

**LESSONS LEARNED FROM THE GADIGALTAR FLEXIBLE IRRIGATION
PILOT PROJECT, MADHYA PRADESH, INDIA**

B.J. Freeman¹, J.L. Merriam², S.K. Joshi³

ABSTRACT

The observation of failure and less-than-full success is a useful technique for learning to avoid them. Many important lessons can be learned from the experience at the Gadigaltar Flexible Irrigation Pilot Project in Madhya Pradesh, India. The Gadigaltar Pilot Project was completed in 1992 with funding from the United States Agency for International Development (USAID) as a demonstration of the agricultural, social, economic and environmental benefits of a flexible, farmer-controlled irrigation supply system. It was expected that this would facilitate upgraded on-farm management and cropping procedures, higher yields, more convenient and reduced labor requirements, minimized water applications, rainfall conservation, decreased soil erosion, and decreased project maintenance.

The pipeline demonstration project, which consists of about 550 2.0-ha average size farms each with its own turnout valve, is broken up into 67 groups with a total net irrigated area of 1,150 ha. The supply is from a 900 ha m reservoir normally filled during the summer monsoon rains. Various techniques were used to obtain water delivery flexibility: a sloping canal with operational spillage and night-time flows re-regulated in a mid-area reservoir; a level-top canal and semi-closed pipelines always full regardless of extraction rates; and a limited rate arranged-demand schedule controlled by a Water Users Association (WUA) encouraging daytime-only irrigation.

Shortly after completion of the project construction and well before attaining the planned operations, deterioration began. Though training and operation procedures were written and orally presented; there was no agency or personnel to actually provide the necessary continuity; personnel were transferred; no provisions were available to provide in-the-field follow-up support at the farm nor operating-level; maintenance funds were negligible; farmers in their ignorance broke valves and trash screens, but not the buried pipelines; the WUA did not function so that the Madhya Pradesh Water Resources Department (WRD) operated the system as usual (rotation) within limits of negligible maintenance and was able to deliver water to all farmers, although with difficulty.

¹ Senior Irrigation Engineer, Irrigation Training and Research Center, California Polytechnic State University, San Luis Obispo, California 93407, tel: (805) 756-5368, fax: (805) 756-2433, email: bfreeman@calpoly.edu.

² Professor Emeritus, BioResource and Agricultural Engineering Department, California Polytechnic State University, San Luis Obispo, 235 Chaplin Lane, San Luis Obispo, CA 93405. Pres. Merriam Irrigation Education Foundation.

³ Sub-Engineer, Water Resources Department, Khargone, Madhya Pradesh, India.

In 1997 contact was made by the non-governmental organizations (NGO) Fund for Furthering Flexible Irrigation (4FI) and the Merriam Irrigation Education Foundation (MIEF) about providing educational support, technical services and limited maintenance funding to re-establish the project to its original capabilities. Much educational and technical support follow-up work was done and in November 2001 the system was capable of fully operating and an active Board for the WUA was enthusiastically functioning. The farmers better understand the need for having an operating pipeline system and expressed regrets for having ignorantly damaged the system.

1. INTRODUCTION

The observation of failure and less-than-full success is a useful technique for learning to avoid them on planned irrigation pilot projects. The future capability of international irrigation projects to provide a flexible irrigation water supply at the farm level is a major determinant of the opportunity for sustainable and productive use of water resources and environmental conservation. Farmers can only adopt modern on-farm water management techniques essential for raising water productivity and performing at an optimum production level if they have control of a flexible irrigation water supply. Even so, developing the technical, organizational and institutional conditions to provide millions of small farmers with a convenient, reliable and flexible irrigation water supply will be a major challenge for policy makers and engineers.

The Gadigaltar Pilot Project was built in 1992 with funding from the United States Agency for International Development (USAID) to demonstrate the agricultural, social, economic and environmental benefits of a flexible, farmer-controlled irrigation water supply system. The stated objective of the Gadigaltar Pilot Project was to provide a large group of farmers with control over the flow rate, duration and frequency of their on-farm irrigation water deliveries. It was expected that this would facilitate upgraded on-farm water management and cropping procedures, higher yields, more convenient and reduced labor requirements, minimized water applications, rainfall conservation, decreased soil erosion, and decreased project maintenance. An integral component of the pilot project was the establishment of a farmers' Water Users Association (WUA) to operate and maintain the canals and pipelines, and to coordinate the arranged irrigation scheduling.

The experience of the participants in the Gadigaltar Pilot Project has powerfully demonstrated the necessity of providing adequate and accessible follow-up financial, technical, institutional and political support by funding agencies, researchers, agricultural scientists, engineers and other consultants. The overall objective of designing and implementing flexible irrigation pilot projects in less-developed countries (LDCs) must be based on the principle of creating self-reliance and local capacity in both the technical and the organizational requirements of a pipeline and reservoir supply system. Just as important however is the provision of effective assistance to all stakeholders in the operation and management of the system. A comprehensive training program for engineers, agricultural scientists and policy makers is required to introduce the concepts and benefits of flexible irrigation water supply systems in LDCs (Merriam 1991, Merriam 1992).

To achieve success a pilot project must not only provide flexible water delivery service to farmers, the development of its operational procedures must involve a thorough consideration of the existing socio-economic conditions that the project will be introduced into. Without the initial and ongoing integration of local conditions and participants into the technical and managerial aspects of the system, pilot projects will be irrelevant in the context of meeting food security and increasing crop yields while minimizing adverse environmental impacts. Trained engineers can design flexible irrigation water supply systems, but farmers must be taught how to effectively use these capabilities. The details of the system's design become practical engineering decisions once the purpose of providing flexible water delivery service is recognized by project authorities. Farmers already naturally understand the benefits of a flexible water supply; it is the job of engineers to provide it.

2. LESSONS LEARNED

The provision of adequate financial, technical, institutional and political follow-up support by local and donor agencies for irrigation pilot projects is often neglected and under-funded. Nonetheless government funding agencies, consultants and researchers must continue some level of follow-up support after a pilot project is constructed because changing community-level agricultural practices is a long-term process, perhaps as long as 5 to 10 years. Training small farmers to effectively use a flexible irrigation water supply system and creating institutions that can enforce rules and obligations takes longer than one or two seasons. In addition, the development of a viable WUA organization may specifically require financial resources many years after a project is built.

The Gadigaltar Pilot Project provides many illustrations of important lessons for planners and engineers in order to successfully develop flexible irrigation water supply projects:

- The communication of the fundamental design concepts and principles to the local project participants was fragmented and incomplete. The WRD engineers, operators and farmers had only partial knowledge of how the system operated and needed to be maintained. The function and interdependence of the canal and pipeline components including critical hardware such the float valves and trash screens was not well understood and therefore, not appreciated by the farmers.
- The farmers did not originally identify with the expected social and economic benefits of the flexible irrigation technology. The farmers had no perceived need for the particular advantages that were unique to this type of system, nor was there a sufficient effort by the consultants or WRD to convince them beforehand. It was assumed that the farmers would naturally understand the operational concepts of flexible irrigation supply systems before they ever really understood modern on-farm irrigation management.
- The farmers had only nominal financial involvement and therefore, lacked a feeling of ownership of the project. Irrigation water was being subsidized elsewhere in the region by 60–90% (Joshi 2000). Unlike other resources within the village, the farmers apparently didn't feel common ownership over canals and pipelines. Increasing the participation of farmers in developing O&M budgets and irrigation charges may provide an incentive to take personal care of the system.

- The ten farmers that did receive nominal training in the unique operational aspects of the distribution system were immediately hired by the WRD, rather than work directly for the WUA. Instead of project-wide, intensive and ongoing training for each farmer (either individually or in small groups), the consultants and WRD were relying on these ten recently trained individuals to be responsible for transmitting operational and on-farm water management practices to over 500 farmers.
- Official USAID financing was stopped immediately after final construction was completed, which is typical of too many internationally funded irrigation projects. No extra expenditures were allocated for additional training or educational programs for the WRD engineers and farmers after the project became operational. No funds were provided to either the WRD or WUA for spare parts or maintenance. In addition, the pilot project included few locally-made items and expensive imported components were not secured or locked.
- It is evident that the complex inter-relationships between farmers and WRD engineers were not fully appreciated by the foreign consultants. As a result, the foreign consultants made assumptions that were unrealistic and/or impractical given the established local socio-cultural conditions, which vested each party with very different motivations. The guiding criterion of the WRD was to deliver water on a pre-set rotation schedule in sufficient quantity for a single crop type, either cotton or wheat depending on the season. The farmers on the other hand had existing social institutions and patterns of personal and village-level interaction that mediated their conception of the allocation and distribution of irrigation water.
- No local researchers or advisors were invited to participate in the original project or solicited for advice about existing socio-cultural conditions that may have impacted the project. The only view of the farm and village conditions came to the consultants from the WRD engineers.
- There was an over-reliance on local government organizations such as the Agricultural Extension Service. It may have been unrealistic to expect local government agencies to collaborate in the project and provide educational and training services that went beyond their sanctioned mandate, especially since no additional funding was allocated for staffing or other resource requirements.
- The design engineer and sociologist left the project before final construction was complete. The system was operated during the first season in total isolation, without follow-up guidance or supervision from the original foreign consultants. Deliveries were initially made to farmers in the upper subchaks near the main canal using the traditional rotation schedule. The consultants were not at the project long enough to provide input into the decision-making or administration of irrigation deliveries to farmers during actual operation.

- Due to internal staff policy, the WRD engineers that had participated in the design and construction of the project and received substantial training were transferred within the first year of operation. During construction three engineers from the Khargone WRD came to California for a special workshop on the design and management of flexible irrigation systems. However, each one had left the project within one year. Other initial supporters in the WRD and government, including the Chief and Superintending engineers involved with setting up the project, had limited influence once they had retired or moved to a different district. This situation is not compatible with the extensive education and training over a period of several years that is required to transition from rigid rotation to flexible irrigation scheduling.
- New social organizations had to be created in order to operate and manage the system. The day-to-day operation of the system required a high level of coordination and communication between the farmers, operators and WRD. The lack of successful institutional development can be traced in part to the top-down approach used by the consultants and WRD to impose an organizational structure on the farmers. Rather than embracing and empowering the existing social relationships in the development of the WUA, the foreign sociologist and the WRD designed a structure that the government could officially recognize, but ignore later if necessary.

3. THE NEED FOR AN INTEGRATED APPROACH TO WATER DELIVERY SERVICE IN DEVELOPING COUNTRIES

An integrated approach and continuous follow-up is needed for developing pilot projects in LDCs that demonstrate the agricultural, social, economic and environmental benefits of flexible irrigation water supply systems. In addition to securing food sustenance, the objective of improving water delivery service (flexibility in flow rate, duration and frequency) to farmers in international irrigation projects must be to contribute to poverty alleviation and environmental resource conservation. Since the ability to adopt modern on-farm water management practices is a key determinant of the productivity of farming systems (water, labor, energy, land), the capability of irrigation projects to provide a flexible irrigation water supply has profound effects on the wider financial and ecological sustainability of agricultural societies (Burt 2000, Burt et al 2000). However, there are social, cultural, institutional and policy constraints that affect the allocation and distribution of irrigation water deliveries that are specific to each project. These constraints must be addressed early in the design and planning process of pilot projects.

The Gadigaltar Pilot Project has benefited from an integrated view of irrigation water supply technologies and farming systems. A large part of the previous research and development work on addressing the performance of international irrigation projects has focused on measures to improve on-farm water management. Many of the follow-on recommendations concentrate on issues such as specific irrigation equipment (sprinklers, drip, surge flow, etc.), methods for refining on-farm irrigation scheduling, and procedures for reusing drainage water. A common element of all these refined techniques is that they require some modification in the flow rate, duration or frequency of the on-farm irrigation water supply.

While the apparent constraints of rigid, rotational water supplies on the operation and management of farming systems in LDCs have been accepted and described in broad terms, they have not been fully recognized or challenged. Even if farmers are aware of the benefits of modern on-farm irrigation technologies and management practices, they are generally not able to implement new techniques or technologies because of the level of water delivery service that is available at the farm level. A flexible irrigation water supply can facilitate an improvement in on-farm water management, an increase in agricultural production and the alleviation of rural poverty.

The Gadigaltar Pilot Project has successfully demonstrated the technical aspects of the design and engineering of flexible irrigation water supply systems and provides many valuable lessons for engineers, researchers, economists and policy makers. The pipeline system has managed to reliably deliver irrigation water to each farm, even when a large number of hardware components were damaged or removed. However, the allocation and distribution of irrigation water is more complex and difficult, especially in rural communities in LDCs, than commonly recognized. There were complicated social, cultural, organizational, legal and economic conditions that had a profound impact on the ineffective outcomes of the pilot project. These issues also illustrate important lessons for the future of irrigation development.

It is striking that neither the farmers nor the WRD identified the original purpose of the project, which was to provide a flexible irrigation water supply under the control of the farmer, as the reason for conflict and failure. All the participants agreed that the concepts and management techniques that the pilot project was supposed to demonstrate were not well understood or even considered central to the operation of the system. Indeed, neither group considered the amount of flexibility in irrigation service as a criterion in measuring the success or failure of the project.

Firstly, the farmers had no basis to compare the benefits of flexible irrigation with conventional rotation schedule systems. This was their first exposure to modern irrigation technologies and on-farm water management. Their primary need was to have a reliable and sufficient water supply; effective on-farm water management was a secondary concern. Furthermore, the WRD's directive and historical mandate was in complete opposition to the adoption of the operational and management requirements of a flexible irrigation system.

There is little direct information available about the original training sessions given to the farmers and the WRD (Ehera 1992, Water Resources Department 1991). However, certain conclusions may be drawn based on subsequent interviews conducted with the WRD engineers and farmers. The author's first impression was that the project participants had little or no knowledge of the actual intended operation of the system. This was especially apparent when the WRD engineers would discuss the appropriate irrigation scheduling procedures. While the current WRD staff had a practical understanding of how to use the system (even with missing and damaged valves) to deliver water, they had no idea about how the system was supposed to be operated for flexible irrigation. This is a critical distinction since the potential benefits of the project were dependent on the particular hydraulic characteristics of the system.

SUMMARY

The capability of international irrigation projects to provide a flexible irrigation water supply at the farm level is a major determinant of the opportunity for sustainable and productive use of water resources and environmental conservation. Even so, developing the technical, organizational and institutional conditions to provide millions of small farmers in less-developed countries (LDCs) with a convenient, reliable and flexible irrigation water supply will be a major challenge for policy makers and engineers. The Gadigaltar Flexible Irrigation Pilot Project in Madhya Pradesh, India was completed in 1992 with funding from the United States Agency for International Development (USAID) as a demonstration of the social, economic and environmental benefits of a flexible irrigation water supply system. An integral component of the project was the establishment of a viable Water Users Association (WUA).

The long-term objective of the project was the development of policies and institutions that promoted the realization of farmer-controlled, flexible water delivery service and provided measurable on-farm benefits in terms of crop yields, labor cost and convenience, and irrigation water productivity. Unfortunately, the Water Resources Department of Madhya Pradesh (WRD) abandoned the planned operation utilizing an arranged-demand schedule within the first season, and instead of supporting the institutional development of the WUA and upgrading of on-farm management, it enforced the traditional rotation schedule.

Farmers in their ignorance removed much of the water control hardware on the canals and pipelines including expensive, imported float valves. The WRD performed only nominal maintenance and the damaged components were not replaced. The potential of the project to demonstrate the benefits of a flexible irrigation water supply was further reduced by major financial and technical setbacks that occurred during the first crop season primarily due to inadequate farmer training and direct participation in the establishment of the project; and a severe lack of follow-up financial, technical, institutional and political support by local and donor agencies. The minimal involvement by farmers combined with the local socio-cultural environment resulted in the participants having no appreciation for the operational details of the project including their own control of the farm turnout valves and arranged schedule. As a result, the farmers and government operators developed alternative management practices to cope with the operational consequences of the damaged system.

The planning, design and implementation of irrigation pilot projects in LDCs must be based on the principle of creating self-reliance and local capacity in the technical, operational and organizational requirements of a flexible water supply. This involves a thorough consideration of the existing socio-economic conditions that the project will be introduced into. Without the initial and ongoing integration of local conditions and participants into the technical and managerial aspects of the system, irrigation pilot projects will be irrelevant in the context of real-life problems.

Funding agencies and consultants must continue some level of financial, technical, institutional and political support after a project is constructed because changing community-level agricultural practices is a long-term process, perhaps as long as 5 to 10 years. Training small farmers to manage and operate a flexible irrigation water supply system takes longer than one or two seasons. The development of a viable WUA organization may require resources many years after a project is built

The well-conceived development of a flexible irrigation pilot project consists of both the physical water distribution system and the adequate training, education and support in the use of the system. Neither can be neglected. The systematic observation of failure and less-than-full success is a technique for learning to avoid them. Disentangling the technical and social aspects of the Gadigaltar Pilot Project will hopefully provide some insight into the real potential for flexible irrigation water supply concepts to be adopted on a large-scale in LDCs.

CONCLUSIONS

The Gadigaltar Pilot Project has successfully demonstrated the technical aspects of the design and engineering of flexible irrigation water supply systems and provides many valuable lessons for engineers, researchers, economists and policy makers (Merriam 1991, Merriam 1992). There were complicated social, cultural, organizational, legal and economic conditions that had a profound impact on the ineffective outcomes of the pilot project. These issues could have been addressed through adequate follow-up support and they illustrate important lessons for the future of irrigation development based on flexible water delivery service.

The planning, design and implementation of irrigation pilot projects in less-developed countries must be based on the principle of creating self-reliance and local capacity in the technical and organizational requirements of a flexible irrigation water supply. Of equal importance is that funding agencies and consultants must continue some level of financial, technical, institutional and political support after an irrigation pilot project is constructed because changing community-level agricultural practices is a long-term process, perhaps as long as 5 to 10 years. Training small farmers to effectively use a flexible irrigation water supply system and creating institutions that can enforce rules and obligations takes longer than one or two seasons. The successful maturity of a viable Water Users Association may require financial resources many years after a project is built.

REFERENCES

- Burt, C.M. 2000. Irrigation District Modernization in the U.S. and Worldwide- The Necessary Link for Efficient On-Farm Irrigation. ASAE National Irrig. Symposium, Proc. of the 4th Decennial Symposium. Phoenix, AZ. Nov., 2000. 428–434.
- Burt, C.M., A.J. Clemmens, R. Bliesner, J.L. Merriam and L. Hardy. 2000. Selection of Irrigation Methods for Agriculture. Prepared by ASCE On-Farm Irrigation Committee. Environmental and Water Resources Institute.
- Ehera, T. 1992. Water Users Association for Flexible Water Supply System: The Gadigaltar Pilot Project Experience. Prepared for USAID/GOMP under Irrigation Support Project for Asia and the Near East. Technical Support Center, 1611 N. Kent St., Rm 101, Arlington, VA 22209.
- Joshi, S.K. 2000. Sub-Engineer, Water Resources Department, Madhya Pradesh. Personal communication.

Merriam, J.L. 1991. Flexible Irrigation Supply Pilot Projects. Part I: Principles; Part II: Sri Lanka, Pakistan, India, and Egypt. ASCE Irrig. and Drain., Div. Proc. Honolulu, HI. July 1991.

Merriam, J.L. 1992. Flexible Water Supply Systems Facilitated by Low Pressure Semi-Closed and Closed Pipeline Systems. Advances in Planning, Design and Management of Irrigation Systems as Related to Sustainable Land Use. International Conference, September 1992. Center for Irrigation Engineering, Katholieke Universiteit, Leuven, Belgium, and ECOWARM.

Water Resources Department. 1991. Gadigaltar Tank Project: Status Report. USAID Project No. 386-0483. Government of Madhya Pradesh, Water Resources Department, Office of the Superintending Engineer, Khargone, M.P., India.