RESEARCH PRIORITIES IN WATER DEVELOPMENT
WHAT KIND OF RESEARCH DO WE NEED NOW?

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Contents

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This paper speculates on factors influencing priorities in water-related research, suggests complementary and corrective approaches, and sketches some of the priorities which might emerge from using them. The values underlying judgments in the paper concern improving the levels of living of the people, especially the poorer people, in rural areas of the third world. Throughout, "research" includes Research and Development (R and D), and the "natural sciences" are the physical and biological sciences.

The justification for thinking about priorities in water-related research lies paradoxically but precisely in the complexities and difficulties of water as a focus. Its ubiquity in the biosphere and its critical part in photosynthesis and in plant and animal life; its elusive nature, changing so often from one form or medium or combination to another, making it hard to keep track of and measure; the many sources from which it is obtained by man, including condensation, rainfall, springs, rivers, pools, dams and wells; the great number and variety of techniques which are used for allocating, appropriating, transporting and storing it; its many uses by man including drinking, washing, cooking, cooling, watering animals, irrigation and recreation; its seasonal but variable supply to and removal from rural environments through tropical weather, setting the patterns of cycles of work and leisure, of health and sickness, of abundance and austerity, of festivals and fasting - these make it as important as it is difficult to encompass it in a balanced view.

It is no surprise, then, to find many disciplines engaged on water-related research, including climatology, geology, hydrology, soils science, geography, engineering, agronomy, botany, zoology, medicine, sociology, social anthropology, economics, and most recently political economy, to name but some of those that are prominent in the tropical rural context. With so many specialised points of entry, the danger is that no one will take a balanced view because no one is competent to do so. In these circumstances, multi-disciplinary approaches are called for, but may be merely assemblies of narrow searchlights which illuminate some faces of

the subject but leave others in darkness. Interdisciplinary research may similarly involve the exchange of insights and methods between disciplines, but may still leave gaps between them. The solution, it will be argued, lies in a different approach to identifying concerns and priorities and in a bold readiness to explore gaps.

An Agenda for Introspection

What factors determine priorities is a question for empirical research. There is no intention in what follows to denigrate good work in the great range of water-related research which has been undertaken, and which in any case the writer cannot hope to know about. But in trying to improve decision-making about priorities, one must ask whether there are influences, conscious or unconscious, which bend research choices and designs away from what on a stricter and broader view would be higher priorities. The points which follow are less assertions of fact than an agenda for introspection for those concerned. They are:

professional training and prestige
biases of dominance
difficulties studying water
a problem-orientation

First, to what extent are research priorities influenced by the skills and concerns of the professions and disciplines available? 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 water such as these, and is programmed with relevant research skills. Moreover, professional prestige and advancement are achieved through work which is highly regarded by professional colleagues. Research tends to use conventional methods and, in Thomas Kuhn's terms (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?

Second, and closely linked, are research priorities subject to biases of dominance, reflecting flows from cores to peripheries: from North to South, from temperate to tropical, from industrial to agricultural, from urban to rural, from research station to its surrounds, from scientist to the (rural, human) objects of scientific investigation? Such flows have in common a top-down, centre-outwards, elitist character. Wisdom, skill and power reside in the centre and are deployed outwards. The political dimensions need no elaboration but the technical aspects are also significant. The disciplines themselves have evolved and become differentiated for other priorities in other environments. The application of disciplines evolved in temperate, rich, industrialised countries may leave gaps or may in other ways be inappropriate in a tropical, poor, rural country. An example of a gap is the management of irrigation bureaucracies, a key subject neglected partly because it was the province of no easily available temperate climate expertise. An example of inappropriateness is the treatment of land and water in agricultural economics. Temperate agricultural economics without irrigation can treat land as a proxy for water since there is a linear relation between the two: land is water-augmenting since water comes from the atmosphere. In tropical countries the position is often reversed: water, through irrigation, is land-augmenting. It can be asked whether the biases of temperate agricultural economics diffused through professional dominance have not nurtured a tendency, even where water is scarcer than land, to think of yield per unit of land rather than per unit of water, diverting research from critical questions.

Third, are priorities partly determined by the nature of water itself? Not only does it combine with and separate from many other inorganic and organic compounds, but in its uncombined forms it flows, seeps and percolates, evaporates, freezes, thaws, condenses

and transpires. The weather brings it rather unpredictably into rural environments and then takes it out again. So difficult is it for scientists to measure that they are driven to sharpening the focus of research to make their work manageable and their findings precise. Their searchlights, as it were, narrow their beams to shed a more intense light on a smaller area. As prudent researchers they study the studiable, not only for their PhDs but also for their professional lives. They may even not try to measure some of the water transferences which, though important, are especially significant (of which the evapotranspiration from water plants and the water around them may be an example). The problems posed by water as an object of study may, indeed, serve to draw the disciplines apart from one another, or together into rather tight clusters. May the outcome be a sort of micro-myopia, an obsession with one small scene to the neglect of its surroundings?

Fourth, are research priorities influenced by a problem-orientation and the selective manner in which problems are perceived? The more obvious problems posed by water include health hazards, floods, droughts, erosion, pollution, silting, and declining water tables. These are all negative aspects of water, problems which with time may become more acute, acquire a political dimension, and generate a demand for research. Such research may of course be fully justified. The point is, however, that it is reactive; it is responding to problems which are either visible or political or both. The research is then intended to some extent to identify correcting mechanisms, to contain or overcome the problem or to restore the status quo ante. Research resources may be well employed on such tasks, but they are also preempted from alternative uses. Can a problem-orientation, in this sense, have high indirect costs through preventing an opportunity-orientation with a more positive approach of seeking to increase the productivity or usefulness of water?

These four linked factors - professional training and prestige, biases of dominance, the difficulties of water-related research, and a reactive problem-orientation - might be extended by adding others. Enough should have been said, however, to provoke the reader who is concerned with water-related research to ask self-critically what factors determine priorities and whether those priorities, from the point of view of the rural people, especially

the poorer rural people, are suboptimal. Are the values on which "good" research is judged derived from rural needs or from professional training? From the peripheral rural reality or from the dominant norms and ways of thought of the elitist core? From the place of water in the lives of rural people or from the problems of researching and measuring it? From the opportunities for improving the use of water or from the problems which it creates? To what extent is "good" research, consciously or unconsciously, research which is methodologically sound, designed to refine a paradigm, related to earlier respectable research, requiring sophisticated equipment and measurement, and enabling the researcher to enhance his reputation with a tidy, citable, footnoted paper with tabulations to two places of decimals, published in a hard international journal? Which, in short, determines priorities more - the rural situation and the needs and wishes of rural people, or the professional situation and the needs and wishes of professionals?

Towards a Balanced Determination of Priorities

Priorities are related to values. If the values stated at the outset of this paper are accepted, then there may be a case for a balancing reversal of flows in determining research priorities, namely: that they should follow not from the urban, rich country, Northern inclinations and perceptions of a professional elite but from the interests of poor rural people; that the prime criterion for good research should be that it is likely to mitigate poverty and hardship among rural people, especially the poorer rural people, and to enhance the quality of their lives in ways which they will welcome; that, in short, priorities should be arrived at less by an overview than by an underview, grounded in the reality of the rural situation. Starting with rural people, their world view, their problems and their opportunities, will give a different perspective. To be able to capture that perspective requires a revolution in professional values and in working styles; it requires that scientists should learn the skills and approaches of anthropologists; it requires humility and a readiness to innovate which may not come easily in many research establishments. The approach at first must necessarily be experimental, involving R and D on R and D.

In determining research priorities, more specific criteria are also needed. Some of these will be elicited from the rural people themselves, and will vary from place to place. Others are a matter of personal choice. One short list is:

(i) productivity. Insofar as water is scarce, research should pay attention to its sparing use and productivity

(ii) equity. Research should be directed to making access to water more rather than less egalitarian, and using it to diminish inequalities between individuals and between families.

(iii) stability. Research should be directed towards achieving stable and renewable water supplies.

(iv) quality of life. Research should be directed towards enhancing the quality of life of rural people in ways which they welcome. These may include the generation of livelihoods for the poorer rural people, the alleviation of drudgery, the elimination of food shortages and the reduction of disease.

(v) non-seasonality. Less obviously, water in tropical climates (much more than in temperate) is a determinant of seasons. Much poverty is reinforced by seasonality; shortages of food and sickness during cultivation limit the crops grown; crops go in distress sales at harvest when prices are low in order to pay off debts; and the next season's cultivation is again limited by shortages of food and sickness. Water may often be a key to reducing the worst effects of seasonality and helping people to escape from this particular poverty trap.

An Approach through R and D on R and D

The approach suggested to counterbalance current biases has five main complementary elements:

(i) working with and learning from rural people. Rural people know what their life is like and what they do. They know when

water is available from what sources. They know how they transport it, how they repair their receptacles, how they manage their irrigation, and how they use water domestically. They know the problems they experience and where it hurts. The housewife in her hut or the farmer in his field may lack specialised technical knowledge but their non-disciplinary underview is more balanced in the range of its insights than the disciplinary overview of the visiting scientist. A first step, then, is to learn how to learn from rural people. A second step is to understand their daily life and needs and to identify problems and opportunities. And a third step is, with them, to develop ways of overcoming those problems and exploiting those opportunities.

(ii) holistic appraisal. The entire rural environment, including its micro-environments, is potentially relevant. What has been called a "Gandhian-Systems Approach" (Chaturvedi 1976:75) can be developed to combine the holism of villagers with the technical insights of outsiders. Care is needed to follow water through its flows, allocations, appropriations, transformations and uses, including stages and aspects which do not fall neatly into the lap of any specialist. The linkages between the physical aspects and the human behavioural aspects may need special attention.

(iii) opportunity-orientation. A reactive problem-orientation - dealing with bilharzia, floods, salinity, drought and the like - is useful but should be balanced by a positive opportunity-orientation which sees water as a resource capable of multiple exploitations in conjunction with other resources.

(iv) creative lateral thinking. Because much research is cramped by disciplinary rigour, the scope for creative lateral thinking may be extensive. In identifying research priorities in any field, there is a stage for encouraging flights of imagination to generate new ideas, a few of which may turn out to be very useful. To pursue this approach needs innovation in the social psychology of research. In particular natural scientists and social scientists have much to gain by questioning one another and learning from one another how to see familiar questions from new angles. This suggests free interaction between disciplines and the exchange of insights, ways of thought and modes of analysis. It requires that those taking part should be open and undefended; for it may be only by becoming

vulnerable to one another that a group of people can be optimally inventive.

(v) practicality. It is not enough for research to establish new knowledge. That new knowledge has to be applied. It is here that both natural and social scientists so commonly and so disastrously fail. Adept at analysis and criticism, they are inept at making the leaps from understanding to prescription and from prescription to implementation. One corrective is a much closer involvement in longer-term action research with opportunities for iterative feedbacks between programme experience and analytical research. Another is that professionals involved with rural water should themselves take part in implementation.

An Illustrative Gap: Irrigation Management in Sri Lanka

Some of these points can be illustrated from an example in the field of irrigation (for more detail see Chambers 1975:2-5).

Large-scale irrigation systems have attracted much attention. Proposals for new systems are subjected to intensive investigation by teams of high-powered experts. The assumption has been, it seems, that if a team was sufficiently multi-disciplinary, all relevant aspects would be covered. In the case of the Mahaweli Ganga project in Sri Lanka, the largest irrigation project in the island, many international experts were mustered to investigate, scrutinise and develop proposals. Each did what he knew how to do. They concluded that although 1.5 million acres were potentially irrigable, only 900,000 acres could be irrigated because of shortage of water. This being so, a critical issue in their appraisal, it might be supposed, would have been the organisation and operation of the bureaucracy which was to control and issue the water. It was already well known in Sri Lanka that permissive issues of water by irrigation staff (notably on the Gal Oya project) were a major factor limiting the acreage irrigated. The multi-disciplinary team was, further, explicitly enjoined to examine organisational and management problems in existing irrigation and settlement schemes. In the event, however, there is little in the three volumes of their main Report that has any bearing on the organ-

isation and operation of the proposed irrigation system. Although the third volume is entitled "Organisational and Management Requirements", the main presentation on irrigation management is less than a page and is concerned with organisational structure and not with operating arrangements, compared with an average of 8 pages each for four other subjects: the supply of agricultural inputs; marketing; agricultural credit and cooperatives; and agricultural research, extension and education. What might have been considered the most central question of all is almost completely ignored.

For our purposes it is revealing to look at the report of the sociologist (Barnabas, 1967). As might be expected, he conducted surveys: one of people in irrigation colonisation schemes; and one of colonisation officers. At least three of his survey findings pointed straight at lower level water management as a concern. For example, when people were asked "what more do you want the administration to do for you?" a majority mentioned better irrigation facilities; and in reporting this he comments "It seems that the functions of the Irrigation Department need to be looked into in the Colonies". But at the end of his report there are 23 recommendations, none of which mentions water. In this example, the sociologist, starting by learning from the local people, was pointed straight at a key central problem but neither he nor any of his colleagues were able or willing to follow up the pointer.

The lessons are useful. Making a team multi-disciplinary does not necessarily mean that all relevant aspects will be covered. The most significant aspects may not be in the domain of any available discipline, as in this case. Nor will calling the research "inter-disciplinary" necessarily help. Inter-disciplinarity can mean collaboration and exchange of ideas and methods between disciplines. It by no means ensures a holistic view of an environment, and may also leave gaps. In contrast, asking the rural people in this case did point to a gap - the organisation and management of irrigation control staff - which presented a major problem and opportunity but which the multi-disciplinary team did not tackle.

The management of those who operate canal irrigation systems has since become a subject for research, notably in the pioneering

work of Anthony Bottrall (c,1975: ff) and Robert Wade (1975, 1976a, 1976b). For the future a body of knowledge and an expertise should gradually be developing for use on appraisal teams and consultancy. That it does not already appear to exist is a dramatic illustration of the inappropriate conservatism of core-periphery disciplinary flows. Work in such a no man's land does not in the short run bring conventional professional rewards; but in the long run its contribution to development and to the poorer rural people may be out of all proportion to the numbers of people who undertake it. What is difficult to understand is the blindness and lack of imagination which failed earlier to identify this gap and to encourage and sponsor research on it. Finally, this example raises the wider question of what other gaps there may be for similar reasons in other water-related fields.

Some Priorities for Research

It may be rash, having argued that priorities should be generated from a holistic view of particular environments, to suggest priorities which may have more general application. Each reader will have his own ideas arising from his own experience and imagination and the environments which he knows. Suffice it here to list some of the fields where changes following on from water-related research might help rural development generally and the poorer rural people in particular. There are, of course, many other priorities. The point of mentioning these is that they follow on from the argument and may not receive the attention or resources they deserve.

(i) water reform. The potential for increased agricultural production and more equitable distribution of water to farmers on existing medium and large irrigation systems is probably enormous, not least because production potential has been greatly enhanced by the new agricultural technologies of the past decade. But, as already seen for Sri Lanka, performance on most irrigation systems is very inefficient and falls far below expectations. In Pakistan, for example, it has been calculated that improved management on existing irrigation could save more than three times the water that will be supplied by the Tarbela dam (costing $1.2 billion). More generally, the supply of water is frequently inequitable, with

those at the head receiving more than their fair share, and those at the tail receiving amounts which are small, uncertain, and untimely, if indeed they receive any water at all.

Diagnosis tends to be inadequate because of disciplinary blinkers. Engineers are concerned with physical works and water flows, agronomists with crop water requirements, sociologists with organisation and access within communities, and economists with the costs of water. None of the prescriptions which flow from these narrow views - bigger and better works and maintenance for the engineers, more predictable and appropriate water deliveries for the agronomists, methods of conflict resolution for the sociologists and water pricing for the economists - tackle the central questions of how in practice water is and should be controlled and allocated by bureaucratic irrigation organisations. Again and again studies suggest that the decisions and actions of engineers, water supervisors, water guards and the like are critical for more productive and more equitable distribution of water; yet until recently almost nothing has been known about them.

The priority here is for research on what may be termed water reform - the organisation and management of irrigation bureaucracies to ensure more productive and more equitable distribution of water. Such research is as difficult as it is important. It should include case studies of successful reform, research in the tradition of social anthropology on the lives, actions and rationality of staff members in irrigation bureaucracies, and action research and evaluation in implementing reforms. Such research, involving as it often may a corrupt bureaucracy and staff who may be few and easily identified in any written account, presents special problems. But it is far too important to be neglected and a high priority should be to build rapidly on the work of Bottrall and Wade, especially with action research.

(ii) <u>traditional domestic technology</u>. Little research appears to have been done on traditional domestic technologies for the extraction, transport, storage and use of water. They may have received little attention partly because they tend to concern women more than men. Some possibilities may be: the design of techniques for conserving domestic water for washing, cooking etc., including recycling it through solar stills; the design of cooking pots to

conserve water; and cheap storage for roof-runoff rainfall (as developed in Kenya); and even, where water is distant, the use of gas balloons to carry water, towed by men or animals.

(iii) water-appropriating technology. The design and choice of pump technology in particular has potential for social engineering through decisions taken, especially about scale, during the R and D process. Larger horsepower pumps favour larger farmers who can then appropriate more of the communal groundwater. Smaller pumps give a better chance to smaller farmers and may generate more livelihoods. Change has been rapid in pump technologies and is likely to continue to be so. Possibilities for the future include solar pumps; pumping systems which use human power more efficiently; improvements to existing animal lift systems; the conjunctive use variously of wind, solar and human or animal power for pumping; and linked livelihood-intensive methods for water application in irrigation.

(iv) water conservation and storage. Among the most obvious possibilities are the old opportunities presented by reducing evaporation from open bodies of water (windbreaks, shade, rafts, vegetation, chemical films), reducing seepage from channels, dams and tanks (the engineer's dream, expensive with concrete and awaiting a very cheap harmless technology); and the artificial recharge of groundwater (still at a rather primitive level). The benefits of such developments might be appropriated by rural elites but they should usually benefit the poor through making available more water for more of the year. It is surprising that there have not been more breakthroughs in this sphere. (It may be noted that such breakthroughs would be no substitute for water reform.)

(v) slack resources for the poor. Even without land or water reform, water often presents a slack communal resource for part or all of the year. Without loss to local elites, ways might be sought whereby the poorer people could exploit this resource. Some examples might be: in villages with seasonal village tanks, growing and harvesting aquatic plants for fertiliser (either N-fixing blue-green algae, or larger plants); where flooding occurs, anchored bamboo baskets for growing fish fingerlings, or floating gardens; in irrigation canals, floating cages of fish (as proposed by

Daget 1976), perhaps fed on weeds which otherwise would harbour bilharzia - host snails; with dams, cultivation on the seasonal draw-down margin; or in villages, the impounding and use (for fish-farming, for irrigation) of run-off water from the village area. Particular attention might be given to the seasonality of the slack resource. Often it may be that it is slack and exploitable during and following rains, at precisely the time of year when the poorer people may be shortest of food and therefore likely to benefit most.

Conclusion

The most evident conclusion is the humbling one that we have much to learn. This applies between disciplines, especially between the natural sciences and the social sciences. But more importantly, we have much to learn from rural people who can point our attention in directions which are important to them but which we might not see on our own. Their knowledge and their insights, coupled with open-minded and imaginative research by those from outside, provide the best means of ensuring that gaps are filled, problems solved, and opportunities exploited.

RJC/SH

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