ZARAFSHAN WATER DISTRICT IMPROVEMENT PROJECT IN UZBEKISTAN

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ABSTRACT

Irrigation plays an important role in the economy of Uzbekistan with almost ninety percent of the cropland irrigated. Fifty percent of the irrigated area in Uzbekistan is already affected by water logging and/or salinization. Zarafshan and other Soviet-built irrigation schemes are in disrepair and not functioning efficiently. Crop losses and high operating costs ensue. Water flow information and communications systems are unreliable, forcing scheme administrators to make management and operational decisions based on insufficient information.

The Zarafshan Water Districts Improvements project is design to be a model program that will guide the rehabilitation of other irrigation districts in Central Asia. This paper describes this program and what lessons have been learned to date.

Key Words: irrigation scheme, rehabilitation, modernization, Uzbekistan, Central Asia, Aral Sea basin

INTRODUCTION

Since the break-up of the Soviet Union, the effectiveness of water control and allocation in the Aral Sea basin has been reduced, largely due to a deterioration of regulating structures and the lost of experienced personnel. Irrigation schemes are in need of improved and automated flow measurement, gate control, and SCADA systems. Improvement in flow measurement and control is needed throughout Uzbekistan to ensure the stability of agricultural production and to reduce the potential for conflict over water allocations.

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One area with particularly critical need is the Zarafshan River Basin in Uzbekistan, where the livelihood of 5.5 million persons depends heavily on irrigated agriculture. The Zarafshan River Basin has an irrigated area of 560,000 hectares. It extends into the four Oblasts (administrative regions) of Jizzak, Samarkand, Navoi and Kashkadarya near the Tajik-Uzbek border and runs along about 350 km of river (Fig. 1). Water management in the basin is under the responsibility of Zarafshan Basin Irrigation Systems Authority (BISA), which is under the Ministry of Agriculture and Water Resources (MAWR) of the Republic of Uzbekistan.

Funding for the Zarafshan Water Districts Improvement Project has been provided by the United States Agency for International Development (USAID through the Natural Resource Management Project (NRMP), which started on September 1, 2000. A related project, entitled the Special Initiatives Water Project (SIWP) for Uzbekistan and Tajikistan, Task Order 812, began on May 1, 2002. The objective of the SIWP is to increase the ability of CAR (Central Asian Republics) water managers to measure, control and allocate water resources in critical areas of the Zarafshan river basin.

Initial meetings were held with water managers responsible for allocating and controlling water supply to determine priorities for improving equipment and procedures. Equipment that showed the greatest potential for improving operations was made available to Zarafshan BISA. During this time, field visits were made to identify areas with potential for making operational improvements through enhanced measurements or automated controls. Elements of the project plan included acquisition of heavy construction equipment for system maintenance of communications and automation equipment, and additional funding for civil works needed to install the automation and communications equipment systems.

The President of Uzbekistan issued decrees in March and July 2003 that replaced the existing territory-based water resources administration with a basin-based management approach. New Basin Irrigation System Authorities (BISA) were introduced within the water management sector to ensure and promote:

- common policies in regulation and use of water resources
- the rational use of water resources on the basis of market economy principles
- technical reliability of water management structures
- accurate calculation of water consumption.

New Main Canals Authorities and Irrigation Systems Authorities became the structural sub-units of the BISA. World experience shows the basin-based water

management as the most efficient and flexible. This new organizational structure will help assure equitable water distribution by avoiding undesired interference and pressure of local authorities in the water distribution process. It is expected that this organizational reform will significantly increase operational efficiency of the water management sector in Uzbekistan.

PROJECT DETAILS

Eleven sub-tasks formed the core of the improvement program as initially developed.

Heavy equipment

Zarafshan BISA has requested the NRMP to assist in provision of vehicles and heavy construction equipment for irrigation system repairs, maintenance, and improvements. Heavy equipment and light vehicles for canal inspections and maintenance operations were identified as a top priority by national and local counterparts. Since their own heavy construction equipment was in bad condition and the number of units in operation was declining, Zarafshan BISA was not properly maintaining their canal systems and cleaning hydro-structures from the sediments brought by the river. Canal capacities were reduced by sedimentation, resulting in reduced and unreliable deliveries to users. In total, thirty-seven pieces of equipment were supplied to the Zarafshan BISA by September 2003. The equipment has been in nearly constant use since that time, and has been of major benefit to system maintenance and operations.

Construction and improvements to selected water control facilities

There are many offices and operational stations (dispatch centers) throughout the Zarafshan River Basin. Most of the office and operations facilities were in good condition, and required only minor renovation work. After a discussion with the management of BISA, 20 key locations including the dispatch center in headquarter building were selected for preparation for communications and data management systems improvements. Responsibility for rehabilitation of existing offices at these key control points was imposed on the management of BISA. Instead, NRMP was asked to renovate a dorm facility for training participants at the central warehouse of BISA.

Communication systems

The highest priority communications project is the installation of a MPT 1327 trunk radio system in the Zarafshan region. This project has large visibility within NRMP, USAID, and the counterpart organizations due to its size, importance, and schedule ramifications.

Preliminary design work and specifications for a new radio communications system was completed during late 2002 and early 2003. It was determined by detailed investigations that a trunk radio system operating in the 400 MHz range was most suitable for the required application. Field surveys and additional consultations with counterparts were undertaken to develop and refine a list of sites throughout the region for the installation of communications stations. Based on the findings and following discussions with the Ministry of Agriculture and Water (MAWR) and Viol Company, who assisted in the site surveys, NRMP concluded that a trunk radio system with three base stations for Zarafshan region would be sufficient.

Automation of irrigation structures

Funding was insufficient to complete all planned automation projects. Thus, the MAWR recommended undertaking one project that would demonstrate how modern equipment collect, process, and store up-to-date water flow information needed to ensure optimal and equitable water distribution.

The Ak-karadarya Barrage was chosen for this automation project. It is the second water control structure in the Zarafshan River, and is located 425 m downstream from the river and next to the Tashkent–Samarkand railroad bridge. The barrage was constructed during 1968-1973 and has a total capacity of 888 $м^3/с$ (31359.3 cfs) It supplies water to the main canals of Kurbanabad and Central Miankal, to the secondary ("interfarm") canals of Kalandar and Sulakhly, and distributes water to Karadraya and Akdarya rivers. The total command area is 114,100 ha. The facility consists of a series of 16 gates used for flow diversion into the main and interfarm canals, and into the rivers. An upstream head monitoring station is located next to the headwork structure of Akdarya river. Downstream monitoring stations are located approximately 25-100 meters downstream of the each of the canals and rivers.

The work consists of mechanical refurbishment of the gate hoist mechanisms, installation of a new electrical motor (including the refurbishment or replacement of faulty motors), and gate automation system. The work was broken into five phases:

1. Design
2. Mechanical refurbishment
3. Installation of New Electrical System
4. Installation of Automation System
5. Training and Final Documentation

All works related to the barrage automation was completed by March and includes a SCADA (Supervisory Control and Data Acquisition) system. The barrage is now automatically operated by dispatchers through special computer software. All water related data is processed in real time and can be transmitted to the head organization through a modem connection.

Local area network and mini-telephone station in HQ building

To further improve data exchange and efficiency of management, a new local area network and mini-telephone station was installed. Computers were networked together, so that data entered in the dispatch center could be observed by management and used to make timely decisions. The old telephone system that used over 30 separate telephone lines, was replaced with a new mini-telephone station capable of serving more personnel with only 8 telephone lines.

Office equipment

Advanced data collection and transmission required additional computer and other equipment for the management organization. Under this component it is planned to provide key locations in the HQ building with necessary equipment.

Establishment of the system maintenance group

A system maintenance group was needed to maintain newly provided equipment and communication systems. The maintenance group was provided with a vehicle and tools, and was staffed with trained specialists to conduct various maintenance tasks in the field and the HQ building.

Computerized Water Database

An additional important component of the project was the development of a computer database program. The original concept was to develop a computer program to correlate projected crop demands with system supplies as provided by automatic flow measurement stations throughout the irrigation system. With the removal of the automated flow measurement stations from the work plan, it was decided that a computer database for storing, managing, and analyzing system data was more useful and appropriate at this stage. This plan was executed with the development of a customized database with geographical information system (GIS) interface.

The database/GIS system allows the irrigation department staff and management to manage and analyze information much more efficiently. When the communications system is operational, the program will allow data to be input from remote locations throughout the irrigation system via radio modem (and telephone modem from some locations). Data collection, analysis, reporting and archiving will be greatly improved.

It was decided to develop a Centralized Water-Management Data Storage and Processing System (CWMDSPS) of BISA. The system provides data entering and data transferring capabilities between different BISA subdivisions, dispatch centers and MAWR. Furthermore, the system provides several tools for data analysis, preparation of graphs, reports and output forms.

The CWMDSPS consists of independent software components, including:

- Relational water-management database
- Data entering software component
- Data exchange software for synchronization of BISA and MAWR databases
- Analytical component (AC) which provides some basic capabilities for water-management data processing as well as reports and graphs preparation
- Geographic Information System (GIS) Interface providing map-based access to all water-management and technical information in CWMDSPS

MS Access was chosen as a Database management system (DBMS) for CWMDSPS because it can be easily managed and maintained by BISA specialists. Data entering software was developed to enter water-management information to CWMDSPS database. The final version of software was provided to end-users as a distributive installation package, and was developed in the Visual Studio.NET programming environment.

All software components were installed and tested in dispatch centers of the BISA and Main Irrigation System Authority. All system capabilities were demonstrated to the BISA management during a presentation organized in Samarkand in July 2004.

Currently, all the required water-management data is being transferred from Zarafshan BISA dispatch center to MAWR using CWMDSPS. All CWMDSPS software was developed as a flexible set of components, which allows future adaptation for additional requirements by BISA staff. Such flexibility is very important for long-term and sustainable system operating. The CWMDSPS was also successfully adopted by the Amu-Surchon BISA.

Establishment of training facilities and programs

Both MAWR and Zarafshan BISA asked NRMP for assistance in establishing a training center and programs for water specialists from the bordering oblasts, with the goal of reducing costs by conducting training activities on-site rather that in

Tashkent. Taking this into account, several rooms were renovated and equipped with needed equipment. On a regular basis, the BISA staff attended training programs on advanced computer skills, database and spreadsheet development. Meanwhile, the facility has been used for trainings and seminars for water specialists from Jizzak, Navoi, and Kashkadarya oblasts. The facility is becoming an integral part of the effort to improve water resources management and economic life in the Zarafshan River basin.

The data communications system and irrigation database use IBM-compatible personal computers and software. Training of system managers and operations staff in the use of computers and various software applications was essential to allow the use of these powerful tools and to derive the anticipated benefits. In January 2003 a plan was developed to set up a permanent training facility in the central office of the counterpart's headquarters building in Samakand. From March 2003 through July 2004 training sessions were conducted at the Samarkand training facility. Each group consisted of 14 participants and the aim of the training was to teach how to maintain and upgrade the computers and database system after the completion the NRMP Task. Trainings were held in basic and advanced computer literacy, database, Geographic Information Systems (GIS) and related computer mapping. A total number of 200 dispatchers and operators of the systems were given training in basic and advanced personal computer training, computer service and maintenance, GIS, and the use of the NRMP-developed Centralized Water-Management Data Storage and Processing System (CWMDSPS) of the BISA.

The trainings were very well received by the participants and felt to be very successful overall. The computer skill level of the participants was clearly and significantly improved, and, combined with the provision of computers by the NRMP, the participants found the trainings to be of great practical value in their work activities.

Public Awareness Activities

The dissemination of knowledge related to water as a limited resource is seen as a mandate of the NRMP. Public awareness and input to the NRMP program is desirable to help assure sustainability of the improvements. Many very successful public awareness events were conducted during the course of the Task, and many other products and services for the dissemination of information were developed

All components above were seen to compliment and reinforce each other, providing a synergistic effect and improving the total expected benefits of the program.

CONCLUSIONS AND RECOMMENDATIONS

Most of the work initiated under this project has been successfully completed and is providing significant benefit to the counterpart agency and the Zarafshan basin as a whole. This work includes:

1. Provision of 38 units of heavy equipment and vehicles for canal maintenance and SMG.

2. Establishment of a Training Center in HQ building and renovation of a Dorm Facility at the Central Warehouse of the BISA.

3. Improvements to voice and data communications including new telephone exchange, telephones, trunk radio-communication.

4. Provision of 52 computers, 39 printers, large format plotter, copy machine, custom database for irrigation system management, and computer training for over 335 irrigation system staff.

5. A successful public awareness campaign promoting careful use of water as a scarce resource, public participation, and project sustainability.

The following recommendations can be made to continue the support to BISA:

1. Improvement the flow monitoring system within the BIS by establishing automatic flow monitoring stations, which will link with trunk radio communication system into the existing database

2. More training