Banganga Irrigation System: Preliminary Results on Main System Management Improvement

V.S. Mishra[1]

1. Introduction

1.1 System Description

The Banganga Irrigation System (BIS) is located in the western terai region of Nepal, Kapilbastu district. The water sources for the system are the Banganga river and the Kaila river. The system is completely dependent on the Kaila river during the dry season, because the discharge of the Banganga river is trapped by the farmers upstream. The water diverted from the Banganga river into the system is channeled into the Jagdishpur reservoir. This feature of BIS is not present in other large irrigation systems in the country. The system covers about 6215 ha, within 16 Village Development Committees.

The Command area has a gentle slope from north to south (Figure 1). Rainfall in the command area is not uniform through out the year. The average annual rainfall (1989-1991) in this area is about 1660 mm, out of which 1500 mm of rainfall occurs from June to September. In the dry season rainfall is minimal, so winter crops depend on irrigation water.

During the rehabilitation period (1982-1989) of the system under the Command Area Development Project (CADP), there was a separate set up for the operation & maintenance of the system. Agency staff numbered 47, including administrative and field staff. When the system merged under the District Irrigation Office of Kapilbastu, only a few staff were involved in the operation of the system, mostly on work charge basis. About 10 persons consisting of dhalpas, chowkidars, and supervisors were engaged in the operation of this system.

The main cropping patterns in the command are characterized by the two seasons namely: monsoon and winter. During the monsoon season the major crop is paddy. This crop is grown from June to October. Winter season starts in November and ends in March. This is the time for growing wheat, oilseeds, vegetables, and other crops. A third cropping pattern is practiced in limited areas for early crops of paddy and maize. These are planted in April and harvested in July.

There has been a shift away from planting wheat in the winter season. During the 1992 winter season oilseeds, vegetables, banana, sugarcane, and chaite crops were grown in many areas. The diversification of crops indicates an improvement in water management.

1.2 Land Holding Size

Land holding size is categorized into three groups based on farm size: small (below 2.38 ha), medium (2.38 to 5.10 ha) and large (above 5.10 ha). This classification was used in the study of Income, Consumption, and Employment patterns of Nepal, 1977 (National Planning Commission).

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1 *Acting Divisional Engineer, Kapilbastu District Irrigation Office, Western Regional Irrigation Directorate.*

About 93% of the households are categorized as small farm size, accounting for 70% of the entire command area, 6% of the households belong to the medium group, representing about 18% of the command, and 1% of the households belong to the large farm size category, representing about 12% of the irrigated area. The estimated average size of land owned is about 0.72 ha for the small farm size, 3.12 ha for the medium, and 8.83 ha for the large categories. This information is based on the sample survey collected by BIS in 1991-1992

The purpose of this paper is to present the procedures used and provide preliminary results achieved in improving the management of the main system. It also includes participatory management results collected during the DOI-IIMI program. This paper points out the need for participatory management, particularly in attaining improvements in the overall performance of large irrigation systems.

2. Operation and Maintenance Procedures

2.1 Operation

The cropping schedule was based on existing cropping patterns and practices used. Operation of the system and irrigation water deliveries followed this schedule. The monsoon season starts the second week of June when the major crop, paddy, is planted in 100% of the command area and ends in November after harvest. From the second week of October until the middle of March, in fields where the paddy crop is harvested, about 15% of the area is then planted with oil seeds (mustard), vegetables, and pulses. The winter crop schedule starts in the middle of November where about 35% of the area is planted in wheat, which is harvested in the middle of May. Sugar cane will be planted in the middle of May and early paddy and maize (chaite crops) are also planted in April for about 5% of the command area.

This cropping schedule developed from discussions with the farmers before the season started. Several meetings were organized in different villages of the command area to explain the operation and maintenance (O&M) of the system. These meetings were also used to strengthen the water users groups, build up the norms related to O&M, discuss problems related to O&M, crop diversification, and other related issues.

Meetings with the chairmen of the water users groups were organized before the start of both monsoon and winter seasons to discuss problems that were observed during the previous seasons and possible solutions for implementation in the future. During these meetings, water delivery schedules were discussed, in particular, with the dates of water releases from the Jagdishpur reservoir. Rotation among the different sections of the system for water distribution was discussed, including the proper maintenance of irrigation and drainage facilities at the tertiary level.

Informal as well as formal meetings were held with other agencies, principally with the Agriculture Input Corporation (AIC) and the Agriculture District Office (ADO). This was done to facilitate the farmers' procurement of production inputs and technology. After a long delay only one meeting of the Sub-Project Coordinating Committee (SPCC) was held. The SPCC was formulated during the construction period of the CADP to assist the project in construction, operation, and maintenance. This particular meeting was held to decide about the handing over of two Godowns constructed within the command area. One was given to a co-operative organization and the other to the AIC. During the same meeting, decisions were made regarding the enforcement of rules and regulations related to irrigation.

Several other meetings were conducted in the villages and in the BIS office to decide on the types of crops, period of sowing, and other relevant matters. These

discussions were helpful in planning the procedures for allocation and distribution of water. The previous records of system operation were also analyzed to provide additional information for deciding on water allocation among different sections of the system. The needs of different sections of the system were also assessed. Using these considerations, a water delivery schedule was prepared for paddy crops in the monsoon season of 1991 The whole area was divided into four blocks, and delivery was made on a rotation basis from head to tail. The water delivery schedule for monsoon season 1991 is presented in Table 1

a) Paddy irrigation delivery pattern during monsoon

The outflow of irrigation water from the Jagdishpur reservoir and inflow to the different outlets in the main canal, distributaries and branch canals were monitored. Monitoring was done in terms of number of days these outlets were to receive water. Several water flow measurements were taken at the diversion headgate, inlet and outlet of the reservoir, and at several points in the main canal. Rainfall and reservoir levels were monitored daily to optimize water delivery the reservoir

A comparison of the actual number of days that water was delivered to the head, middle, and tail sections of BIS for two monsoon seasons (1990-1991) was made (Figure 2). This was made to determine the pattern of water distribution during the monsoon seasons. The resulting pattern of water distribution for paddy crops, indicated that in 1990 the largest number of days was delivered to the head-end. The middle and tail sections received water less than half of the total number of days compared to the head-end. This pattern indicated inequitable distribution; with the head-end getting most of the irrigation water.

In 1991 monsoon season, the head-enders received irrigation water for a greater number of days than the middle and tail-enders, reducing water distribution by as much 12%. Improved control and cooperation were exercised to attain this reduction. The increase of water delivered to the middle section indicated that improvements were being achieved to equitably distribute water during the monsoon season. More control will be needed in the future to minimize delivery of excess water to the head-end and increase the number of days of water delivery to the middle and tail reaches of the main canal. The increase in the number of days of water delivery to the middle reach can be considered a significant improvement. The middle section contains the largest proportion (44.5%) of the command area, so that improved water delivery to this section should alleviate the inequitable distribution during the monsoon season.

Rainfall was monitored in order to use it effectively. If rainfall was sufficient to meet crop water requirements, then the Jagdishpur reservoir outlet gate was closed. This leads to changes in the water delivery schedule as indicated in Table 2.

During the monsoon of 1990, there was a total of 1345 mm of rain. While for the 1991 monsoon season, only 1110 mm rainfall was received. This led to more days of water releases from the reservoir (Table 2). Even though less rainfall was received, water control cooperation from the farmers improved, particularly in the head section of the system (Figure 2).

This illustrates the significance of the reservoir, even in the monsoon season. This also indicates that the operation of the reservoir is an important activity under system management. Regular monitoring, not only of the reservoir, but also of

rainfall in strategic locations in the command area, has to be undertaken to effectively use the rainfall.

b) Irrigation water delivery pattern in the winter season

During the winter cropping seasons of 1991 and 1992, Figure 3 indicates that in 1991 about 50% of the total number of days of water released for winter crop was consumed in the head reach. This shows that an excessive amount of water was wasted at the head reach. Only 30% of the water was provided to the middle and 20% to the tail reach of the system. While during the 1992 winter crop season, the resulting water delivery pattern was much more equitable, because the farmers practiced better control and cooperation. Despite this improvement, there still exists opportunities for further improvement in reducing water waste at the head reaches as indicated in Figure 3. The actual water delivery at the head reach was more than planned by as much as 10%. For the middle reach, the actual water delivered was less than the planned by 10%, and at the tail reach by a small amount.

Changes in the operation of the system had to be made to optimize the available water from the reservoir. It was also noted that one of the major reasons for the tail reach receiving less water than planned was due to the weeds in the main canal, indicating needed improvement in maintenance.

Considering the above problems in operation, the delivery schedule for the entire winter season was not prepared at one time. Before the start of winter season a general meeting of the chairmen of water users groups (WUGs) was arranged to determine relevant problems. The operation of the system and a water delivery schedule was prepared following a tail first to head reach sequence. Three sets of rotation schedules were prepared and conveyed to the farmers. The major lesson learned was that one schedule prepared at the start of the crop season for the whole command area cannot be followed. Irregular rainfall occurring at different locations, resulted in changes in the farmers demand for irrigation water. For this situation a different water delivery schedule was prepared for each set of rotations. All three rotation schedules are attached (Tables 3, 4, and 5).

As for the methods of water delivery and the schedule prepared, it was observed that the delivery was of mixed type (continuous, rotation, and continuous-rotation combined). Because of the scheduling difficulties mentioned above, this was found to be an effective way of using irrigation water. In small areas having the same social, cultural, economic, and environmental conditions a rotational system can be followed satisfactorily, but in the case of a larger area it was found to be difficult due to the differences in the foregoing factors.

c) Water users groups participation in operation

Meetings were conducted for the purpose of forming or reactivating WUGs. During WUG formation, discussions regarding cropping schedule, irrigation delivery schedule, and demand assessment were undertaken. Before the 1991 monsoon season, a meeting for WUG chairmen was held to schedule water delivery. Only 8 chairmen attended. Another meeting of WUGs chairmen was conducted for scheduling water delivery for the winter season beginning November 28, 1991. The number of participants were 38; most were chairmen. During this meeting, the participants themselves decided on the allocation and the pattern of irrigation water delivery. They agreed to follow the pattern or sequence of tail first to head end. This was a very significant achievement in terms of getting

WUGs and other farmers to participate in making decisions on main system management.

2.2 Maintenance

The maintenance budget is planned based on existing problems. These are evaluated and placed in the program of work for the coming year. For this the Ministry of Finance has developed one format. The overall maintenance budget requested was 34 Lakh, but only 7 Lakh was allocated. In this allocation, 1.5 Lakh was for operating the system. Last year, 1.7 Lakh was spent with a wage rate of Rs 25/day for labor. The present rate is Rs 32/day, indicating that 1.5 Lakh is insufficient.

A work estimate for desilting the diversion canal (DC) was prepared for 8 Lakh last year. But for the rehabilitation of the DC, Main Canal (MC), and all the distributaries, only 3 Lakh was allocated. After monitoring the silt accumulation in the DC, it was determined that every year about 25 cm to 30 cm of silt has been deposited. The last time that desilting was done was in 1985. Presently, the estimated silt deposition is about 100-125 cm. Silt and weed build-up in the main canal prevents effective water flow to the tail reach of the system. Last year, the budget allocated for maintenance work, including costs for work charge staff in canal operation, was 5 Lakhs. This amount was not sufficient to undertake the desilting, weed removal, and other structure repairs works.

The estimated regular yearly budget is proposed to overcome the maintenance difficulties and effectively carry out canal operation. In Table 6, the estimated cost per year is 177 Nrs per ha. This can be reduced, particularly in Item No.4, by appointing regular field staff. Item No.3, can also be reduced after two years by handing over the responsibility below tertiary level to WUGs. Even Item No.1 can be reduced, if the main canal could be handed over to the overall central committee of all WUGs in the system.

Weeds can be considered a major problem in the DC and MC, because they reduce the flow of irrigation water. This reduction reduces the amount that reaches the tail-end. With a reduction in flow, a corresponding increase in head upstream occurs, causing losses through the outlets. In some portions of the MC, the rapid growth of weeds require clearing at least twice a year.

Measurements were made to determine the effects of weeds in the main canal. The maximum discharge measured was 2.5 cu.mec at a depth of 1.59 m. The designed supply level (FSL) is 1.3 m and the design discharge is 5.68 cu.mec.. The discharge released was 3.075 cu.mec at a depth of 1 m measured over 5 km of the main canal, which had been cleared of weeds. Other measurements were made as indicated in Table 7.

More than one month after cleaning, almost the same discharge was released at a depth of 1.30 m. Since the reservoir level affects the discharge released, the initial delivery in the reservoir level (RL) was 107.88 m. After more than one month the RL level was 108.5 m. Even with a higher head, the design discharge cannot be attained due to impediment provided by the weeds in the canal. Weed growth over a short period of time indicates that weed removal is an important maintenance activity in order to provide irrigation water and meet the water delivery schedule.

Maintenance affects the operation of the system. As discussed earlier, the tail-end portion of the system received the least amount of water. Poor maintenance of damaged or defective outlet gates in the upstream portions of the main canal is partially responsible for water waste. In the 1991 monsoon crop season, the head reach was cleared of weeds. This resulted in an increase in duration of water delivery to the middle reach, but less went to the tail reach than in the 1990 monsoon crop season (Figure 2).

There are some irrigation and drainage structures that need to be modified or repaired as requested by the farmers. Performing this request is necessary to motivate the farmers to participate in the management of the system. With constraints in the budget, these requests might not be fulfilled affecting the canal operation.

a) Participation of the WUGs in maintenance

Presently, 13 WUGs covering 2,000 ha have been organized under the DOI-IIMI program. In addition to these, there are 16 other WUGs that are actively participating in an O&M program in the system. In the 1991 monsoon season, a length of about 41 km of distributary, tertiary canals, and farm ditches were maintained by farmer members of WUGs. These WUGs have understood their responsibilities and have contributed accordingly in system maintenance. They have also realized the benefit of their contribution.

Other WUGs, have formed their own rules for operation and maintenance below tertiary level. Some WUGs employ chowkidars on a seasonal payment basis. For maintenance, they have agreed upon sharing labor from all households for tertiary canals as well as farm ditches. In some cases only farm ditches are maintained by the farmer members of the WUGs. In other cases, for various reasons, farmers that do not contribute labor are asked to pay.

All 13 WUGs organized have formulated rules and regulations. They fine members for violating regulations, such as livestock animals damaging embankments. Several groups have implemented these rules. Collecting fines has caused problems for many groups. In some cases, these problems are brought to the attention of the BIS office. The BIS Office has assisted the WUGs in enforcing those rules. Seven cases regarding livestock animals, 5 cases of embankment cutting, and dismantling of structures were presented in the office by different WUGs. These cases were solved through WUGs with assistance from the BIS office in the presence of members of the WUGs. This assistance helped the WUGs to effectively implement and enforce rules and regulations.

2.3 Roles, Responsibilities, and Rights

Presently, the WUGs are responsible for the maintenance and operation below tertiary level. Above that, system O&M responsibilities rest with the staff of the Department of Irrigation (DOI).

At the main system level, it is the responsibility of DOI to operate and maintain the canal so that the specified amount of water is delivered at the right time and right place. When the farmers are properly organized and merged into a single central association, maybe main canal operation and maintenance can be handed over to them.

It is the responsibility of the DOI staff to release irrigation water, according to the schedule, to all of the outlets and operate all the check gates and outlets of main system as undertaken by the DOI field staff.

The DOI staff also provides agricultural assistance to farmers relevant to system O&M. This is done in coordination with other agencies to promote agricultural production.

The DOI staff helps provide assistance and a suitable environment for the formation of WUGs. The DOI staff also informs the farmers if there is any problem in the main system, which will delay the operation of the system.

When a maintenance problem occurs, it is the right of DOI to set the priorities of work as in accordance with the budget allocated for the main system. DOI can ask for assistance from the WUGs in emergency cases to undertake repair or other works for

the main system. If a water user violates the rules and regulations, the water user or farmer can be punished by the DOI staff in accordance with the Irrigation Regulation Act of 2045. If any farmer group or farmers damage facilities in the main system or do not follow the schedule, they can be forbidden from taking water from the irrigation canals by DOI. If there are problems, the DOI can change the operation schedule, notifying the farmers in advance while clarifying the problems or difficulties. It is the duty of DOI to inform and discuss with the farmers relevant rules, regulations, and procedures pertaining to the operation and maintenance of the system.

Within DOI, an appropriate set of criteria and procedures for reward and punishment should be made, so that the duties and responsibilities of the DOI staff can be carried out effectively. Presently, a performance evaluation method for the DOI staff does not exist. Performance could be improved through some type of staff evaluations.

In the Banganga Irrigation System, an effort was made to evaluate staff performance at the field level (field-man). Out of seven field-men, two were awarded with two additional grades for good performance. Later, all were terminated including these two. So, it is difficult to say whether they were rewarded or punished.

3. Impact of Main System Management during the Participatory Program

During the 1991 monsoon season, there was drought in the Kapilbastu area. Despite the drought in the command area of BIS, the production of paddy was satisfactory. The farmers developed more confidence in the systems performance. They still experienced difficulties in the tail reach of the command area, which had fewer number of irrigation days. Overall, during the winter crop season of 1992, water distribution was more equitably distributed compared to the previous winter crop season.

The improved performance of the system, encouraged the farmers to plant a third crop and to introduce several new crops like vegetables, banana, sugarcane, chaitedhan, etc.. The change in the cropping pattern increases the cropping intensity, indicating an improvement in the main system management. Fewer conflicts over irrigation water were observed and reported in both winter and monsoon crop seasons as a result of improved management.

4. Conclusions

4.1 Problems and Issues Encountered

a) Lack of operation and maintenance budget: Due to this there is always a canal maintenance problem, and inefficiency in system operation. Budget constraints resulted in farmers reluctance to participate in proper maintenance of the system. The farmers demands for desilting and irrigation structures repair or modification cannot be met by DOI because of limited O&M budget.

b) Lack of field staff: This is a severe problem. The lack of field staff affects the effective operation of the system. Without field staff, critical information about system operation and maintenance is not given to the farmers. Communication gaps between the farmers and DOI will be present.

c) Lack of farmer involvement: Since the farmers were not involved in the early stages of planning and construction, they feel indifferent toward the system and its maintenance. If a policy was drafted to hand over main system management to the farmers through a centralized association of WUGs, then

the farmers might have a sense of ownership and responsibility in the operation and maintenance of the system. Farmer involvement would solve some of the above issues and alleviate budget problems.

d) Irrigation structures not appropriate, creating difficulties between farmers and DOI field staff: All the structures were constructed for flexibility in providing irrigation water, which requires a high degree of management intensity. However, the farmers and DOI field staff were not prepared to cope with structures that need regular supervision and maintenance. The farmers have the impression that DOI has unnecessarily provided them with these sophisticated irrigation and drainage structures and facilities. The use of these structures requires knowledge and skill regarding the systems' operation and agricultural practices for the effective use of water.

e) Lack of institutional development activities at BIS: Institutional development activities should be conducted by DOI to make the farmers aware of how the system functions and what their duties and responsibilities are. These activities should include organization of farmers into WUGs to enable them to make effective use of the systems resources, (water, facilities, and support services from other agencies) and participate in decision making with DOI regarding operation and maintenance.

f) Lack of confidence in the water delivery schedule: With excessive use of water by the head end farmers, water then becomes inadequate downstream, despite the water delivery schedule. Farmers downstream in their desire to get their rightful share based on the schedule will sometimes break the rules and regulations. This contributes to the loss of credibility in DOIs ability to enforce the water delivery schedule. This became more critical with the termination of the DOI field staff.

g) Lack of knowledge regarding agricultural practices and economic use of water: A large number of farmers in the command area are not aware of high yielding crop varieties and irrigation methods that minimize water use. The farmers are dependent on traditional crop varieties and practice "wild" flooding method of irrigation. This method reduces effective water use and leads to inefficiency in the operation of the system.

The above problems and issues describe the present condition of the Banganga Irrigation System. Providing the right amount of irrigation water at the right time and right place would give the farmers confidence in the system. This leads them to constructively participate in the operation and maintenance of the system.

From the experience gained at BIS, every DOI program regarding the preparation of cropping calendars and water delivery schedules should involve the farmers through water users groups. This promotes a feeling of membership within the farmers groups. In new irrigation projects, farmers must be involved right from the start of the planning the system.

A training program for the farmers as well as for field staff should held to instruct them in the proper use of irrigation water and use of irrigation and drainage facilities. The DOI field staff should also be trained in developing knowledge and skills for water users group organization and system operation and maintenance.

Regular monitoring and evaluation of the system are important aspects of system operation. This allows for an analysis of the systems performance to be made and for corrective measures to be adopted for future improvements. Records of cropping patterns, water use, crop yields, areas irrigated, and problems experienced in water distribution for each year should be made and reviewed for making improvements. An action plan for implementing suggested measures and recommendations for improving main system management with participatory management is presented in Table 8.

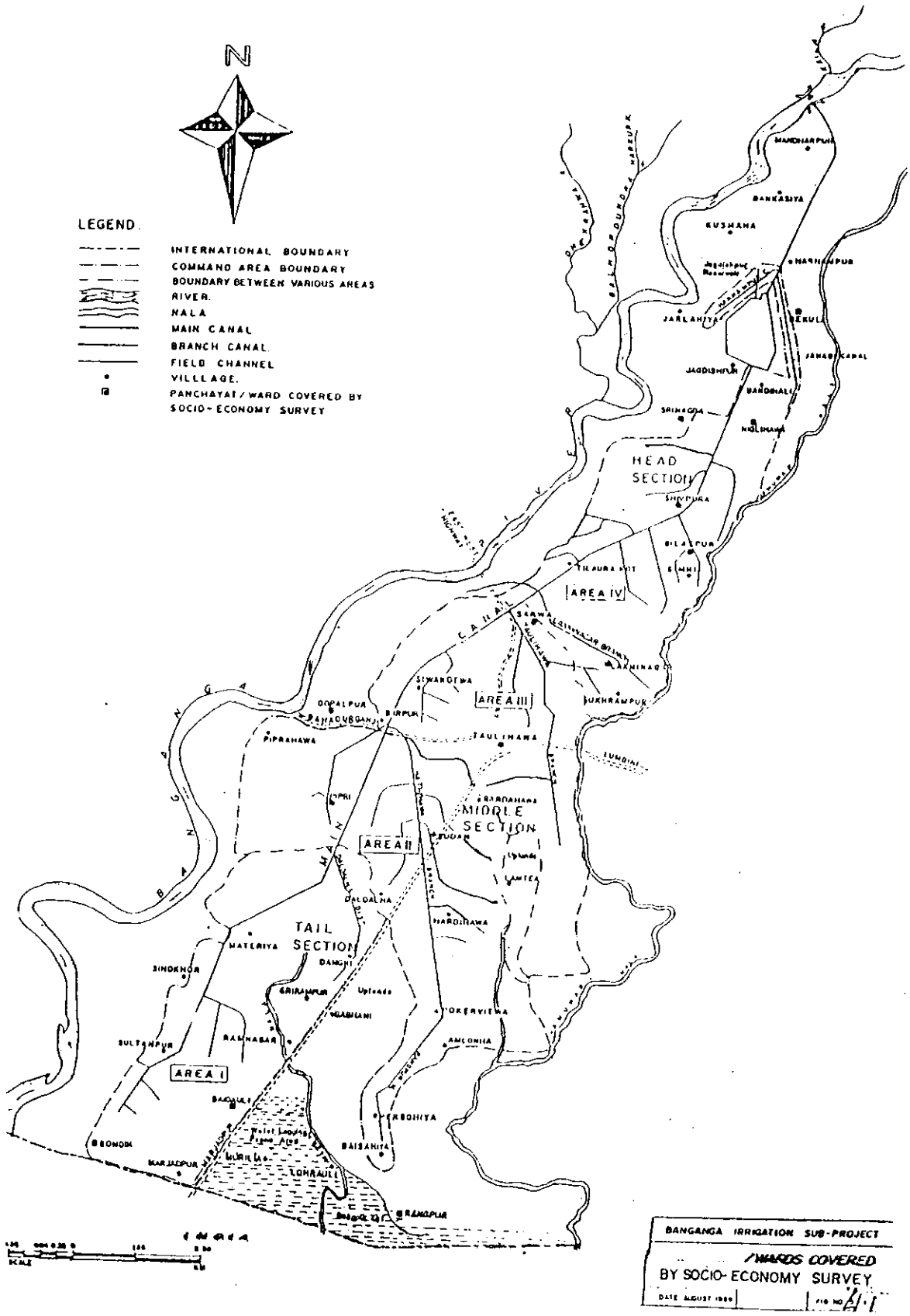
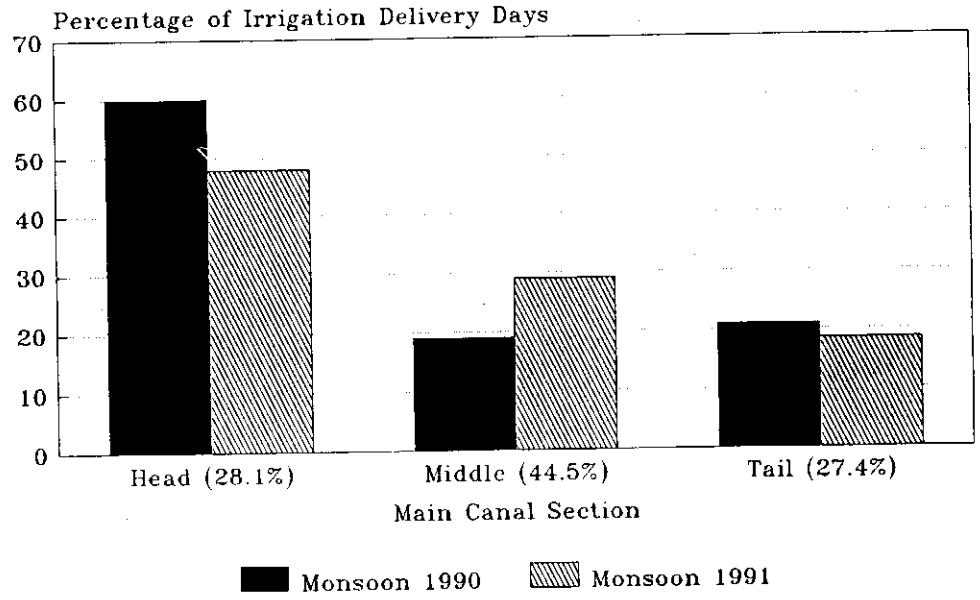


Figure 1: Map of Banganga Irrigation System

Figure 2: Patterns of Water Distribution for Monsoon Seasons 1990 and 1991



Numbers in brackets ()are proportions of area irrigated in each section

Figure 3: Patterns of Water Distribution for Winter Seasons 1991 and 1992

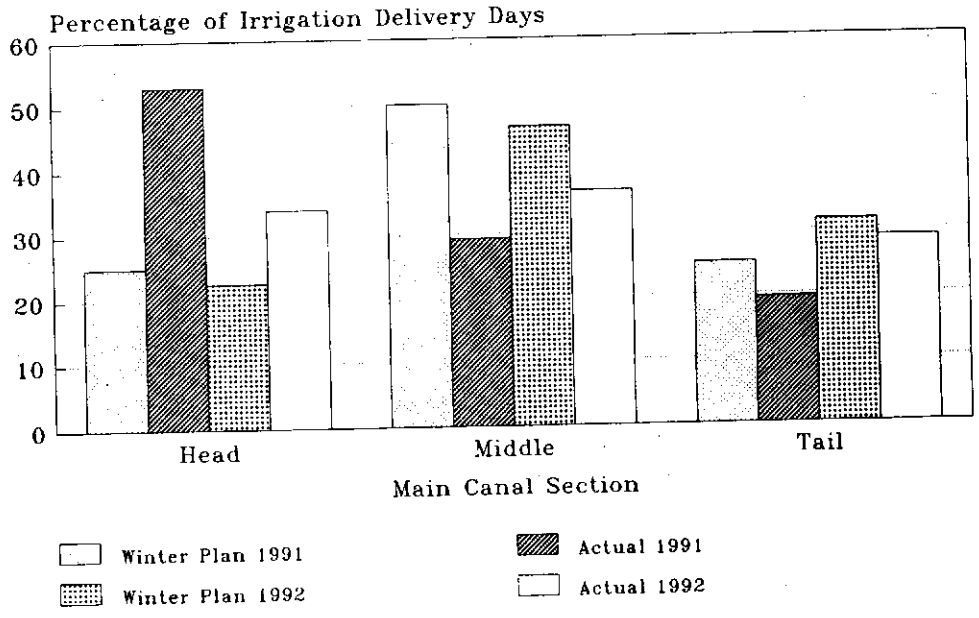


Table 1: Irrigation Water Delivery Schedule for Monsoon Season 1991 (Paddy Crop)

Name of Canal	Block No.	Area	Opening	Closing
1. Main Canal	MC 1-30	691	11Jun-17Jul	10Oct-70ct
2. Laxminagar	MC 1-12	447		
2. Bilaspur	MC 11-19	267		
3. Jahadi Minor	DC 1-4	143		
4. Harnampur		200		
subtotal		1748		
1. Main Canal	MC 31-39	387	18Jun-24Jun	80ct-140ct
2. Birpur	BD 1-5	251		
3. Taulihawa	TB 1-16	662		
subtotal		1300		
1. Pipari	PB 1-5	317	25Jun-1Jul	150ct-210ct
2. Hathihawa	HB 1-15	949		
3. Rangapur		200		
subtotal		1466		
1. Main Canal	MC 40-62	1277	2Jul-8Jul	220ct-280ct
2. Baidauli	BD 1-9	232		
3. Daldalaha	DD 1-5	192		
subtotal		1701		
Total		6215		

Table 2: Water Released from the Jagdishpur Reservoir 1990-1992

Opening Date	Pond Level (meters)	Closing	Pond Level (meters)	No. of Days	Reason for Closing
For Paddy 1990					
15 April	108.32	19 April	108.29	5	
10 June	108.95	07 Jul	107.99	28	Rain
04 August	109.13	12 August	109.03	9	Rain
19 August	109.30	13 Sept	109.25	26	Rain
16 Sept	109.35	15 Oct	109.24	30	Rain
21 Oct	109.37	04 Nov	108.64	16	crop ready
Total				114	
For Winter Crop 1991					
25 Nov	108.94	05 Dec	108.60	10	
09 Dec	108.71	14 Dec	108.61	6	
17 Dec	108.68	27 Feb	107.55	73	
26 March	108.12	31 March	107.84	6	
Total				96	
For Paddy 1991					
14 April	107.86	20 April	107.44	7	
25 April	107.43	26 April	107.41	2	
22 May	107.76	25 May	107.44	4	
11 June	107.93	22 June	108.18	12	Rain
26 June	108.20	30 June	107.99	5	Rain
07 July	108.44	16 August	108.41	41	Rain
02 Sept	109.52	11 Nov	107.08	69	crop ready
Total				133	
For Winter Crop 1992					
30 Nov	107.52	25 Dec	106.97	26	
17 Jan	107.68	18 Jan	107.67	2	
29 Jan	107.92	08 Feb	107.18	11	
21 Feb	107.48	22 Feb	107.48	2	
03 March	107.61	10 March	107.20	8	
Total				41	

Table 3: Water Distribution Schedule for Winter Season 1991-1992 (Wheat Crop), First Rotational Schedule at Banganga Irrigation System

Sequence No.	Name/Location of Canal	Date of Distribution
1.	Hathihawa Branch Canal	01 Dec - 07 Dec
2.	Laxminagar Branch Canal	05 Dec - 07 Dec
3.	Pipari Branch Canal	05 Dec - 07 Dec
4.	MC 53 to MC 62	08 Dec - 11 Dec
5.	MC 40 to MC 52	12 Dec - 14 Dec
6.	Daldalaha Distributary	12 Dec - 14 Dec
7.	Baidauli Distributary	12 Dec - 14 Dec
8.	MC 1 to MC 39	15 Dec - 18 Dec
9.	Birpur Distributary	15 Dec - 18 Dec
10.	Taulihawa Branch Canal	15 Dec - 18 Dec
11.	Bilaspur Distributary	15 Dec - 18 Dec
12.	Jahadi Minor	19 Dec - 21 Dec
13.	Jariahiya Minor	19 Dec - 21 Dec

Note: The sequence of irrigation water delivery will be from tail to head of each branch canal and the next rotation will be repeated after 21 days. A total of four irrigation deliveries will be provided to the wheat crop.

MC - are main canal outlets

Table 4: Water Distribution Schedule for Winter Season 1992 (Wheat Crop), Second Rotational Schedule at Banganga Irrigation System

Sequence No.	Name/Location of Canal	Date of Water Distribution	Remarks
1.	MC 40-62 Daldalaha Distributary Baidauli Distributary	30 Jan - 05 Feb 30 Jan - 05 Feb	The next rotation will be indicated in the distribution schedule
2.	Hathihawa Branch Canal	06 Feb - 11 Feb	
3.	MC 1-39 Laxminagar Branch Canal Taulihawa Branch Canal Bilaspur Distributary	06 Feb - 11 Feb 06 Feb - 11 Feb 06 Feb - 11 Feb 06 Feb - 11 Feb 09 Feb - 11 Feb	
4.	Jahadi Minor Jarlahiya Minor	09 Feb - 11 Feb 09 Feb - 11 Feb	

Table 5: Water Distribution Schedule for Winter Season 1992 (Wheat Crop), Third Rotational Schedule at Banganga Irrigation System

Sequence No.	Name/Location of Canal	Date of Water Distribution	Remarks
1.	MC 40-62 Daldalaha Distributary Baidauli Distributary	03 Mar - 09 Mar 03 Mar - 09 Mar 03 Mar - 09 Mar	Irrigation water released for winter crop such as wheat and early paddy
2.	Hathihawa Branch Canal Pipari Distributary	10 Mar - 14 Mar 10 Mar - 14 Mar	
3.	MC 31-39 Taulihawa Branch Canal Birpur Distributary	15 Mar - 18 Mar 15 Mar - 18 Mar	
4.	MC 1-30 Laxminagar Branch Bilaspur Distributary	19 Mar - 23 Mar 19 Mar - 23 Mar 19 Mar - 23 Mar	

Table 6: Estimated Yearly Budget for Banganga Irrigation System

Description of Works	Amount	Remarks
1. Desilting work	250,000.00	Yearly
2. Weeds clearance	250,000.00	Yearly
3. Structure repair and maintenance	200,000.00	Only for two years
4. Canal operation	300,000.00	75% can be reduced if regular staff will be appointed
5. Others	100,000.00	

Table 7: Jagdispur Reservoir Outlet Data for 1991

Date	Time	Reading H (m)	Discharge cu.m.	Head in reservoir (m)	Remarks
13-06-91	15.10hrs	1.00	3.0753	107.8	Water release for paddy crops just after cleaning the weeds 5 km of MC
14-06-91	13.30hrs	0.70	1.449		
16-06-91	16.12hrs	0.70	1.441		
27-06-91		1.05	2.597		
20-07-91	14.18hrs	1.30	2.9568	108.46	
21-07-91	18.15hrs	1.32	2.6529		
24-07-91	17.45hrs	1.24	2.41728		
03-08-91	16.45hrs	1.19	1.3005		
08-08-91		1.30	1.62933		
12-08-91	16.20hrs	1.53	3.1789		

Table 8: Action Plan

	Activities	Period	Remarks
1.	Farmers training program	Regular	Training program to the farmers should be given in parts or step by step in smaller groups regularly. The DOI should take interest in providing funds and expertise for the establishment of training center for farmer organization or hire NGOs.
2.	Organizing and strengthening of WUGs, to enable them to participate in the O&M of the system.	Always	DOI has realized the importance of farmers participation including it in the new irrigation policy as participatory management.
3.	Enforcement of rules and regulations, delegation of authority to WUG.		Power should be delegated to WUG through legal procedures to enforce the rules and regulations.
4.	Training field staff		Short term training to the field staff should be provided regarding cropping pattern development, water requirement, water distribution and to development of organizational skills.
5.	Request for maintenance and operation budget	Yearly March-April	Problems should be identified during operation period and on that basis proper budget should be requested for the coming year and DOI should make that budget available.

6.	Proper communication between farmers and DOI	Always	Every decision should be made clear to the farmers by DOI in time, to avoid conflicts and for solve problems. It will build up confidence and credibility.
7.	Monitoring and Evaluation of project performance.		
a.	Surveying and record keeping of cropping pattern, cultivated area, amount of water supplied, area irrigated and associated problems.		During canal operation in winter and summer months.
b.	Evaluation and review in preparing future programs and calendar of operation.	Always	Useful in preparation of programs for operation and maintenance of the system.