From a Research Project to Information Techniques for Irrigation Systems (ITIS) Network

In 1986, IIMI's researchers embarked on a program on irrigation canal operations in Sri Lanka.

It was decided that the first phase of the program would consist of designing a user-friendly computer model, able to simulate the hydraulic conditions in canal systems. The objective was to provide managers with a tool which could assist them in operating their canals in a more efficient, equitable and flexible manner in the context of diversified cropping.

The Kirindi Oya Irrigation and Settlement Project was selected as the pilot experimental site in 1986, after a mission during which about 10 Sri Lankan irrigation schemes were visited. The Kirindi Oya Scheme was still under development and regularly faced water-shortage conditions. The Right Bank Main Canal, of a regular shape, appeared to be adequate for initiating the modeling exercise even though the managers did not show a real enthusiasm for the project at that time. The design of the computer software was subcontracted to CEMAGREF, and the Government of France agreed to fund the project. The complete story of the work undertaken and realized since then in Sri Lanka, a country which unfortunately had to face many periods of political unrest, is interesting in many ways. A few key points are mentioned below:

Project Monitoring

From the inception of the project, IIMI set up a Study Advisory Committee (SAC) comprising representatives of the donor, researchers and users. This committee worked in a very flexible and voluntary manner and played an important role.

Evolution of the Project

The first output of the project came in 1990 in the form of a hydraulic simulation software, tested by the canal managers, and immediately it proved to be useful for the improvement of some of the management rules in place. Nevertheless, it appeared at this stage that this tool alone could not answer the complete spectrum of the concerns expressed by irrigation canal managers. In 1991, the committee acknowledged the necessity to integrate it in a wider information system taking into account the need for dynamic data acquisition, transmission and storage. During a second phase of the project, the first prototype of the Irrigation Management Information System (IMIS) was designed and tested following these recommendations. Further work, enlarging on the experience gained through contacts in Pakistan and Mexico, permitted to begin a third phase of the project aiming at producing generic outcomes in terms of decision support which can be applied to a wide range of situations encountered in irrigation canal systems around the world.

Partnership

Conducting research in partnership with collaborators who have different cultures and who live in countries at different stages of development is challenging. A good understanding of the needs is a difficult exercise. In this case, the commitment of all partners from IIMI, CEMAGREF and the Sri Lankan Irrigation Department for sustaining a continuous dialogue and deriving orientations for the research proved to be determinant. The experience shared during the first phase of the project led to a better formulation of the needs and the emergence of the present research agenda whose relevance is confirmed by the interest it has generated in different countries.

In Pakistan, Mexico, Sri Lanka or almost in any other country on the planet, the production of food through agriculture is a major challenge. To meet this challenge, irrigation is essential. A good management of irrigation systems thus becomes essential for satisfying the food requirements of our increasing world population as well as for ensuring the sustainability of essential resources such as water and land. The work undertaken is a contribution towards this objective of better management of irrigation systems.

A successful project and a continuous effort for sharing the experience gained are key ingredients for setting up a network: ITIS. This network was in gestation in 1992 when

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The Network

The Information Techniques for Irrigation Systems Network (ITIS) links the conceptual to the practical—the world of Decision Support Systems (DSS) to the world of irrigation. This newsletter is intended to serve as that bridge, to facilitate the dissemination of knowledge concerning the application of information techniques for improving the management of water in irrigation systems.

The IIMI-CEMAGREF Project in Kirindi Oya, Sri Lanka was the foundation on which ITIS was launched. Following the successful development and implementation of decision support tools in Sri Lanka, the project has entered a new phase with work being initiated in Pakistan and Mexico. Work on the IIMI-CEMAGREF Project will progress for another five years. It is hoped that ITIS would have gained a sufficient critical mass by that time to sustain itself.

CEMAGREF

CEMAGREF is the French institute of agricultural and environmental engineering research. It is a parastatal organization supported by both the French Ministry of Research and the French Ministry of Agriculture. It has a strength of more than 500 researchers and conducts research programs in the field of land and water management, environment and agricultural engineering. Its irrigation division is located in Montpellier, France.

IIMI

The International Irrigation Management Institute (IIMI) is an autonomous, nonprofit international research and training institute supported by the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of public- and private-sector donors that supports a worldwide network of 18 international agricultural research centers, including IIMI, conducting global research on agriculture, forestry and fisheries. The CGIAR is sponsored by the Food and Agriculture Organization of the United Nations (FAO), the International Bank for Reconstruction and Development (World Bank), and the United Nations Development Programme (UNDP) and comprises more than 45 donor countries, international and regional organizations, and private foundations.

IIMI's mission is to foster the development, dissemination and adoption of lasting improvements in the performance of irrigated agriculture in developing countries. With its headquarters in Colombo, Sri Lanka, IIMI conducts a worldwide program to generate knowledge to improve irrigation management and policymaking, strengthen national research capacity, and support the introduction of improved policies and management approaches.

Are Decision-Support Systems Useful in Irrigation System Operation?

Decision-Support Systems (DSS) are procedures, often computerized, to evaluate options in system operation, and, hence, they identify those that will have better results with respect to specified objectives. Though the line dividing Management Information Systems (MIS) from DSS is not always clear, the focus of the former is on the orderly presentation of data, while the aim of the latter is to interpret and evaluate alternative courses of action based on such data. The evaluative nature of DSS provides the basis for caution in their application in areas where the response being predicted or evaluated includes behavioral relationships. This note is not aimed at DSS that help managers to follow known operational rules, but rather at those (including large models of irrigation systems) which suggest "better" rules.

The argument for caution has three foundations.

First, is the evaluation function right? This point is self-evidently applicable to any modeling system, but is worthy of mention in this context if we note the extraordinary difficulty normally encountered in explaining farm-level behavior. Most of the users have seen "if not actually constructed" farm models that indicate that strawberries, or some local or exotic equivalent is the best choice of crop. Far fewer have succeeded in capturing the set of physical, market, and experience/expectation parameters which result

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IIMI and CEMAGREF organized an international workshop in Montpellier on the use of computer models for irrigation canal management. This is the first issue of its newsletter.

IIMI's mandate and its international status have made possible this evolution of the research program from the Kirindi Oya pilot study to the consideration of more generic concerns. IIMI is at the crossroads of research in the North and of operational projects in the South and is committed to promoting institution building along with technology transfers. ITIS is thus naturally integrated in IIMI's activities. The network hopes that all readers interested will join its efforts for contributing to advances in the field of irrigation management.

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in the cropping pattern observed in the field. Until we have sound models that embody farmer perceptions of constraints and opportunities, our ability to evaluate operational alternatives will necessarily be limited.

Second, whose objectives? Real-world decisions involve tradeoffs between competing interest groups, for example:

* Maximizing the gross value of production (scheme manager's objective);
* Minimizing area suffering from complete crop loss (insurance company's objective, also shared by agency receiving water charges, where these depend on the area of crop matured);
* Maximizing net revenue at farm level (farmer's objective);
* Minimizing total diversions (farmers in low-lying areas prone to waterlogging);
* Maximizing total diversions (negotiators in interstate water rights disputes); and
* Maximizing carry-over storage into the dry season (hydropower objective).

The complex set of possible objectives and conflicts point to the need for careful specification and identification of benefits and costs of each objective.

The two foundations noted above, though complex, are at least obvious and transparent. The third foundation is more difficult to define, and more difficult still to incorporate into DSS. It is, feedback instability: farmers behave rationally within an uncertain world—they do not grow only strawberries, as linear programs would have us believe; they do not always put the full amount of fertilizer and pesticide that extension agents recommend and they do not grow only those crops that give the best return to the limiting input, be it water, labor, credit or land. Farmers make choices in response to long experience, and can often be observed following cropping practices that reflect the distribution of uncertainties they have experienced.

Irrigation is a means of reducing uncertainty, and its availability has two quite distinct impacts on agricultural production:

* a static impact (better soil-moisture availability automatically results in higher yields in economic terms—a shifting up of the production function); and
* a dynamic impact (farmers plant higher-value, more moisture-sensitive crops if water is assured—a shift to a new production function).

Advocates of DSS would argue that better analysis of operational options should result in better allocation of water, and improve both the static and dynamic effects of irrigation.

But what impact will "rational" DSS have on farmer behavior? If DSS save a higher proportion of the crop in a time of shortage than an alternative simple allocation, this must also be seen as a learning experience for the farmer. And here the fact that the experience of the individual differs from the project-level experience is critical. In the short run, noting perhaps that high-value crops were favored in the DSS solution to shortage, farmers may "learn" that high-value crops receive a more secure water supply. Shifts in that direction will simply increase the extent of losses when the next shortage arrives, and then undermine farmer confidence in the future.

A transparent allocation system that divides the available water over the irrigated area provides each farmer with a reliable supply, in the important sense that he understands exactly how his entitlement is defined. More complex allocation rules are likely to undermine that understanding, and while our ability as modelers to incorporate the impact of farmers' reactions to such perceived uncertainties is limited, the role of DSS as practical guides to operational decisions will similarly be limited. The contrast between neural networks and artificial intelligence is relevant—neural networks seem to be "discovering" that humans utilize subconscious knowledge in making judgements: we do not even know what we know! This has serious implications for modelers of rational behavior.

Some readers will have mentally rejected each of the above points, noting quite rightly that the topic is Decision-Support Systems, indicating that human judgement is being assisted rather than replaced in this process. The point is valid and appropriate. But note that computerized models have two common characteristics—they do well in "normal" times, much worse when we really need their expected contribution; and second, they can incorporate and evaluate almost endless rules and factors. As time goes on, and new users exploit existing models, some rules may become both forgotten and obsolete, rendering advice invalid, though still delivered with the precision and assurance that our computers provide.

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