MODERNIZATION OF IRRIGATION SYSTEMS:  
THE ROLE OF THE WORLD BANK  
AND NEW OPPORTUNITIES  

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Irrigation sector has been one of the largest recipients of public investments in the developing world. Seven percent of the World Bank lending, amounting to about $35 billion in constant US dollars, has been for irrigation. Lending for irrigation is now in decline: the annual lending for the subsector and the number of irrigation projects are about half what they were during the peak period 1975-85. Despite this decline, however, the World Bank and the regional development banks as well have largely contributed to the expansion of irrigation and to the contribution of irrigated agriculture to meeting the food needs of rapidly increasing population during the last half-century. However the role of the World Bank in the modernization of irrigation has not been as valuable as one would expect. This paper discusses the reasons for the slow progress in modernization in Bank-financed irrigation projects and explore some new perspectives for modernization by combining institutional reforms and physical improvements.

The evolving role of the Bank in irrigation

The world has changed tremendously over the past fifty years, and so has the Bank-in its membership, organizational structure, the size of its operations and its development agenda. Projects financed by the Bank are now radically different from those financed in the 1950’s when there was little concern for policy frameworks, poverty alleviation, environmental protection, or the privatization of inputs and services. The World Bank started lending for agriculture through large irrigation projects, in keeping with the prevailing emphasis on large infrastructure. In the 1950-60’s, the Bank did not finance rehabilitation works of existing irrigation systems. Rehabilitation was considered the responsibility of the borrowing governments. Similarly, the Bank limited its contribution to the construction of the main and distribution systems, assuming that the farmers would contribute in constructing themselves the tertiary systems in addition to the on-farm development works. Experience invalidate that hypothesis.

The food crisis in India in the mid 1960’s focused attention on the need to improve foodgrain productivity and new technologies. The Bank began lending for agricultural research and extension, rural credit and the production of high-yielding varieties and fertilizers either directly through specific agricultural projects or as components of irrigation projects. In the 1970’s, under the Presidency of Robert MacNamara, the Bank turned its energies to alleviating poverty. Irrigation projects became overloaded with rural development programs, such as rural roads, schools and health centers. Irrigation projects became very difficult to prepare and implement because of the number of sub-components and agencies involved. Since 1976, the Bank’s internal
regulations require that project preparation be upgraded to completion of detailed design and bidding documents at the time of Board presentation to avoid delay in implementation and to reduce the risks of cost overruns. Post evaluations showed that many irrigation projects did not comply with this requirement and, if they did, emphasis was placed on the structural design of infrastructure, not on canal operation and delivery of water to the users.

By the 1980’s, it became evident that faulty policies seriously affected production in many countries. It also became apparent that competition for water was acute in many countries, water quality was seriously affected and water-related issues could no longer be treated separately by each subsector. In 1993, the Board of Directors of the Bank approved its Water Resources Management Policy which encourage the adoption of institutional reforms, analytical framework for managing water resources, water conserving technology, decentralization of responsibilities to local governments, user participation and environmental protection. The Water Policy marked a turning point in the formulation of irrigation projects which progressively shifted from the agricultural sector to the water sector.

In the early decades of its lending for irrigation, the Bank financed specific individual projects or a group of subprojects which were all well identified. The attention now given to the recommendations of the Water Policy has contributed to shift the Bank-supported irrigation program to projects national or regional in scope. For example, some projects cover the entire irrigated area of a State in India, a Province in Pakistan, or even the entire multiple-year plan of a country, such as in Mexico. A “new style” project typically includes two major components: an institutional component supporting the creation or strengthening of water user associations and reforms of irrigation and water agencies and a physical component for rehabilitation or differed maintenance works. Depending on the needs of the project, financing of environmental studies, agricultural research or support services or creation of basin agencies are also included. The main focus is on the software recommendations of the Water Policy such as the participation of users or the legal framework enabling the setting up of water rights and water market.

The scope and concept of modernization

Modernization of irrigation systems has different meanings depending on the background of irrigation experts. Modernization is not necessarily the conversion of an irrigation system to the state-of-the-art in technology and management. Modernization should be understood as any physical or institutional change which would contribute to an improved service to users, to a reduced deterioration of water quality, and to a reduction of government intervention in management.

The scope of modernization could therefore include a large range of activities:

- Operation of the main and distribution system through advanced water control structures and modern operation tools;
• Water application at farm level through adoption of water saving techniques;

• Construction technology, such as the use of geomembranes for canal lining, use of canal lining machinery, and prefabrication;

• User participation either through transfer of management responsibilities or any other consultative approach;

• Administration and accounting.

This paper focuses on proper water control and water delivery which is a prerequisite to getting full benefits from water saving techniques at farm level and the implementation of institutional and policy reforms. Application of volumetric water charges and quotas, implementation of water rights and active water markets, and demand management are reform tolls which require confidence from the users in the water delivery service, and proper water control to provide that service.

The World Bank experience in irrigation modernization

Most of the irrigation projects supported by the Bank are gravity irrigation projects. This simply reflects the regional distribution of projects. Most irrigation lending—50 percent of the projects and 69 percent of the money loaned—has occurred in Asia, where rice cultivation predominates. However, the Bank has financed sprinkler irrigation projects in water-scarce countries such as Morocco, Jordan, Romania, and Northeast Brazil and, at smaller scale, drip irrigation in Cyprus and Turkey, for example. The Bank has and continues to finance investments for water conservation at farm level consisting of lining of tertiary canals, or conversion to low pressure systems, for example in China, India, Chile, and Mexico.

The World Bank has successfully financed irrigation projects in countries where modern design standards are the norm, such as in North Africa. Successful transfer of water control technology in individual projects has also been achieved in some countries which have not yet standardized their design. Kemubu or Muda projects in Malaysia or Lower Klalis project in Iraq are a few examples. However, some modern water control pilot projects have failed for various reasons:

• Implementation agencies should be committed at the highest level to the success of pilot projects; Pilot projects should be integrated in a long-term modernization strategy;

• Training should not be limited to a small project design team; training should include staff involved in control of quality of construction of pilot projects and those who will manage these projects;
• Water control equipment should be manufactured according to the technical norms of the original designer; locally modified control equipment to avoid patent issues rarely works. As usual, one gets what one pays for;

• Continuity in staff of the implementation agencies as well as of the lending agencies is needed to avoid loss of interest or change of focus.

Besides a number of modern projects mostly in water scarce countries and a few isolated cases in other countries, the majority of projects are based on simplistic hydraulic design standards. The complexity of unsteady flows which are common in operation of irrigation canals, the interaction between control structures, the impact of rigid or unreliable water delivery on farmer behavior, the operation of canals at less than full supply are not always understood. The reasons for the slow adoption of modernization are extensively discussed in the World Bank technical Paper 246 (chapter 8: The debate on modernization).

The fundamental cause for the slow rate of technology transfer identified in the above paper was a lack of knowledge of available technologies and a misunderstanding of the nature of irrigation. The recent research funded by the World Bank on the Performance of Irrigation Systems strongly confirmed that hypothesis. There is an immediate need for a major training in the concepts and details of modernization of irrigation.

Adverse administrative and behavioral reasons for the adoption of modern design are more difficult to address. The pressure from the World Bank Management to reduce the time of preparation has further increased during the last years. The trend towards low cost rehabilitation and maintenance programs is also not in favor of modernization. Economic pressures on irrigation agencies responsible for the management of irrigation systems and contractual motivation for their consultants are still missing. Irrigation managers, engineers and others are still adhering to outdated designs and resisting to changes in many countries.

The Bank-funded research study, referred above, provides well documented evidence of the benefits of modernization and should be a milestone in the dissemination of the advantages of modernization. That study should widely contribute to the rejection of some unfounded myths against modernization. Modern design, defined as a concept and not by the technology and equipment, is not too sophisticated for developing countries. A number of low cost changes can be gradually introduced without affecting the economic viability of the project. In many cases, the first step in modernization may be shifting from inadequate to rational design based on the understanding of simple but sound hydraulic principles, for example adopting the right combination of control structures at cross regulators and offtakes to limit the hydraulic sensitivity to inflow fluctuations.

The slow adoption of modern design and the failure of some pilot projects should not overlook the progress which have been made in the dissemination of knowledge
about modern irrigation. The World Bank has largely contributed to the transfer process through training courses, study tours, audio-visual programs, conferences and workshops. It is now encouraging that some countries located in the humid tropics, an environment considered by some experts not suitable for adoption of arid irrigation technology, are now experimenting with new concepts for example, the Magat project in the Philippines. Majalgaon Project in Maharashtra, India and the High Level Pehur Canal in Pakistan are encouraging examples of transfer of technology in countries with strong adherence to old design manuals in the past.

Comprehensive approach to modernization: The case of Mexico

The best example of comprehensive approach to modernization of irrigation is found in Mexico. The Mexican Government implemented a policy reform program, including decentralization and price liberalization of its entire economy in the late 1980’s. To date, the management of over 3.2 million hectares in 80 irrigation districts has been transferred to 410 Water User associations, and to eleven federations for the main systems. The national irrigation agency, CNA, implemented a massive training program of the professional technical and administrative staff of the User Associations and of the members of the Boards of these associations. CNA also retrained its own reduced staff to its new role of advising and supervising the associations.

The reform of the Mexican irrigation sector was not limited to the institutional aspects. With the assistance of an international consulting firm, the CNA design standards were upgraded to address the problem of unsteady flow conditions in irrigation canals and operation at less than full supply. A training program was implemented for CNA staff and private local consulting firms. Most remarkably, irrigation modernization was incorporated in the curriculum of Mexico Universities to prepare the next generations of irrigation engineers.

Once the management transfer in Mexico was well advanced, the CNA focused was on the modernization of the maintenance concepts and equipment through adoption of weeding chemical and biological treatment methods and purchase of specialized maintenance equipment.

A project, currently under preparation in Mexico, will break new grounds in the process of modernization of irrigation systems with a bottom up approach. Modernization would be carried out at the initiative of User Associations which would contribute to 50 percent of the investment costs.

The success of Mexico in transfer management, widely disseminated by the World Bank, has encouraged the Turkish irrigation agency, DSI, to embark in a similar transfer program. As of end of 1997, the management of about 1.2 million hectares has been transferred to 222 associations. The World Bank is providing financial assistance for the purchase of specialized maintenance equipment and, at pilot scale, for the
conversion to drip irrigation of about 1200 hectares at the demand of two associations which would contribute to 70 percent of the costs.

**Possible scenarios for modernization**

As discussed above, the formulation of irrigation projects has considerably evolved over the last decades. On one side, there is a risk that the importance now given to overall water resource management, institutional and regulatory systems, poverty alleviation, environmental protection and other issues during project preparation might overshadow the technical aspects for improving canal operation and water service to users. Dealing with all the policy issues with the challenge of currently decreasing financial resources for project preparation is not an environment favorable to the modernization of irrigation systems which require an in-depth diagnosis of their functioning by well trained experts as well as detailed studies of alternative solutions.

On the other side, the “new style” projects, which are now national or regional in scope, offer the opportunity to shift from the project-by-project approach to a global approach to modernization through training program, revision of design standards, involvement of the users in the decision process and financing of investment costs. The World Bank strategy to promote irrigation management transfer may also give a new impulsion to the modernization of irrigation systems. The user associations have a real interest in improving the physical infrastructure to provide better water service to the members and to reach financial sustainability. Large business-type associations with real decision powers on investments and water allocation policies may succeed if properly advised on the alternative solutions for modernization.

Institutional and policy reforms should be combined with a program of modernization of the irrigation infrastructure. Irrigation management transfer is not an end-objective, but should be the beginning of a new era for irrigation. IMT programs should be designed with that long term vision.