Environmentally sound irrigation projects

by Linden Vincent

A review of the 1980s as a decade of learning in irrigation management, leading to guidelines for greater actual advancement in environmentally sound irrigation projects by the year 2000.

IRRIGATION IS PRACTISED in many very different environments, some of which have been stable for hundreds of years. It has enabled a vital expansion in the production of foodstuffs that has helped to support greatly increased populations, and has reduced the likelihood of famine in many countries as well as supporting production for industry and export. Yet in issues of resource allocation and environmental impact, few development initiatives raise more debate and controversy than irrigation. In the race to increase output from irrigated production, technologies have often been taken up without a full appreciation of the political, social and economic structures that can provide environmental stability. Thus in irrigation development, whether intensifying traditional schemes or constructing new projects, the scale of potential improvements in production, employment and welfare can often be counteracted by risks of environmental degradation.

What have irrigation practitioners learned from the past to help design and achieve environmentally sound irrigation schemes in the 1990s, and what dilemmas do we still face? What new challenges are facing us from new technologies, increasing water scarcity in some areas, and the tough financial climate of the late twentieth century?

The 1980s was an important decade for understanding the links between environmental management and development issues. We came to understand that we not only needed to prevent the degradation and loss of land and water resources, but we also needed agricultural systems with reduced dependence on non-renewable energy inputs, the use of which can also contribute to reduction of land and water quality. We not only gained a better understanding of the processes of degradation, but understood that, while the activities which caused degradation could be the result of local mismanagement, more often they had their roots in wider economic and social crises at the regional, national and international level.

Table 1 presents a summary of the issues which influence the prospects for promoting environmentally sound irrigation development. This shows the activities that can cause imbalance in resource management, and the themes of intellectual and political analysis that can help develop appropriate irrigation strategies. The activities are summarized in relation to different scales of analysis for degradation and sustainability, although of course there are many interrelationships. Generally speaking, we have made a lot of progress in understanding the myriad causes of degraded irrigation environments, and the negative impacts that irrigated areas can have on their surrounding regions. We have, however, been less successful in developing appropriate changes in resource-management techniques and in making more environmentally sensitive economic plans and development decisions.

A full discussion of all the items in

Upstream deforestation increased flood flows and silt loads, destroying these irrigation canals in Tanzania.

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Table 1 is beyond the scope of this paper, which will focus instead on four issues of irrigation management where we may see improvements in the 1990s: livelihood security, construction, drainage, and health. For these issues we not only understand how they contribute to degradation, but have begun to promote physical, economic and social changes that will lead to better irrigation practice.

Secure livelihood

Irrigation must provide a secure livelihood: for most communities this means that promotion must be profitable and feasible at available levels of labour and technology. In some cases irrigation is better as a supplement to rain-fed production activities rather than as a complete farming system on its own. Poor profitability, or over-zealous and inappropriate production targets, may lead to the reallocation of water, land, or labour to other crops or livestock interests, the part-time cultivation, or even the abandonment of land. All these can contribute to inefficient and inadequate water use and poor soil management. A reasonable and reliable income not only provides protection from poverty, but will encourage involvement with issues of water and land management. Profitability also enables the producer to pay water charges, and repay other loans thereby ensuring an adequate water distribution and maintenance service.

To gain a secure livelihood from irrigation, the irrigator must be able to obtain the water required for the crops sown, to sell or exchange the goods produced, and generally have sufficient funds to cover any additional domestic needs. We saw successes in the 1980s in improved water distribution and management which provided farmers with a reliable water source, and in the improved collection of water charges and their use to support more efficient management and maintenance. The 1990s will see further studies of bureaucratic decision-making, and many training programmes as organizations try to improve and streamline their services and manpower. We will also see many programmes of modernization of infrastructure, as water conveyance and distribution is altered to suit economic needs and social organization.

We can, however, still see problems in the synchronization between production and markets. The 1980s have seen studies of the renovation of production programmes, and of crop diversification in areas affected by changes in international markets, such as rice production in Asia. Many irrigated areas, however, still face problems in balancing specified production targets, often providing foreign exchange, with food needs and local market opportunities. Some countries do not have pricing policies that support irrigated produce, in order to keep food cheap for the domestic market and to compete in world markets. Domestic needs and potential in livestock-keeping and fuelwood production still tend to be poorly planned and integrated in newly irrigated farming systems. Until we think more about the livelihood of the producer, rather than only about the goods produced, we may continue to see unsustainable land and water use practices.

Table 1. Issues influencing environmentally sound irrigation development

1. The local production environment
- water control
- pesticide and fertilizer pollution
- crop choices
- cropping practices
- water - and/or rodent-based diseases
- livestock and fuelwood management

2. Sustainability of local irrigation practices
- technology choice (delivery and application)
- infrastructure maintenance
- energy availability
- water availability
- adequate drainage
- soil fertility maintenance

3. Interrelationships of irrigated areas with their surroundings
- upstream vegetation change affecting silt loads and flood risks
- impact of irrigation schemes on neighbouring agricultural systems
- water quality and quantity consequences for other uses
- mining of water reserves
- drainage and development of wetlands
- upstream pollution reducing water quality for irrigation

4. The world economic system
- debt and structural adjustment reducing government funding
- global market oportunities and limitations
- aid criteria for irrigation development

5. Adequate intellectual tools
- technical understanding
- farmer participation
- flexible design methodologies
- environmental economic techniques
- cost allocation techniques
- understanding interrelationships between irrigation practice and social change

6. Adequate political tools
- means to co-ordinate private and state development
- forums to debate resource allocation problems
- involvement of farmers in management
- appropriate personnel and policies for technical assistance and management
- appropriate personnel and policies for financial assistance and management

Construction standards

The necessity of ensuring good construction standards for irrigation infrastructure and providing for their maintenance is vital. This can reduce water losses and seepage and provide better water control, lessening waterlogging or soil erosion. Governments and donors alike were shocked in the 1980s by the scale of renovation needs, sometimes of irrigation fabric only 10 years old. Causes include poor and incomplete construction; the creation of structures inefficient or inappropriate for water distribution; poor maintenance, and the fragmentation of responsibilities between designers, construction teams

and the subsequent management and maintenance teams. Renovation will, together with modernization, be a major theme of the 1990s, and improved supervision enforcing higher standards brings us some hope for better construction in the 1990s. Some countries and aid programmes will help to develop or strengthen national construction agencies or sections of irrigation agencies, to reduce costs and increase accountability.

Drainage design

Proper drainage design, implementation and maintenance to combat waterlogging and salinization is crucial. The 1980s has seen research into the processes of salinization as well as both physical and chemical techniques for reclaiming soils. Causes of salinization include: delays in the construction of drains after irrigation commences; resistance to funding the optimum density of drains recommended (particularly in the early years of new projects when irrigators may be using a lot of water); and failure to develop appropriate leaching programmes manageable by farmers.

For the 1990s, where irrigation managers and farmers have the technology and the funds to implement it, we will see fewer problems from salinization, and more successes in the reclamation of degraded, irrigated land. Shortages of land and water are, however, pushing governments into developing vulnerable soils, and into using deep mineralized groundwater reserves. Greater irrigation development within river basins will increase salinity levels of water downstream, while general shortages of water may require the reuse of water. The pressures of water scarcity are promoting the development of many new designs in the area of high-lift pumps, water purification and soil-reclamation technologies, but we still need new policy guidelines for integrating them into existing irrigation practice for control of salinity.

Health aspects

A fourth area where much has been learned has to do with the links between water and health. We now know much more about diseases with vectors associated with water, such as schistosomiasis, malaria and guinea worm, and about links between health and water quality, especially the effects of algal blooms and chemicals that can often be traced back to the indiscriminate use of fertilizers and pesticides. Much, too, has been learned about rodent infestation, which does great physical damage as well as providing a health risk. We should see much healthier irrigation environments in the 1990s, through better hygiene education and better incorporation of health issues in the planning of irrigation schemes. However, much will also depend on adequate social and extension services, to provide advice and treatment, and on the motivation and prospects for farmers to maintain their surroundings.

Farmer participation

There are many interrelationships between these four issues, but the pivotal one is the link between the farmers and the water and land they use. It is no surprise, therefore, that farmer participation in design, management, renovation and modernization has a critical impact on the functioning of irrigation schemes. This has been a major theme of research in the 1980s, and is perhaps the tool most likely to give us environmentally sound irrigation in the 1990s, especially as international problems of indebtedness and structural adjustment reduce the funds available to run irrigation bureaucracies, and encourage the decentralization of irrigation management.

Funding

Appropriate investment decisions and adequate funding for infrastructure, drainage and maintenance are a second critical focus. We now know much more about the strengths and weaknesses of economic planning and forecasting methods, and many aid donors are including health and environmental impact criteria in their finance decisions, but we know there are still inadequacies in our methods. Increased competition for what may be smaller amounts of aid money in real terms increases the responsibilities of donors to make decisions that will give adequate financial resources and technical guidelines to the projects they do fund, and to resist political pressure to fund projects where the environmental outlook is unstable. We know too that the private sector must be made to use appropriate financial and environmental assessment techniques. In many countries of the world, it is the private sector which has developed much of the irrigation: the screening and credit procedures of banks should be tightened and integrated with agencies with environmental and agricultural responsibilities.

Date production in the saline soils of a Tunisian oasis.

Technologies

If, then, we now have the ability to stop some of the degradation associated with irrigation, how have we fared in the field of renewable inputs into irrigated agriculture? In terms of providing nutrients, much irrigated agriculture still remains heavily dependent on chemical fertilizers and pesticides, despite the problems of cost and availability. The energy required to mobilize water will also be an issue in the 1990s, as competition for power has an increasing impact on the availability and cost of irrigation water.

On the one hand, we have the potential of water itself to generate power. The 1980s has been a decade of progress in the development of smaller hydroelectric installations, and particularly the uptake of micro-hydro equipment not requiring water storage. Hydropower development tends to bring more prospects for new irrigation activity, but to have variable impact on former irrigation practice. Micro-hydro can provide the power to lift water, and with larger power projects based on dams, the water stored is often also used to support irrigation schemes. With traditional irrigation, however, dams often interfere with downstream patterns of water availability and take wetland sites used for seasonal irrigation, recessional agriculture or grazing. Even the smaller micro-hydro plants may change the timetable over which water is available for different activities in the local community. Overall, however, we should see a more responsible approach to

hydroelectric development in the 1990s than in the previous decades.

On the other hand, the impact of renewable energy technology on water lifting generally remains somewhat variable. This is partly a reflection of the limitations of technology, but also reflects the difficulties of competition with conventional energy sources, which are often subsidized or benefit from economies of scale and reduce demands for labour or livestock. The main technical limitation is the trade-off between volume and lift. Where the height for water lifting is less than five metres, water, wind, human, animal and solar power have considerable potential.

While we can only hope for more developments in water lift technology based on renewable energy, we also need more specific polices for the promotion of existing technologies. In the 1990s, competition for power should bring about major revisions of fuel costs and electricity tariffs, making renewable sources more competitive and reducing wastage in use of conventional energy sources. Renewable energy sources will never be able to provide all our water-lifting needs for irrigation, especially as groundwater development goes ever deeper. However we still need better training in the potential, maintenance and marketing of renewable energy technology, so it can be better integrated with conventional sources. We also need electricity pricing policies to promote efficient energy use.

Challenge of scarcity

In effect, we have found procedures for promoting environmentally sound irrigation where we have combined our understanding of the causes of environmental mismanagement with attempts to find economic and political solutions that better manage irrigation technology and water resources. Our problems for irrigation in the 1990s remain the issues for which such a nexus has not been developed - where we do not have the technology, or where we do not have the financial or managerial commitment to developing or maintaining the technology, or where we do not have the political forums that can resolve resource management issues raised by controversial irrigation projects or new water mobilization technologies.

The challenge for the 1990s in sustainable irrigation management can be summed up in one word—scarcity. Scarcity of funds, at the national and international level, will be creating particular pressures on the development and management of larger irrigation schemes. Lack of money may undermine our ability to implement the reforms we now want in renovation and modernization, and particularly work on salinity control. Scarcity of reliable markets may reduce the incomes of irrigators and irrigation agencies and undermine the prospects for maintenance of the irrigation environment. Scarcity of land will continue to put pressure on the development and renovation of irrigation as it underpins more reliable and higher levels of output of food crops and industrial crops. Scarcity of water will lead to ever greater intervention in the hydrological cycle for controversial water storage schemes, over-development of groundwater resources and the deliberate exploitation of fossil groundwater reserves, with increasing international repercussions. Scarcity of energy will raise questions about the viability of certain irrigation technologies and affect the incomes of many irrigation farmers.

The crucial issue as we begin the 1990s, however, is the scarcity of commitment, despite the environmental concern we voice. The challenge for irrigation development is the same as for other environmental interventions. We know what the issues are, and have developed solutions where the problems are not related to the constraints of the international economic order. However, we have still so far not felt sufficient international obligation to develop the incentives, the controls and the sharing of resources that will really enable farmers to practise environmentally sound irrigation. The 1980s have been an important decade of learning in irrigation management: it is hoped that *Waterlines 2000* may be able to look back on a decade of greater actual achievement. ■

A secure livelihood for irrigators encourages reliable maintenance and better water and land management.

Coming in the July issue

The July issue of Waterlines will focus on Urban and Peri-urban Projects, and will be co-ordinated by Professor John Pickford of WEDC. Articles will include:

- Water pollution and control measures from China.
- Water for the urban poor in the Honduras.
- Bangkok's deteriorating groundwater.
- Slum upgrading in Peshawar and Lahore.
- Reduced-cost sewerage.