologists and social anthropologists of irrigation communities. These studies are often fascinating. A community is studiable and irrigation is a sharp focus, at least initially, for exploring social organisation. There is also an exciting mix of uniformity and variation between cases. But one has to ask: so what? Is this much more than stamp-collecting? To what implementable prescriptions, with what benefits to whom, do such studies lead? Some, like the work of Wade (as yet unpublished) on village organisation on a large irrigation system in South India, do seem likely to lead to useful ideas for policy and practice. Can one say that of all?

The second danger is related and more damaging. It is the tendency for the various biases, including disciplinary inbreeding, to operate so that there are major gaps: in questions which are not asked; in aspects and activities which are not examined; in methods of research which are not adopted; and as a result in opportunities missed and benefits foregone.

In this paper I cannot presume to draw up a list of research priorities. Many of these will properly concern work which is already in hand, and work and problems which I do not know about. What I shall now try to do, rather, is to point to some research areas and approaches which may be relatively neglected because of the biases listed and where the benefits may be high in terms of the six criteria (productivity, equity, stability, non-seasonality, population support, and convenience to irrigators) and through them in terms of the main objective of reducing poverty; where, in short, the deployment of research resources may be especially cost-effective.

Management in Irrigation Bureaucracies

With the most notable exceptions of the work of Bottrall (1978a, 1978b, and Newsletters of the ODI Irrigation Organisation and Management Network 1975 to present) and Wade (see references) there still appears to be an astonishing neglect of research and prescription concerned with the management of the bureaucracies which manage medium and large irrigation systems.[1] At the same time, there are many indications that this is an area where there is great potential for improving the achievement of the main objective and the six criteria.

Again and again, analysis of other aspects of irrigation leads towards the importance of efficient and predictable operation of the larger irrigation system. The report on a 1976 research seminar on irrigation systems in Southeast Asia cites evidence from the Philippines and from East Java (the Pekalen Sampean Irrigation Project) (Lazaro et al 1977:6). Valera and Wickham reporting on action research in the Philippines, have written (1976:7)

> "In traditionally managed systems, there is little benefit to be realized from intensive on-farm development as long as the supply of water in the distribution canal is unstable and unpredictable. For example, farmers with easy access to water have little incentive to build on-farm ditches because they already receive more than enough water. Farmers at the lower end of the system likewise cannot be expected to build ditches if the supply of water in the canal is not sufficient to supply these ditches reliably."

The same authors two years later, reporting on six years' research in the Philippines on irrigation systems ranging from 3,600 to 75,000 ha, reinforced the point:

> "... Most farmers will cooperate provided they get a dependable supply of water. ... To the extent that farmers can depend on good management within the system, they can be expected to take more initiative at the farm level. The program to encourage farmers to form irrigation associations would also be enhanced by more predictable main-system management. It is very difficult, however, to convince a farmer to build a potentially useful farm ditch if he feels that there will be no water in the canal to supply the ditch when it is completed." (Wickham and Valera 1978:74)

---

1. Many of the points made in this section have already been made by Bottrall and Wade; but responsibility for them here is of course mine alone.

In similar vein, Duncan reporting preliminary findings from a study of efforts to achieve greater farmer participation in the operations and maintenance of a 1,840 pilot area in Thailand concluded that the condition that seemed most essential for full farmer participation was the adequate and timely delivery of water in the main irrigation system. He found only a modest response in farmers participating in new irrigator's groups and in following recommended irrigation schedules and practices.

> "Perhaps the principal factor is undependable water delivery in main irrigation systems. Without added attention to main-system O and M, expecting greater participation of farmers in off-farm O and M will not be realistic" (Duncan 1978:191)

Much earlier, in Sri Lanka, the sociologist with the UNDP appraisal mission for the Mahaweli Ganga irrigation project found at least three of his survey findings pointing at system water management as a concern, and he concluded that "It seems that the functions of the Irrigation Department need to be looked into in the colonies." (Barnabas 1967:56). But he did not look into them himself; nor did anyone else. Apart from the work of Bottrall and Wade, the furthest one is usually taken into the bureaucracy is the lowest level - the ditchtender or his equivalent, as in the studies and analyses of Coward (see references). The operation of the larger system is, in Robert Wade's phrase, a "black box".

The potential from improvement of main-system management may be vast. For any country it depends, of course, on the extent to which irrigation is based on systems in which water supply is regulated at a level above community control. In absolute terms, and possibly in terms of proportion of irrigated area, such irrigation systems will increase during the next decade. India, for example, has plans to extend such systems by no less than 8 million ha (Government of India 1978:20) in the current 5 year plan period. It can be expected that a high proportion of the $55 billion estimated by the International Food Policy Research Institute to be required to finance the irrigation needs of developing countries over the next ten years will be devoted to major and medium irrigation. Sri Lanka has embarked on accelerated implementation of the Mahaweli Project, far larger than any previous project in the country. But more significant than new irrigation is almost certainly the potential from improving the management of what already exists. Some idea of the potential can be gauged from the work reported by Valera and Wickham (1976) although they do not elaborate

on the management aspects of the changes they brought about. Wade (1978) has shown how increased production and improved equity of distribution resulted, on an Indian canal, from reform carried out by officials against political opposition, and again (1979) how in a crisis of water shortage engineers were broadly successful in distributing a shortfall of more than 50 per cent in total water supply (canal plus rainfall) approximately equally over most of a command area; there was then little loss in cropped area and average yields were reduced by only about 25 per cent. Elsewhere there are negative indications of what is not achieved as a result of permissive management. In Sri Lanka, for example, the Uda Walawe Irrigation Project irrigates only about one quarter of the planned acreage, a major factor being capitulation to the demand of farmers for virtually unlimited and continuous flows of water. While this may be an extreme case, it does suggest a remarkable potential for more productive, more equitable, and more livelihood-intensive uses of water might be achieved through changes in management behaviour.

The reasons for the neglect of the realities of management are mainly to be found in the research biases. The distribution of irrigation water is the very stuff of politics. Water is money. It is not surprising that this is a sensitive area. Researchers hold off. Aid agencies prefer to ignore what really happens. A social scientist working for a consultancy firm on a large irrigation project proposal who tackles the problems of the realities of water distribution has his part of the report suppressed. There is almost a conspiracy of silence. Civil servants and politicians do not wish to recognise that there is a nettle to be grasped. In Sri Lanka, although the priority for management reform, supported politically, has been pointed out since 1974, there is[1] currently no substantive research on the management of irrigation systems, although this is critical for the success of the largest development project in the country. There is no discipline which readily claims the management of an irrigation bureaucracy as its field. There are numerous studies of mechanisation, but none, in Sri Lanka at least, of the realities of water distribution.

---

1. To the best of my knowledge.

The challenge here is to dare to look at, discuss, and improve the real world. Wade and Bottrall have shown that it is researchable. They find political influence, civil servants either bribed or threatened with transfer, unofficial augmentation of official salaries, systematic falsification of water flow records and hence misleading statistics, care taken not to exercise detailed supervision, tacit connivance at unofficial practices; and also of occasional imagination and courage in taking the risks of attempting reforms. The civil servants concerned are often behaving rationally in very difficult personal and political circumstances. If main system water distribution is to be improved to meet the six criteria, and especially the equity criterion, then these realities of the working conditions, incentives and difficulties of irrigation staff have to be faced as realities.

The challenge and opportunity are considerable. The area is at last being opened up, as for example by the recent Commonwealth Workshop on Irrigation Management held at Hyderabad (Commonwealth Secretariat 1978). What appears needed is a combination of research, consultancy and training. The research is needed, among other things, to enable us to know about

> "how irrigation officials at various levels actually make decisions, about the sort of pressures that are brought to bear on them and their response to those pressures. (And one must know, too, about what decisions they do not make and the pressures which are not brought to bear on them)." (Wade 1975:1743)

But a major problem is to know who is competent to do research and to act as a consultant in this field. It has been said that "Behavioural scientists should have the major responsibility for designing the organisational arrangements for water delivery ..." (Levine et al 1972:13). As more becomes known and understood about the realities, behavioural scientists may perhaps become less imcompetent at attempting this. It may well be that there already exists considerable experience in this field, but that it has not been written about. There seems no particular reason why any one discipline or group of disciplines should monopolise it. In this sort of research and consultancy, the personal qualities of sensitivity, of openness to information, of a readiness to learn from farmers, from staff, and from other disciplines, and of a recognition of what one does not know, are probably more important than any particular professional training.

R and D

A complementary approach is R and D on organisation and procedures.

On the organisational side, a more conscious approach to political engineering may often be required. We need to know more about the political techniques which can be used to achieve the main objective of reducing poverty and to satisfy the six criteria. One priority is to explore techniques which can be used to offset the physical advantages of access enjoyed by topenders. These may include irrigation constituencies for a management committee which makes decisions about water allocations between groups, perhaps over-representing tailenders; and various methods of policing, from the posting of guards by tailenders to the use a mobile police squad. A comparative study of these methods would be useful.

On the procedural side, much more work appears to have been done, for example by Valera and Wickham (1976), by Honadle (1978) and most recently by Daniel Benor (Government of Andhra Pradesh 1979). Experiences such as that with the pasten system in Indonesia are also relevant (Pasandaran and Taylor 1976). R and D with procedures may be undertaken at various levels, though the principles underlying them may be similar. More experience, over time, would be valuable with a range of approaches, including those reported by Honadle which include joint programming exercises, workshops that contain civil servants and irrigators, and procedures which enable irrigators to exercise legitimate demands on the bureaucracy.

A further aspect requiring imaginative R and D is the appraisal of existing irrigation systems. The relationships between water supply, the timing of operations, the supply of inputs, different power sources, yields, and so on, are notoriously complex. The challenge here is to devise methods of learning about irrigation systems which are "quick-and-clean". Much research is "long-and-dirty", in the sense that vast arrays of unreliable data are collected and then never processed; or if processed, never analysed; or if analysed, never written up; or if written up, never read; or if read, never believed. It may now in rural development generally be timely to break out of the straightjacket of disciplinary respectability and develop a new rigour in quick, simple and reliable - in short, cost-effective -

methods of investigation, relying especially on local knowledge.[1] Diagnosis, as it is called, is commonly identified as a priority. Bromley, Taylor and Parker (1977:36) are concerned "to better understand how to diagnose an irrigation system to determine the greatest problems of water management" (1977:36) with a view to water reform. Bottrall takes this further

> "Improvement in management evaluation and local diagnosis will require the incorporation of more social scientists in field research and, more generally, the encouragement of more practical and interdisciplinary approaches to learning in universities and other centres of higher education and research." (1978:48)

This would seem correct. An important caveat, however, concerns the dangers of overcomplexity. Each discipline has its own elaborate and time-consuming methods. When disciplines are brought together, the sum of those methods can easily become overwhelming. We need a breakthrough to a new simplicity. Irrigation may provide this opportunity. The gaps between the disciplines are sufficiently wide for there to be benefits from covering them with quite simple approaches. These may concern, for example, working out alternative uses of the same water (for a modest preliminary attempt see Chambers 1975 and 1977 trying to think about this with tank irrigation in Sri Lanka).

Finally, perhaps the greatest challenge is to abandon the secure territory of our disciplines as bases for prestige, and as sources of warming approval from our peer and reference groups, and to swim, as it were, in the open water. There is much rather empty rhetoric about multi-disciplinary research. The reflex of adding disciplines to disciplines in teams of researchers and consultants is not necessarily efficient. There are problems of communication, of management, and of time involved in discussions. There is an even greater danger of leaving the awkward questions to someone else, or assuming that someone else will handle them (which they very likely will not). "When the rockets go up, who cares where they come down, that's not my department ..." as the words of the Tom Lehrer song have it. Scientists and engineers should not be allowed to get away with saying that something is a "people problem" and therefore not their business. Nor should economists or sociologists be allowed

---

1. See the papers of the workshop on Rapid Rural Appraisal, Institute of Development Studies, University of Sussex, 26-27 October 1978.

to get away with dismissing a water distribution or supply as a "technical problem". Scientists and engineers must come to think like social scientists, and especially in terms of political economy, of who gains and who loses; and social scientists must come to think like engineers and natural scientists. Thinking of cost-effectiveness in terms of benefits to the poor, will it be the case, in the 1980s, that the most cost-effective interdisciplinary collaboration will take place in the same brain? And if so, what are the implications for education, training, research, and systems of professional rewards? And are these implications where some of the highest priorities and greatest challenges lie?

REFERENCES

ANDHRA PRADESH, Government of
Project Report and Guidelines for Introduction of Warabandhi System in Sri Rama Sagar Project, Andhra Pradesh
Command Areas Development Dept., Hyderabad, January 1979

BARNABAS, A.P.
Sociological Aspects of Mahaweli Ganga Project,
FAO/Irrigation Dept. of Ceylon, Colombo, 1967

BOTTRALL, Anthony
"The Management and Operation of Irrigation Schemes in Less Developed Countries" *in* Carl Widstrand (ed.), *The Social and Ecological Effects of Water Development in Developing Countries*, (*Water Development, Supply and Management: Vol.7: Water and Society, Conflicts in Development, Part 1*) Pergamon Press, Oxford, 1978.

"Technology and Management in Irrigated Agriculture"
ODI Review, 2, 1978(b), London, pp.22-48

BROMLEY, Daniel W., TAYLOR, Donald C. *and* PARKER, Donald E.
"The Economics of Water Reform: Institutional Design for Improved Water Management in the LDCs"
Center for Resource Policy Studies Working Paper No.8, School of Natural Resources, University of Wisconsin, Madison, October 1977

CHAMBERS, Robert
"Identifying Research Priorities in Water Development" *in* Widstrand (ed.) *op. cit.*, pp.389-398

"On Substituting Political and Administrative Will for Foreign Exchange: the Potential for Water Management in the Dry Zone of Sri Lanka", in S.W.R. de Samarasinghe (ed.), *Agriculture in the Peasant Sector of Sri Lanka*, Ceylon Studies Seminar, Peradeniya, 1977

"Water Management and Paddy Production in the Dry Zone of Sri Lanka", *Occasional Pub. Series* No.8, Agrarian Research and Training Institute, Colombo, January, 1975

COMMONWEALTH SECRETARIAT
Proceedings of the Commonwealth Workshop on Irrigation Management, Hyderabad, India, October 17-27 1978, Food Production and Rural Development Division, Commonwealth Secretariat, London, 1978

COWARD, E.W.
"Indigenous Organization, Bureaucracy and Development: the Case of Irrigation"
J. Development Studies 13(1) 1976, pp.92-105

REFERENCES (contd. 2)

COWARD, E.W.
"Institutional and Social Organizational Factors Affecting Irrigation: their Application to a Specific Case" in International Rice Research Institute; Water Management in Philippines Irrigation Systems: Research and Operations, Los Baños, Philippines, 1973

"Irrigation Management Alternatives: Themes from Indigenous Irrigation Systems", paper presented for Workshop on Choices in Irrigation Management, Overseas Development Institute, at Canterbury, September 1976, ODI, London.

DE LOS REYES, R.P.
"Stereotypes and Facts in Irrigation Management: Preliminary Findings from a Case Study of a Philippine Communal Gravity System" in International Rice Research Institute, Irrigation Policy and Management in Southeast Asia, Los Baños, 1978

DUNCAN, S.
"Local Irrigators' Groups: Assessment of their Operations and Maintenance Functions" in IRRI, op. cit. 1978, pp.185-198

HARRISS, John
"Problems of Water Management in Hambantota District" in B.H. Farmer (ed.), Green Revolution? Technology and Change in Rice-Growing Areas of Tamil Nadu and Sri Lanka, Macmillan, London, pp.364-376

HONADLE, George
"Farmer Organization for Irrigation Water Management: Organization Design and Implementation in Bula and Libmanan", final report, Development Alternatives Inc., Washington DC, August 1978

INDIA, Government of
Draft Five Year Plan, 1978-1983
Planning Commission, New Delhi, 1978

INTERNATIONAL RICE RESEARCH INSTITUTE
Irrigation Policy and Management in Southeast Asia,
Los Baños, 1978

INTERNATIONAL RICE RESEARCH INSTITUTE/AGRICULTURAL DEVELOPMENT COUNCIL
Bibliography on Socio-Economic Aspects of Irrigation in Asia,
Los Baños, New York, 1976

KUHU, Thomas
The Structure of Scientific Revolutions,
University of Chicago Press, Chicago, London, 1962

REFERENCES (contd. 3)

LAZARO, Rogelio C., TAYLOR, Donald C. and WICKHAM, Thomas H.
"Irrigation Systems in Southeast Asia: Policy and Management Issues"
Teaching and Research Forum No.6, Agricultural Development Council, New York, Singapore, May 1977

LEVINE, Gilbert, CAPENER, Harold and GORE, Peter
"The Management of Irrigation Systems for the Farm" in Agricultural Development Council, Research and Training Network: A Seminar Report, No.2, New York, August 1972

MYRDAl, Gunnar
Asian Drama
Penguin Books, Harmondsworth, 1968

PSANDARAN, Effendi and TAYLOR, Donald C.
The Management of Irrigation Systems in the Pekalen Sampean Irrigation Project, East Java, Indonesia,
Research Note No.01/76/RN, Agro-Economic Survey, Jakarta, March, 1976

REIDINGER, Richard B.
"Institutional Rationing of Canal Water in Northern India: Conflict between Traditional Patterns and Modern Needs"
Econ. Development and Cultural Change 23(1) October 1974

SWAN, C.H.
"The Management of Irrigation Schemes"
paper presented to the meeting on the Planning and Management of Irrigation Schemes in Different Social Environments, Overseas Development Institute, London, February 1975, mimeo

VALERA, Alfredo and WICKHAM, Tom
"Management of Traditional and Improved Irrigation Systems: Some Findings from the Philippines", paper presented to the Workshop on Choice in Irrigation Management, Overseas Development Institute, Canterbury, September 1976, ODI, London, 1976

WADE, Robert
"Administration and the Distribution of Irrigation Benefits"
Economic and Political Weekly, 1st November 1975

"Making Better Use of Water: Institutional Innovations in India's Command Area Development Programme", Institute of Development Studies, Sussex, mimeo, n.d.

"On Substituting Management for Water in Canal Irrigation"
Institute of Development Studies, Sussex, 1979 (forthcoming)

"Performance of Irrigation Projects"
Economic and Political Weekly 17th January 1976

"Water Supply as an Instrument of Agricultural Policy"
Economic and Political Weekly 25th March 1978

WICKHAM, T.H. and VALERA, A.
"Practices and Accountability for Better Water Management" in International Rice Research Institute, op. cit. (1978) pp.61-75

WIDSTRAND, Carl (ed.)
The Social and Ecological Effects of Water Development in Developing Countries,
Water Development, Supply and Management, Volume 7: Water and Society, Conflicts in Development, Part 1, Pergamon Press, Oxford, 1978

WILLENS, Alan F.
"Classification and Evaluation of Irrigation Systems - Notes on an Agronomists's Point of View", paper presented to the meeting on the Planning and Management of Irrigation Schemes in Different Social Environments, Overseas Development Institute, London, February 1975

WITTFOGEL, Karl A.
Oriental Despotism: A Comparative Study of Total Power
Yale University Press, New Haven, 1957