Irrigation Management Issues in Bangladesh: Experiences and Lessons from Ganges-Kobadak Irrigation System

M. Noajesh Ali [1]

INTRODUCTION

Irrigation is a critical factor for crop production in Bangladesh. Although, the share of agriculture in Gross Domestic Production (GDP) has been declining over the years, it still remains the largest sector of the Bangladesh economy. At present, agriculture accounts for about one-third of GDP and employs about two-third of the labor force. While the contribution of agriculture to the economy is likely to decline, it will continue to be the single largest contributor to income and employment of the rural population in the foreseeable future. The country's increase in food production appears below the level necessary to meet basic food needs, while its population continues to increase at a rate of 1.8 percent a year. Virtually all of the country's cultivable land is already in use and each year, the farm sizes grow smaller and the number of landless laborers grow larger. However, on closer inspection, a more optimistic outlook for the future is possible. The country has fertile soils in the combined flood plains of the Ganges, Brahmaputra and Meghna rivers. There is more than enough water if properly managed to triple the amount of currently irrigated land and substantially increase food production. Additionally, some innovative attempts like improved management techniques, operation and cost-effective maintenance of the existing irrigation projects may also substantially increase food production. The Government has given highest priority to the development of the agricultural sector and through a series of Five Year Plans has attempted measures with the aim to increase food grain production. Under the plan, the Government has given highest priority to the maximum utilization of the existing facilities and improvement of productivity in areas already covered by irrigation facilities. Command area development, efficient water distribution, crop-water management practices, and participation of local people as beneficiaries of drainage and irrigation program are being encouraged.

Bangladesh Water Development Board (BWDB) created in 1959 is the pioneering organization entrusted with the task of planning and implementing various water resources projects in the country. This organization has already completed a large number of projects within the country. While the growth of water development projects have contributed

[1]Former additional Chief Engineer, Bangladesh Water Development Board , Dhaka.

significantly towards increased agricultural production, the shortfall from expected returns has also been substantial. Gradual deterioration in performance of the project has been identified as one of the main reasons of the shortfall.

The Ganges-Kobadak (G.K) Irrigation Project as conceived in the early fifties was the first major step in Bangladesh to provide supplemental irrigation to traditional rice varieties. It is the largest lift-cum-gravity irrigation system in the country. Like other irrigation projects in Bangladesh, performance of this project is much below the potential level. Inadequate funding for the proper maintenance led to gradual deterioration of the physical infrastructure. In addition, problems such as lack of practical guidelines for main system operation, lack of measuring devices for water distribution and allocation, lack of control at the main system level and excessive use of water by farmers in locations with easy access to water lead to poor performance level.

Between 1985 and 1994, the G.K Project was under rehabilitation with a loan from the Asian Development Bank(ADB) and Technical Assistance from UNDP to address the above deficiencies. The lesson learnt is that changes to the physical works (the hardware) are relatively straightforward and can be accomplished in a reasonably short time span, whereas changes to improve the management, the operation and maintenance (the software) of the system are less straightforward and difficult to accomplish in a limited time span (Burtonand Frank 1989). In this paper, the discussion is made on the aspects of software changes in rehabilitation for efficient irrigation management with sustainable operation and maintenance procedures.

DESCRIPTION OF THE G-K IRRIGATION PROJECT

The project area is located in the southwestern part of Bangladesh. The G-K Project Kushtia Unit comprising two phases was taken up for implementation in 1954. Net irrigable area is about 125,000 ha. Phase-I consisting of about 42,000 ha was implemented during 1954–70 and Phase-II covering an area of about 83,000 ha was completed during 1969–83.

A typical monsoon climate prevails in the project area. Average annual rainfall is about 1,600 mm, about 70 percent occurs during mid-June through mid-October. Rice is the dominant crop occupying about 70 percent of the total cropped area. Pulses, oil seeds, jute, sugarcane, tobacco and wheat are the other important crops.

The Ganges-Kobadak Irrigation Project derives its water from the Ganges river. The project includes two major pumping plants, flood control and drainage facilities and an irrigation distribution network comprising main, secondary and tertiary canals. Irrigation water is pumped from the Ganges river by a main pumping plant having 3 pumps of 36.8cumec capacity and also by a subsidiary pumping plant having 12 pumps of 3.54 cumec capacity each. The project's main canals are about 193 km, secondary canal about 467 km, and tertiary canal about 995 km, in length.

The area has developed because of the project. Good crop production is assured as areas are free from floods and have more or less assured water supply for irrigation. In irrigated areas mainly High Yielding Varieties (HYVs) of paddy are grown. At present, about

93,000 ha are benefiting from a supplement irrigation during Kharif-II season (mid-July – mid-November), against targeted area of 125,000 ha, while about 25,000 ha are irrigated during the Kharif-I season (March – June) due to scarcity of water. In contrast to other areas in Bangladesh no irrigation is supplied for the winter crops (November to February) at present. However, pulses, oil seeds, onion, wheat, tobacco etc. are cultivated in large areas (about 60%) under residual moisture condition during this season. Salient features of the G.K Project are provided in Appendix table 1.

PROJECT ORGANIZATION AND SYSTEM OF OPERATION

Organization

The Ganges-Kobadak Irrigation Project is operated and maintained by the Bangladesh Water Development Board (BWDB). Under BWDB, organization of the G.K. Project has a straight forward structure, where a Superintending Engineer (Project Director) is the head of the Project with Executive Engineers in charge of the Divisions. Divisions are responsible for construction and O&M in the field. For agricultural development activities, an extension unit has been established. The extension staff is primarily responsible for the agricultural extension, water management at the field channel level, and for guidance of the water management association. The extension staff works under the administrative control of the Project Director and under the technical control of the Chief Water Management of BWDB.

Nomenclature of the Project Irrigation System

Water from the river is pumped into the main canals. From the main canals water runs into secondary canals and from secondary canals into tertiary canals from where farmers get water into their land through field channels and plot channels. Command area of a tertiary canal is called a tertiary unit, which receives water from a tertiary offtake. A tertiary unit is subdivided into quaternary units called *chaks*, which vary in size from 25 to 40 ha. A chak receives water from a quaternary channel called field channel through an outlet.

PROBLEMS AFTER COMPLETION OF THE PROJECT

Although the Ganges-Kobadak Project is technically sound in concept, it could not achieve many of the expected benefits due to a number of problems including:

- Heavy sedimentation in the intake channel of the pumping plants;
- Insufficient water supply due to poor pumping plant condition;
- Inadequate and undependable power supply;
- Inadequate tertiary and field channel network;
- High operation and seepage losses from the canal system;
- Poor system management, operation and maintenance;
- Less than adequate extension services, farm inputs and agricultural credit; and
- Inadequate on -farm water management practices.

Inadequate system management and on-farm water management practices have resulted in illegal diversion of water by cutting irrigation canal embankment at the head reaches. The absence of adequate field channels and plot channels lead to the practice of plot-to-plot irrigation where a plot is flooded completely in order to reach an adjacent plot. This practice results in wastage of vast amount of water that is spilled into the drains and percolating into ground.

Originally, when the project was conceived, water requirement was based on more rainfall dependent local rice varieties. Now with the introduction of high yielding varieties of paddy, higher diversion duty is required. Moreover, there is strong pressure from the farmers on the BWDB to provide more water in both pre-monsoon (Kharif-I) as in the monsoon period (Kharif-II). The farmers wish to irrigate a larger area with HYV paddy and therefore they are in need of more water, even in the monsoon season. One of the consequences of the above attitude of the farmers is a larger area in monoculture paddy than foreseen in the original design, thus increasing the water requirement at the primary, secondary and tertiary levels of the irrigation system.

As a result of a UNDP grant for the feasibility of the Ganges-Kobadak Irrigation Rehabilitation Project conducted in 1983, the Government secured a loan from the ADB totaling 34.93 million SDR for financing the rehabilitation of the existing irrigation system.

REHABILITATION PROGRAM

First Phase of the Program

Rehabilitation of the irrigation system started in 1985 and has been directed at remedying the identified problems through:

- Improving hydraulic condition at the entrance and within the intake channel to the pumping plant;
- Improving adequacy and dependability of power supply;
- Rehabilitation of pumping plants to their original design capacity;
- Rehabilitating major existing infrastructure;
- Rehabilitation and improving tertiary and field channel network;
- Strengthening of farmer organizations and agricultural support services; and
- Improving arrangement for sustained operation and maintenance of the system.

As a supplement to the ADB loan for the rehabilitation and improvement of the existing Ganges-Kobadak Irrigation system, UNDP granted a technical assistance in 1985 to provide back stopping support for consulting services in detailed design, construction supervision; training of BWDB staff in system management, O&M and organization and training of water user groups. Joint evaluation of the technical evaluation was undertaken in April 1987. It was found that rehabilitation is more concentrated on physical rehabilitation with insufficient regard for other factors responsible for the need to rehabilitate this scheme like poor management, operation and maintenance and inadequate on-farm water management practices. In addition to the physical rehabilitation of the irrigation system, attention should be directed at strengthening the capacities of G-K project staff and farmers for the subsequent management, operation and maintenance of the rehabilitated system.

Detailed examination of the reasons for the malfunctioning of the system has been carried out and the following points have been observed with regard to the functioning of the main system and also of the system at the chak level.

Functioning of the Main System

The inability of the main system to deliver an adequate and reliable supply of water to the chak outlets is a result of number of factors like deficiencies in the physical infrastructure itself, high conveyance losses partly due to seepage and partly due to losses from defective or even missing control structures, substantial losses from the system from unauthorized cuts made in the embankment by farmers. A number of these problems are, at least in part, due to inadequate planning procedures for the operation and maintenance of the main system by project staff. It is evident, of course, that the simple inadequacy of the budget allocation is also a cause of the inadequate attention to system management. However, the scarce budget allocation could be properly utilized with the establishment of improved maintenance planning procedures.

Functioning of the System at Chak Level (On-Farm Level)

The extent of the irrigation system network below the main system is limited. Large parts of the project area are without field channel network. There is either complete absence of field channels or field channels previously constructed are in a very poor condition. Limited development by farmers of the water distribution network below the outlets has been a consequence of the inadequacy and unreliability of water supply reaching the tertiary canals. Lack of confidence in the regularity of the water supply has in turn discouraged the development of any sort of group discipline regarding water use or field channel construction and maintenance by farmers at the chak level. Any improvement in the present functioning of the system at the chaklevel must then come first from an improvement in the supply of water from the main system.

At the same time studies have also been conducted as regards tertiary unit development and on farm development. Studies recommended strengthening of farmer participation through the formation of Tertiary Water User Associations. Evidence from rehabilitated irrigation schemes around the world also suggests that farmers must be involved in planning, design and construction stages of the project. It was thus decided to develop such an integrated approach also for the G-K project. The concept as envisaged is to develop processes for this in selected model areas and after the processes are developed, to expand them gradually to other areas of the G-K project. The processes to be developed are those that eventually lead to organized farmers taking responsibility for the O&M at the tertiary level and below.

The intended functions of these Water User Associations are to:

- Locate, construct, improve and maintain field channels and plot channels with technical assistance from BWDB;
- Ensure equitable water distribution;
- Resolve conflicts in water distribution among its members;
- Ensure proper cleaning and maintenance of tertiary canals;
- Convey information about water management and communicate farmers needs to the relevant agencies; and
- Help in the collection of water charges.

The approach that was taken as ideal was to organize first small water user groups, an outlet committee in each command area of the outlet and then bind all the outlet committees of the tertiary unit into an association. While the Tertiary Water User Association was the main organization, its success depended largely on the viability of the outlet committee. Thus, it was felt necessary that the outlet committee represents the farmers from the head end, middle and tail end of the field channel and also from large, medium and small farmers in the community, those who have leadership and interest in social work to make it a strong and viable committee.

This program was taken up in 1988 in three tertiaries as model areas where encouraging progress was made which acted as the foundation of future course of tertiary unit development work under farmers' participation program in G-K project.

The terminal evaluation of the Phase-I UNDP supplemental Technical Assistance to the Asian Development Loan for the G-K Irrigation Rehabilitation Project was carried out jointly by GOB/UNDP/ADB in June 1989. The evaluation concluded that although substantial implementation progress had been achieved, the G-K project would benefit from a further technical assistance in the following fields:

- Completion of physical work on chak development through farmer participation;
- Establishment of farmer groups responsible for O&M of the tertiary level of system; and
- Strengthening of the O&M capability of G-K project organization.

Second Phase of the Rehabilitation Program

The implementation of second technical assistance started in May 1991 and was planned for a duration of 30 months. It was funded/financed through a UNDP grant and an equity of the Government of Bangladesh. The objectives of this technical assistance were:

- Development of the tertiary units and the formation of Water Users Associations, comprising groups of farmers which would be responsible for the operation and maintenance of the tertiary canals and for cost recovery;
- Training of all levels of project staff and farmer groups on operation and maintenance of various aspects of the project; and
- Direct support of water management unit (WMU) to be established within the project organization which would be responsible for water distribution, planning and operation through the introduction of a computer-based scheduling model.

The essence of the Technical Assistance design was to provide the G-K project staff with the necessary training, experience and facilities to make major changes in the project functions, transforming it from an organization with a central responsibility for operation and maintenance to a participant organization responsible for main system control and the supply of water to independent agricultural enterprises. Completion of the tertiary level physical development and improved operational control in the main system were essential for successful conclusion. The activities carried out are stated below:

Organization of Water User Associations

During the rehabilitation period that ended in June 1993, 324 Water User Associations (WUAs) were formed. These water user associations participated in the remodeling of tertiary canals. To improve water distribution below the outlet, water user associations constructed field and plot channels in locations agreed upon by G.K staff and the farmer beneficiaries. Their participation in tertiary remodeling was a unique undertaking, i.e., the WUAs had to provide the funds for remodeling the work then, later on reimbursed by the project management. The source of funding was individual contribution by beneficiaries, but in some cases for smallholders, they had to work for the equivalent amount of their contributions. Any profit from these activities formed part of the capital of the WUAs. There were, however, areas where farmer beneficiaries adopted the wait and see attitude, and it took sometime to convince them. But since they observed that farmers in the more advanced WUAs were satisfied with the water supply at the farm level, the participatory movement gained grounds.

Training of G-K Staff and Water Users

A training program ranging from the fundamental principles of water management to a more advanced water management was designed, implemented and participated by selected personnel from the field staff to the senior management. Practical training for members of the WUAs, regarding leadership and financial management to prepare them for the full management of tertiary level facilities and manage their association not only for O&M but for a more responsive production economic oriented group.

Water Management in the System

A unit called Water Management Unit responsible for main system operation was established within the G-K project organization. To help this unit, the consultant of the project developed a software to develop a central database for storage and analysis of system operation information. In addition to the storage and processing of basic operation data, the software calculates crop water requirements, determine target discharge control structures making use of feed back on actual field conditions. The software is capable of providing target discharges and reports for actions by gate keepers and system operators. Procedures for monitoring, control and assessment of the operations of the main system as well as development of operating guidelines and communication links were also developed.

EXPERIENCE OF THE CANAL ROTATION PROGRAM CONDUCTED BY IIMI-IRRI-BRRI RESEARCH GROUP

During the rehabilitation program, an experiment on canal rotation program was conducted by the IIMI-IRRI-BRRI research group with the active involvement of the farmers and G.K project officials during 1989–90.

Rotation

As the Ganges-Kobadak system is deficient in water in relation to the total needs of the farmers within its command area, a nine-day rotation (with three days on followed by six days off) among secondaries was rather loosely followed for some years. In 1990, the rotation was changed to that of ten days—with five days with water followed by five days without. The IIMI-IRRI-BRRI research group, in consultation and collaboration with the G-K project officials, undertook an experiment on one secondary canal so as to monitor the implementation of the rotation and examine its results.

The previous (nine-day) rotation system had faced a number of problems which the action research experiment attempted to resolve. These problems included: a) non-observance of rotation among tertiaries; b) deteriorated condition of canals and field channels; c) unauthorized cuts in canals; d) poor condition of hydraulic structures as well as that of some bridges and culverts; e) absence of farmer-organizations and participation; and f) a general lack of communication and interaction between farmers and the project officials. The secondary canal chosen for study (denoted as S8K) was one of those having significant problems. Project officials arranged for repairs to this canal and its control structures and devised a system so as to ensure that the 5+5 ten day rotation could be strictly observed with regard to water deliveries to the secondary. Project officials, along with the research team members made special efforts to keep the farmers along the secondary informed as well as to encourage their participation.

As a result, area irrigated under S8K in the 1990 Kharif-I season increased from 54 hectares in 1989 to 528 hectares, an increase of 877 percent. The distribution of water among different tertiaries and among the head, middle, and tail farmers along the various field channels also became much more equitable in 1990 than before.

LESSONS LEARNT FROM THE REHABILITATION OF THE SYSTEM

There were positive and negative experiences gained during rehabilitation of the system. The negative experiences were as a result of unenlightened water users, and inadequate maintenance planning. But these are not insurmountable ones as solutions to these problems developed overtime. At least with these experiences, the span of the rehabilitation, operation, deterioration and rehabilitation cycle in irrigation development could be

lengthened. Attempt was made to institutionalize the lessons learnt within the G-K Project to improve and build upon the sustainability of the system.

While organizing water users is a long and tedious process, once given the right motivation they can become willing and excellent partners in remodeling irrigation facilities, operation and maintenance, water management at the field level and in cost recovery, thereby contributing to the sustainability of irrigation system operation.

- Proper and adequate maintenance of irrigation facilities is a key to successful operations.
- Continuous training is necessary to improve the capability of both irrigation staff and water users in the management of irrigation systems.
- Regular monitoring and an efficient management information system is indispensable in the effective operation and maintenance of irrigation systems.
- Labor-intensive practice if properly managed is a sustainable approach in system rehabilitation and improvement.
- Appropriate management environment (characterized by irrigation managers and farmers interaction) can improve system performance to a large extent.

From the lessons learnt through the rehabilitation program of the G-K Irrigation Project, it could be concluded that improved efficiency of the project is very much dependent on the software of management and training. Rehabilitation tries to make the scheme technically perfect. But a technically perfect system does not automatically imply a proper functioning of the system. To function effectively, the scheme also requires proper operation and maintenance of the main system, as well as an efficient use of water by farmers. In other words, it is essential to focus on elements such as: (i) main system management, (ii) improvement of O&M procedures, (iii) strengthening and training of O&M staff, (iv) participation of the water users, (v) coordination among all parties, (vi) socioeconomic impact on the farmers and (vii) environmental aspects of the project area.

Although the future looks bright with the rehabilitation program of the G-K Project, there is no room for complacency. Improvement of the management skills are still required for sustainable operation and maintenance.

Appendix table 1. G-K. Irrigation project at a glance.

Project area	197,500 ha.
District	4 Nos (Kushtia, Chuadanga, Jhenidah, Magura)
Upazila/Thana (small administrative area)	13 (Kushtia, Kumarkhali, Khoksha, Mirpur, Bheramara, Daulatpur, Alamdanga, Chuadanga, Harinakundu, Jhenidah, Sailkupa, Magura and Sreepur)
Population	20 lac
Irrigable land	1,25,000 ha
Project implementation period	1st Phase : 1955-56 to 1969-70 2nd Phase : 1960-61 to 1982-83
Project implementation cost	Tk. 739 million
Project rehabilitation cost	Tk. 2126 million
First irrigation supply	1962
Pump house	2
Total discharge Capacity	153 cumec
Flood control embankment	39 km
Irrigation canal	
a) Main irrigation canal (3 nos)	193 km
b) Secondary canal (49 nos)	467 km
c) Tertiary canal (444 nos)	995 km
Drainage canal	971 km
Hydraulic structure	2,184 Nos
Inspection road	228 km
Project's electricity requirement	14 Mega Watt
Highest irrigation achievement	99,119 (Aman) ha 42,742 (Aus) ha
Annual operation cost	Tk. 290 million
Water user association formed	324
Total number of outlets	3,500

BIBLIOGRAPHY

DHV Consulting Engineer: Inception Report of G.K Irrigation Rehabilitation Project.

DHV-ACE Consulting Engineers: Interim findings on Water Users Association in the G.K Project.

Z. Alam; K. Matsunami; S. Sirajuddin and S. Shotton, 1987, Joint evaluation report on technical assistance for implementation of G-K Rehabilitation Project.

M. A. Burton; and T. R.Franks 1989. *Successful rehabilitation: Can old habits be changed?* Paper presented in the Regional symposium on the modernization and rehabilitation of irrigation drainage scheme held at Development Academy of the Philippines.

David Groenfeld 1988. The potential for farmer participation in irrigation system management. *Irrigation and Drainage Systems* 2(3).

FAO. Irrigation and drainage paper 40 on organization, operation and maintenance of irrigation schemes.

Ankum P. 1988. *Management of irrigation rehabilitation projects an experience from Indonesia.* Paper presented at the Asian Regional Symposium on the Modernization and Rehabilitation of Irrigation and Drainage Scheme.

M.A. Hakim, D.E. Parker and M.A. Ghani 1991. *An experience in water rotation in the G-K. Irrigation System*. Paper presented at the IIMI/BRRI/IRRI workshop on “Applied Research for Increasing Irrigation Effectiveness and Crop Production” held in October at BARC, Dhaka.