OPTIMIZATION OF IRRIGATION PERFORMANCE THROUGH PHYSICAL CHANGES AND INSTITUTIONAL REFORMS: THE EXAMPLE OF IRAN

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During the last three days, the participants to the tenth International Seminar on Participatory Irrigation Management (PIM) have been discussing the issues and challenges of PIM in the field. They have shared their experiences in the three sub-themes of the seminar that are related to the PIM frameworks and models, organizational reforms, legal strategies, socio-cultural and political grounds and support system for PIM sustainability. Before coming here, I again read the invitation to this Conference. I found refreshing that the Chairman of IRNCID, Dr. Rasoul Zargar, was confident that this event will also offer an opportunity to all participants, scientists, engineers, specialists and others to exchange ideas and transfer technologies relevant to water users and PIM in Iran and other countries. I would like in this keynote to respond to Dr. Zargar by addressing the technical changes needed to support PIM.

It is increasingly accepted that combining physical changes and institutional reforms is required to optimize the performance of irrigation projects. I therefore believe it is appropriate to end up this Conference by addressing the complementarity of these two aspects. I will address that question by highlighting that our host country has already in place either the reforms or the physical infrastructure needed for modern irrigation in different regions of the country. However there are not yet examples where reforms and appropriate infrastructure are present together. Of great interest for the international community is the experience of Iran that is experimenting with an institutional arrangement which is expected to evolve towards privatization of irrigation management. That approach is seldom used in other countries, where irrigation schemes are managed either by government agencies or by organizations of user associations or jointly.

My involvement with irrigation development in Iran dates back to a few decades. I had the opportunity to visit a number of irrigation schemes in many regions of Iran: The large rice-based Guilan project in the humid region along the Caspian sea, the Dez project in Khuziztan, the Sistan scheme in the very arid Eastern region at the border with Afhanistan, the Duruzan project at a stone jet of Persepolis and the Moghan project with a Mediterranean climate in the North-East region. Irrigation has been practiced in Iran for centuries. Traditional schemes cover almost 5.9 million hectares, which are supplied by run-off river diversions and by groundwater such as wells, springs and the famous qanats. These schemes have been developed and are still managed by farmers. It

is fascinating to observe how the local users in Iran and other countries have developed complex rules for the allocation and distribution of water among themselves and adjust to the various conditions of climate and variations in water resources in time and space. These schemes are sometimes referred as traditional, meaning they are simple and rustic. Indeed the management rules of these schemes are very sophisticated in some cases, in dealing with seasonal variations of water supply.

However the main purpose of my talk is with the so-called modern systems developed by government agencies. After a very brief background on the modern Iranian irrigation sector, I will discuss the institutional arrangements and the design concepts of large irrigation systems. We will then assess the performance of two typical schemes where either reforms or modern design have been adopted: The Moghan project in the Northeast region and the Drudzan project in the Southeast.

THE MODERN IRRIGATION SECTOR IN IRAN

In Iran, the modern area covering about 1.5 million ha consists in 55 schemes from over 100,000 ha (190,000 ha in Guilan and 125,000 ha in Dez project) to a few thousand ha. The Ministry of Energy (MOE) is responsible for the planning, design, construction and management of all main water systems in the country including all main irrigation systems and for improvement of traditional schemes. MOE mostly operates through its fourteen affiliated regional Water Authorities.

The Ministry of Agriculture and Jihad (MOAJ) through its Directorate of Soil and Water and its Provincial Agriculture Organizations is responsible for all the planning and development activities below the secondary canals. This includes construction of tertiary canals, land consolidation and land leveling, promotion and development of on-farm water saving techniques, including pressurized systems within modern and traditional schemes.

The activities of MOAJ generally lag far behind those of MOE within the modern systems. Although 1.2 million hectares have been developed by MOE in the modern sector, tertiary canals have been installed only on half the area and only one third has benefited from on-farm development. The main causes of this gap in investments between MOE and MOAJ are related to the budget and financing process of MOA works. The farmers should pay 30% of the investments through seven-year loans from the Agricultural Banks at 5% interest. In many schemes land consolidation is necessary to limit the number of parcels of each farm from about 5 or 6 to one or two plots. Land consolidation enables to optimize the layout of the tertiary and quaternary canals and ultimately the distribution of water through leveled fields. Progress in land consolidation is based on the mobilization of farmers by MOAJ staff.

For the reasons discussed above, of which the lag between the construction of the main infrastructure and the distribution system is likely the main one, the agricultural production in the modern system of Iran is far below expectations:

- The crop yields are below the potential indicating either deficiency in irrigation water or non-water inputs. For example the average yield of wheat is about 3 ton/ha, half the yield obtained in pilot farm tests in Moghan scheme.

- The volumes diverted for irrigation are excessive indicating excessive losses at farm level and poor operation of the incomplete distribution system. For example, an average volume of 40,000 m3 is diverted for sugarcane, 24,000 m3 for rice and 6200 m3 for wheat.

- The productivity of water (kg/m3 of diverted water) is two to three times below the potential.

However some schemes are performing much better than the average for reasons that we will discuss later in this presentation, which are related either to the institutional arrangements or a better water infrastructure.

INSTITUTIONAL ARRANGEMENTS

The Operation and maintenance of the 55 national schemes is entrusted to Operation and Maintenance Companies (OMC). As of 2004, only 19 OMCs were established. The responsibilities of the OMC are: i) to deliver water on a volumetric basis, where possible, to the users according to a contract signed on an annual (or seasonal) basis between the OMC and individual users stipulating the volumes to be deliver per crop, ii) to collect the water fees on a volumetric or per hectare basis and iii) to proceed with agreed maintenance activities. The OMCs signed annual contracts with their respective RWAs for operation, maintenance and administrative activities. The OMCs were established through decentralization of the RWAs in the early 1990s. The OMCs have no asset and do not meet the definition of private companies since they are still under the supervision of their parent government agencies. They are water service providers but are contracting with public agencies. The farmers are responsible for all O&M activities of the tertiary canals and below.

Informal user groups exist in a number of irrigation schemes. Under a recently completed World Bank project, water user groups were established in two schemes at the secondary level.

The present arrangements in which the RWAs contracted with OMCs are a transition between the government-managed approach of the past and the user participation envisioned for the future. The objectives of the Government of Iran are the decentralization and privatization of the management of irrigation systems. That approach deviates from the standard model promoted by research organizations and donor agencies after the successful transfer of irrigation management to user associations in Mexico and its successful replication in Turkey. The model proposed by Iranian consultants recognizes that both OMCs and User groups are equal partners in water distribution, which are bound by enforceable contracts. The OMCs are legally obliged to deliver water according to an agreed schedule on a volumetric basis to user groups and the users to pay for water and to distribute it below a certain level. At long term, the signing of contracts with OMCs would no longer be the responsibilities of

Regional Water Authorities but of a Federation (or Union) of User groups at the scheme level. Another approach would be that the Unions establish their own OMC under its direct governance, that is the typical model of direct management by the users.

The first step, which has not been reached in any of the schemes in Iran, is the creation of a Union of the user groups at scheme level and the election of a formal Board by the representatives of informal groups. (CHECK)

DESIGN STANDARDS FOR IRRIGATION AND DRAINAGE SCHEMES IN IRAN

We will turn now to the engineering aspects of irrigation schemes in Iran.

Standards and criteria selected for the design of irrigation and drainage projects has a strong influence on the operational procedures, on the quality of the service provided to the water users and ultimately on agricultural production.

Two types of design approaches are found in Iran reflecting the experience of the foreign consulting firms, which were contracted in the 1960-70s:

- The manual operation approach prevailing mainly in Khuziztan, consisting in installing manually operated gates, motorized or not, to control water level and flows. The flow delivered to the tertiary canals is either controlled by Constant Head Orifice (CHO) or a simple gate associated with a measuring device (Parshall or Replogle flume, or any flow measuring device).

- The hydraulic automation approach introduced in the Guilan and Esfahan projects in the 1970s and replicated to some extend in smaller projects developed during the last two decades. That approach makes use either of simple static devices to stabilize the water levels and flows in the canals such as long crested weirs, emergency siphons and constant flow modular distributors or float operated gates to maintain constant water levels upstream or downstream of the gates.

With only one or two exceptions, all the canals are operated under upstream control. The manually operated systems are very simple in design but are the most complex to operate since there is no consideration for operation at less than maximum design flow and no consideration for unsteady flows. These systems cannot be operated efficiently. The operators are not able to cope with the variations in demand and supply, the lag time between releases at head works and delivery points and the frequent adjustments of all the gates. Manual observations of the flows released to tertiary canals and gate adjustments, if needed, require three to four visits a day to guarantee that the variations remain within acceptable limits. The hydraulically automated systems require minimum staff intervention to provide irrigation water and adjustment of gates only when discharges from one level of canal to the next level are changed.

The sharp difference between these two design approaches is reflected in the performance of the Dez and Guilan projects. The average overall efficiency of the Dez project (25%) estimate in the 1990s was one of the lowest in Iran compared to the high efficiency of Guilan estimated slightly above 50%, which is a remarkable value for a predominantly rice project. The Guilan conveyance and distribution system is consistently equipped of automatic static cross-regulators and user-friendly flow regulators. Field staffs of schemes equipped with CHO gates in Iran and most other countries are not familiar with the procedures to use these devices. Delivery of water is not volumetric but based on staff "experience" in estimating flows.

During the last two decades, the Iranian consulting firms and the Regional authorities have assessed the viability of the two approaches and concluded that the manually operated systems are too demanding in terms of field staff work. Designers of these systems were not aware of the difficulties of operating the systems they designed.

COMPARATIVE PERFORMANCE OF TWO TYPICAL SCHEMES

I am turning now to the discussion of the above-average performance of two irrigation schemes. These two systems strongly differ in the management and the water control infrastructure. Both systems are managed by an OMC, but one is jointly managed with informal user organizations. One is a gated manually-operated system, and the other one benefits from some level of hydraulic automation. A detailed note on two contrasting large irrigation schemes is provided in annex.

Droudzan scheme: This 46,000 ha scheme located about 50 km from Shiraz is managed by an OMC created in 1992 for managing three irrigation schemes. The OMC delivers irrigation water to 211 water groups representing about 10 to 100 farmers each. These groups have no legal form or even any formal organization. There are organized by Islamic Village Councils who encourage farmers to designate a representative for one or two villages.

The canal system is equipped of manually-operated sliding or radial gates and the off takes to secondary canals are equipped of Constant Head Orifice (CHO) devices, properly maintained but not used according to design.

Moghan scheme: This 75,000 ha scheme, located near the border with Azerbaizan, is managed by an OMC. However no formal or informal water groups have been created yet. Construction of the project started in the 1960s. The lag between the construction of the main systems and the distribution system was progressively closed in the 1980-90s.

Part of the system is a manually operated gated system, and the other part is equipped with simple static and structures providing automatic control of water level and flows.

The dramatic progress in performance of the Moghan project during the last decades provides an example the potential agricultural benefits that can be obtained by completing a project infrastructure down to the farm fields.

The construction of the canaletti-type tertiary canals has considerably improved the reliability of water delivery to the farmers and more generally the quality of irrigation service.

Water is delivered to Moghan farmers on a 48-hour notice- under a pre-arranged delivery method. The overall project efficiency has considerably improved to over 42%. The well maintained control structures and the absence of vandalism of gates by farmers is an indication of the satisfactory water management of the Moghan scheme. In Drudzan water delivery is based on seasonal planning and not on demand from the users.

Although the staff of the Moghan OMC has been substantially reduced from 530 to 350, it is still far more than the staff of the Drudzan scheme (100 staff), which is one of the lowest found in developing countries.(one for 450 ha compared to one for 250 ha or less)

The limitations of the number of delivery points by the OMC to the user groups of Drudzan and the management of the system by these groups below the secondary off takes considerably simplify the task of the OMC.

Water fees are paid on volumetric basis in Moghan, although in some areas not fully modernized the volumes delivered to users is rather estimated that measured. In Drudzan, the fees are paid on a per area basis. The difference in calculation of water fee is related to the water control equipment.

Because of the good service provided to the users, the collection of water charges is excellent in both cases. However 40 percent of the collected charges in Drudzan cover the recurrent charges of the OMC and the rest is paid to the Regional Authority for investment in the region.. In Moghan, the charges only cover the OMC recurrent costs.

Obviously the ideal scheme would be one combining the advanced hydraulic infrastructure found in Moghan with the joint management approach used in Drudzan combining an OMC with water user groups. None of these two schemes has reached the advanced level of technology available today.. The user groups in Drudzan have no formal existence; and the control infrastructure in Moghan is not making use of the progress made during the last two decades in telecommunications and computer-controlled technology. However it seems certain that the combination of the approaches used for the development of the two schemes would have resulted in a highly performing scheme: a 2-day advanced delivery service, high efficiency and financially sustainable system

CONCLUSIONS

During the last two decades policy makers and donors have paid little attention to modernization of irrigation systems. Back in the 1970s and 1980s there was a school of thought that improved management could solve all problems and make any business profitable, including irrigated agriculture. There was a wide recognition that deficiencies in management and related institutional problems, rather than technology of irrigation, were the chief constraints of poor performance. The keynote speaker for the Gulhati Memorial during the Congress in Beijing in September 2005 rightly argued that neither improved management or water measurement alone are the answers to the poor performance of irrigation. Improved management may result in small increments, but not in substantial gains. Water management is a key component of water control, but it is not sufficient for significantly improving productivity by itself (Clemmens).

The manually operated systems constructed in many developed countries (Australia, U.S.A, Canada for example) are now under modernization through the installation of remote monitoring systems, remote control and automation of gates. This modernization was made possible though the progress made in the telecommunications and computer industries since the 1970s and the development of equipment suitable for the harsh conditions of irrigation schemes. Iran and other developing countries should seriously consider adapting and adopting these new technologies for improving their irrigation schemes.

Worldwide water-related issues are given great attention in international events such as Water Forum and others. However failures to address the links between the technical improvements of large and medium scale irrigation systems and management reforms are exacerbating the problems of water scarcity and threatening food security, water supply and environment. The shortages of food production predicted for the early 2000s have been averted because of the explosive exploitation of groundwater in many countries associated with a manifold increase in water saving application techniques in groundwater irrigated areas. However mining of groundwater and deterioration of water quality has occurred in many countries particularly in arid regions, affecting the poorest users, and threatening potable water supply projects. There are no other easy and cheap solutions to the food security and water issues. No further complacency is acceptable in addressing the long-standing issue of poor performance of surface-water projects.

RECOMMENDATION

I would like to conclude with a recommendation on the international organizations dealing with irrigation issues. This might be beyond my mandate of keynote speaker in an INPIM conference. However I feel I can do it in the position of External Reviewer of ICID.

IIMI was created two decades ago when it was widely accepted that the poor performance of irrigation was mostly related to institutional aspects and not to the technology. IWMI has now shifted to overall water issues and long-term projections related to food security and other global issues. Two small but efficient organizations were created later: INPIM and IPTRID. IPTRID was created at the initiative of ICID and the World Bank to complement IIMI activities by addressing the technical aspects

of irrigation management. INPIM was also created at the initiative of the World Bank initially to promote the successful IMT program of Mexico and more recently to exchange the different experiences in institutional arrangements, including privatization of water services.

My proposal would be to strengthen the synergy of these two organizations, which are really complementary, through an arrangement to be defined. The above comparative performance of two schemes in Iran provides an indication of the potential benefits that could be achieved in associating physical changes and reforms.