Irrigation Management and Human Health: A Perspective from IIMI

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Introduction

Water is a critical resource affecting tlic fundamental welfare of primary producers throughout today's world. Especially in less-developed countries **(LDCs)** human well-being and productivity are directly affected by the nature. source, and use of water supplies for agricultural production. household consumption, and disposal of wastes. In areas served by irrigation facilities, the nature of the irrigation system and its management may affect not only the agricultural productivity of rural people, hut also their general health. Health consequcnces of irrigation derive from the effects of changes in the environment on the prevalence of water-related diseases such as malaria.

Irrigation and Agricultural Production

The need for increased agricultural production is critical in many LDCs because of their population and income growth which creates a rapidly rising demand for food. For **an** increasingly large number of LDCs, reliance **on** the expansion of cultivated area to meet increased food demands is no longer economically attractive. Attention has shifted to methods of increasing the intensity with which existing agricultural land is used. This involves tlic development of biological and chemical technology that can increase the yield per unit of cultivated area. Efforts in this direction have met with considerahle success. particularly with rice and wheat.

The full potential of the new technology can he realized only if water is carefully controlled. As biological developments permit an increasing nunihcr of crops to bc grown per year on a given piece of land, irrigation often hccomes the primary production constraint. The new technology has thus greatly expanded the potential economic return from irrigation development and improvemcnt. Irrigation is frequently considered to be the key link in the chain of technical developments leading to increased production.[2]

These conditions havc resulted in substantial investments in new and improved irrigation facilities, particularly in **Asia** where this trend is likely to continue for the remainder of the century. Irrigation investment estimates to meet food production target? lor a 15-20 year period in Asian nations range from US$42-53 billion expressed in 1975 dollars.[3]

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[2]Asian Development **Bank.** 1978. Rural Asia Challenge and opportunity in Second *Asian Agriculture* Survey, Vol 1. manila, Philippines. p127 Herdt, R.W. 1980 Stud ***es*** in water management economics at IRRI. in *Report of* a Planning ***Workshop*** on Irrigation Management. Los Banos, Philippines. International Rice Research Institute (IRRI) ppl15-138.

Herdt, R W. and T.H. Wickham. 1978. Exploring the gap **between** potential and actual rice yields. The Philippine case, in Economic Consequences *of* the ***New*** Rice *Technology*. Los Banos, Philippines. IRRI. pp3-24. International Rice Research Institute. 1980 Report *of a Planning* Workshop *on Irrigation Water Management.* Los Banos, Philippines.

[3]Colombo, U., D. G. Johnson, and T. Shishido. 1978 *Reducing Malnutrition in Developing Countries: Increasing rice* production in *South* and *Southeast* ***Asia.*** Report of the Trilateral North-South Food Task Force to the Trilateral Commission, **Triangle** Paper No. 16, June. Food and Agriculture Organization of the United Nations 1980 *Agriculture Toward* ***2000:*** Regional *implications with* special ***reference*** *to* the *third* development decade. Prepared far the 15th FAO Regional Conference **far Asia** and the Pacific, **New** Delhi, March 5-13 Oram, P.. J. Zapata, G. Alibaruho, **and** *S.* Roy. **1979.** *Investment* and *input requirements for* **accelerating** *food production in low income countries by* ***1990.*** Washington, DC: International Food Policy Research Institute (IFPRI) Research Report No. 10

The enthusiasm for irrigation as a key to increased food production has frequently not been matched by results. Numerous problems have lowered returns considerably below original expectations. It is now widely recognized that constructing dams and canals will not automatically lead to substantial increases in production. Attention has shifted toward an examination of problems in the operation and management of irrigation systems, and the types of investments needed to improve the management of these systems[4]

IIMI'S Research Program

Within this context the International Irrigation Management Institute (IIMI) was created. IIMI began operations in mid-I984 as an international organization whose primary purpose is to undertake research, professional development, and information exchange activities to enhance national capacities to improve the management and performance of irrigation systems.

IIMI, as a small, decentralized institute, must develop a research program that is clearly focused on broad problems of practical importance, both to those who manage irrigation projects and to those who make policies affecting the conditions in which the irrigation systems are planned, financed and operated. The research should not he limited to investigations of specific problems faced by a national irrigation agency but focus on problems with international application. The former problems are better addressed by national research programs.

During IIMI's first year, considerable effort was devoted to the delineation of an appropriate research program. These efforts included two international workshops held during 1985. From these deliberations came a framework which incorporates three general areas of investigation: main system management, rehabilitation and design for management, and small-scale irrigation.

Research on system management will include stucies on the operation of irrigation systems from the main head gates and canals to the individual farm fields. The program on rehabilitation and design for management looks at ways to more effectively upgrade both the physical and organizational components of deteriorated irrigation systems. Emphasis is placed on incorporating the knowledge and experience gained from past operation of the system. Research on small-scale irrigation systems will investigate the performance of systems operated in the absence of significant governmental involvement. A major objective is to understand factors critical to the successful operation of such autonomous systems, and to study the implications of proposed government interventions to upgrade them.

There are several dimensions to irrigation management, all of which need to he considered in undertaking research. As indicated in Figure 1, these dimensions apply to each of the three research program areas. In each, IIMI will he concerned with understanding the institutional and social dimension (the behavior of people, including government agency personnel, water users, and external consultants): the physical dimension (the movement, storage, upkeep, and utilization of materials and structures); the biological dimension (the manipulation of the biological environment); the information dimension (the acquisition, processing, and dissemination of information): and the financial dimension (the acquisition, control, and utilization of financial resources).

IIMI and Research on Health Iniplications of Irrigation Management

The relationships between irrigation and human disease vector populations fall under the biological dimension of irrigation management, an area of interest to IIMI. The objective of this workshop is

[4]Botrall, A.F. 1981. Comparative *Study* of the Management *Organization* of Irrigation Projects. Washington. DC: World Bank Staff Working Paper No. 458 May. Taylor, D.C. and T.H. Wickham (eds.). 1979. *Irrigation* Policy and the Management of Irrigation Systems in Southeast Asia. Bangkok, Thailand. The Agricultural Development Council. Svendsen, M.. D. Merrey, and W. Fitzgerald. 1983. Meeting the challenge for better irrigation management. *Horizons* 2(3):17-25.

Figure 1. Management dimensions of IIMI's research program areas.

Dimensions	Research Program Areas		
	Main System Management	Rehabilitation Design for mgmt	Small-scale Systems Mgmr
Institution &Social	X	X	X
Physical	X	X	X
Hiological	X	X	X
Informational	X	X	X
Financial	X	X	X

to determine how the problems of vector contrcl can be addressed through changes in irrigation management.

At least five approaches to dealing with vector-borne disease problems can he identified. One approach is that of environmental management, which has been discussed in a recent FAO publication[5] and by Dr. Shisler's workshop paper (in this volume). A second approach is to attack the problems through irrigation design. Canal lining, design of canals for relatively high velocities of water flow, and provision of deep drains with steep slopes are among the possibilities that have been suggested.[6] A third approach is the use of chemicals to reduce vector populations. Fourth, vector populations may he reduced through biological control methods, such as the introduction of competitors, predator; and infectious agents. Finally, a medical approach focuses on methods of immunizing or otherwise reducing the susceptibility of the human population to the diseases transmitted by the vectors.

Although the above five approaches to control of vector-borne diseases are frequently complementary, the critical questions which IIMI must consider with respect to any particular disease problem are: 1) to what extent is the environmental management approach likely to he a cost-effectin: method of control; **2)** assuming a positive conclusion to the first question, to what extent can the changes in environmental conditions induced by irrigation management techniques he expected to have a significant effect on the disease problem; and, **3)** assuming a positive conclusion to the second question, are there significant research questions regarding alternative management techniques which need to he considered, or is the problem simply one of implementing techniques which have already been proven?

In considering the second question, a distinction should he made between irrigation in semi-humid areas where the predominant crop is rice and irrigation in more arid areas where crops other than rice predominate. In the former case, which is typical of Sri Lanka, parts of India, and most of Southeast and East Asia, the nature of agricultural production dictates high groundwater tables and widespread areas of standing water. Under these conditions one needs to question the feasibility and/or the effectiveness of some of the management techniques suggested to control vector populations. Among these are changes in the water level of reservoirs, rotational irrigation, and alternate wetting and drying of irrigation channels. It has been noted in the Mahaweli Project that even when irrigation channels are closed between the two cropping seasons, erosion in the channel beds results in stagnant pools of water in the canals. Perhaps in such a water-dominated environment, effective control of vector populations can be achieved only as a result of a

[5] Mather, T.H. 1984. *Environmental Management for Vector Control in Rice Fields.* Rome, Italy: FAO Irrigation and Drainage Paper No. 41

[6] Kay, M.G. and R.C. Carter. 1984. Health hazards in irrigation development: A strategyfor improvement. *Outlook on Agriculture* 13(3):125-129.

[7] Jayaraman, T.K. 1982. Malarial impact of surface irrigation projects: A case study from Gujarat, India. *Agriculture and Environment* 7:23-34.

[8] Jayawardene, J. 1985. Water management practice; in Mahaweli Development areas, in *Intersectoral Collaboration for Malaria Control in Sri Lanka.* Colombo. Sri Lanka: Ministry of Health/Anti-Malaria Campaign, Report of a seminar. April 22-26. pp53-57.

broad-based environmental management program, of which irrigation management is a minor component. The situation may be quite different in areas where water is less abundant and crops are grown under non-flooded conditions.

As IIMI defines its research program and priorities, answers to the three questions posed above will be very important. A workshop to identify IIMI research priorities concluded that a number of important areas of investigation significantly related to irrigation performance, such as watershed management, should not be part of IIMI's research program.[9] To be effective, IIMI needs to have a research program which focuses clearly on irrigation management.

The fundamental question is whether the prospect for improvement in human health resulting from research on vector control through irrigation management justifies a major research effort by IIMI. If the conclusion is "yes," then we seek guidance on the types of research activities that would seem most promising; if the consensus is "no," the workshop will have been valuable in helping to clarify IIMI's research priorities.

[9] Small L E 1985 *Research Priorities for Irrigation Management in Asia"* Digana, Sri Lanka IIMI Research Paper No 1