Bangladesh Sustainable Agriculture

Minor Irrigation Development: A Key for Sustainable Agricultural Development in Bangladesh

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ABSTRACT

IN BANGLADESH, OPTIMUM use of water resources and especially irrigation water should be an important strategy for increasing and sustaining increased agricultural production. Minor irrigation covered about 93 percent of total irrigated area in Bangladesh during the years 1989/1990 and according to government projections, would cover about 90 percent by the end of the Fourth Five-Year Plan, 1994/1995 (Ghani and Rana 1991). About 58 percent of total irrigated area during 1989/1990 was and 63 percent of the irrigated area in 1994/1995 will be covered by groundwater. Minor irrigation systems are almost entirely managed by the farmers/beneficiaries. Public intervention is only at the time of developing irrigation facilities (renting of low-lift pumps and installation of deep tubewells). Therefore, about 90 percent of the irrigation systems will continue to be farmer-managed irrigation systems in Bangladesh. But these facilities are operating at about 50 percent of their rated capacities. Improvement in the management and utilization levels of minor irrigation systems in the country, therefore, can cause significant improvements in overall irrigation performance. Studies in the Ganges-Kobadak (G-K), North Bangladesh Tubewell Project (NBTP), Kahalu area of Bogra and Rajshahi areas during 1989 and 1990 dry seasons indicate that water use values for rice cultivation are 0.32, 0.18, 0.96 and 0.39 hectare per liter per second (ha/lps) (or 3.13, 5.56, 1.04 and 2.56 lps/ha), respectively. Productivity of water are 3.6, 3.8 and 5.5 kilograms per hectare-millimeter (kg/ha-mm) for G-K, NBTP and Rajshahi areas, respectively.

In G-K and NBTP, irrigation systems are operated and maintained by government agencies, whereas, in Bogra and Rajshahi study areas operation and maintenance are done by the farmers. From the water use and productivity figures it can be concluded that farmer-managed systems are performing better. However, it has been observed that even these systems fall short of the desired levels. Performance of minor irrigation systems can be improved by adopting water management strategies such as improvements in reliability of water supply, provision of improved operation and maintenance, fixation of irrigation targets per unit of irrigation delivery and diversified cropping plans. These practices could lead to the accrual of additional benefits from the irrigation facilities.

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INTRODUCTION

Bangladesh is located in the lowlying delta of one of the largest river systems in the world and is subject to alternating annual periods of extreme excesses and deficits in rainfall, recurring floods and cyclonic storms. The major portion of the water resources are available during the monsoon months (mostly June to September) causing flooding over about 57 percent of the total area of the country (Planning Commission 1990). Over the 10.36 million hectares of rice land the flood regime stands as 36 percent under less than 0.3 meter (m) depth, 35 percent under 0.3 to 0.9 m depth and 2 percent under over 3.0 m water depth during the flooding season. (Bangladesh Agricultural Research Council and Ministry of Agriculture—BARC and MOA—1988). Therefore, 71 percent of the rice area or about 62 percent of the net cultivable area can be brought under year-round cultivation if irrigation facilities are developed. However, only about 30 percent of the cultivated land has access to some form of irrigation, whereas the irrigable area is about 84 percent and the irrigation potential of the country based on available water resources is about 76 percent (Master Plan Organization—MPO—1991). Due to skewed distribution of available water (river flow) and annual rainfall, only about 40 percent of the cultivable land (9.03 million ha) is cultivated during the winter months.

Water resources of Bangladesh exist in two forms, i.e., stream flow mostly coming from catchment areas outside of the country, rainfall and surface runoff from within the country, and groundwater. The country does not have much control over surface water and most of this flow (about 121 million ha-m) comes during June-September which causes flooding. Most of the streams remain dry or nearly dry during November to May, and therefore cannot be used as a reliable source of irrigation unless some form of augmentation facilities are created. Therefore, the most dependable irrigation source is groundwater extraction. About 58 percent of the total irrigated area during 1989/1990 was and 63 percent of the irrigated area in 1994/1995 will be covered by groundwater (Ghani and Rana 1992). Minor irrigation (irrigation using low lift pumps, deep and shallow tubewells, hand tubewells and doon and swing baskets) has been in the past and is expected to stay so in the near future as the driving force behind irrigated agriculture in Bangladesh. Improvements in management and capacity utilization of minor irrigation systems, therefore, will have a significant impact on the agricultural growth of the country. This paper will focus on different management types of irrigation systems in some selected areas of Bangladesh, their utilization levels, water productivity status and their impact on further improvement.

METHODOLOGY AND MEASUREMENTS

Studies were conducted in the Ganges-Kobadak (G-K) Project, North Bangladesh Tubewell Project (NBTP), Rajshahi area (within and outside Barind Integrated Area Development Project or BIADP) and Bogra area (Kahalu) to establish management type and status and water use status. Study sites and relevant measurements are briefly described as follows:

Ganges-Kobadak Project

The Ganges-Kobadak (G-K) Project is the first and still the largest irrigation project in Bangladesh. It pumps water from the Ganges River and distributes over the project area through gravity canal networks (main, secondary and tertiary canals and field channels). Pumping capacity is 153 cubic meters per second (m^3s) and irrigable area is about 141,700 ha. Three secondaries, three tertiaries and fifty observation plots were selected to represent the head, middle and tail reaches

of main, secondary and tertiary canals, respectively. Studies in G-K area started in 1981 but only 1989 and 1990 data have been used in this paper to be compared with NBTP, Rajshahi and Bogra findings.

North Bangladesh Tubewell Project (NBTP)

Twelve deep tubewells were selected to study input use, management practices and improved allocation and equitable distribution of irrigation water and increasing irrigation efficiency, service area per unit volume of available water and for increasing production. This study was also initiated in 1981 but data of 1989 and 1990 will be used for this paper.

Deep Tubewells in Rajshahi Area

Sixteen deep tubewells were selected in Rajshahi area for water management-related studies. Out of 16 sample deep tubewells 7 were under BIADP management, 3 deep tubewells under each of IFAD, Rental and Private management categories.

Deep Tubewells in Bogra

Bogra is the most intensive tubewell irrigated area in Bangladesh. Ten deep tubewells were monitored for discharge, irrigated area and operating hours and fluctuation of water levels. All of these tubewells were installed by the Bangladesh Agricultural Development Corporation (BADC) but are managed and operated by farmers.

RESULTS AND DISCUSSIONS

Average water use status under different irrigation systems are presented in Table 10.1. Water use status in Bogra area is much higher than in other areas. G-K Project data have been presented to compare status of gravity irrigation with deep tubewell irrigation systems under different managements. Utilization status in terms of area coverage per unit discharge in Bogra is 3 to 5 times higher than that in Rajshahi and NBTP areas. In Rajshahi area tubewells are under government agency and private management whereas in NBTB all the sample tubewells are under government agency management (Bangladesh Water Development Board). It is clear from this table that agency-managed systems are irrigating a much lower area than their potential. One of the major reasons for low irrigation coverage may be low operating hours (Table 10.2) which is 6.12, 5.05 and 10.3 hours on an average for NBTP, Rajshahi and Bogra areas, respectively. The operating hours per day in the dry season should be higher (16 to 20 hours), for best utilization of the expensive equipment and for bringing more area under cultivation.

Table 10.1. Average water use status (ha/lps) in the selected locations in Bangladesh during the dry seasons of 1989 and 1990.

Sample location	G-K (ha/lps)	NBTP (ha/lps)	Rajshahi (ha/lps)	Bogra (ha/lps)
1	0.28	0.09	0.56	0.87
2	0.33	0.18	0.35	1.00
3	0.32	0.11	0.09	0.56
4	0.34	0.17	0.33	0.82
5	0.40	0.15	0.24	0.85
6	0.09	0.17	0.40	0.79
7	0.51	0.18	0.24	1.44
8	0.31	0.12	0.33	0.96
9		0.30	0.48	0.68
10		0.26	0.61	1.66
11		0.15	0.39	
12		0.33	0.22	
13			0.61	
14			0.54	
15			0.45	
Average	0.32	0.18	0.39	0.96

Notes: G-K = Ganges Kobadak Project.
NBTP = North Bangladesh Tubewell Project.

Productivity aspect of the irrigation water was analyzed and for G-K, NBTP and Rajshahi areas, and on an average, the corresponding values are 3.6, 3.8 and 5.5 kg/ha-mm, respectively (Table 10.3). It is also revealed from Table 10.3 that water productivity is higher under privately managed tubewells than under agency-managed irrigation systems. In the real sense, irrigation systems in Bangladesh are either partially or fully managed by the farmers/beneficiaries. In agency-managed minor irrigation systems only the equipment is managed by the agency personnel whereas distribution and management of irrigation water and the cropping plan are entirely in the hands of the farmers. Government Agricultural Extension Department offers some limited advisory service to the farmers. In large lift-cum-gravity irrigation systems, operation and maintenance of the main systems and water distribution up to tertiary level are managed by agency personnel and distribution and utilization of water at farm level are managed by the farmers.

Irrigation coverage, operating hours and water productivity figures in the study areas reveal that there is potential for improvement. However, planning at the project and national levels do not show any signs of improvement. It can be observed from Table 10.4 that the major contribution to the increase in the total irrigated area will be through minor irrigation.

Table 10.2. Average daily operating hours of the deep tubewells in NBTP, Rajshahi and Bogra areas in Bangladesh during the dry season of 1989 and 1990.

Location	NBTP (hours)	Rajshahi (hours)	Bogra (hours)
1	4.2	6.5	9.0
2	5.0	7.4	12.6
3	5.0	2.0	9.1
4	4.6	8.0	16.5
5	10.2	4.2	4.8
6	8.3	7.6	10.4
7	6.8	3.7	11.8
8	5.8	5.3	10.3
9	5.8	5.0	8.0
10	7.3	4.5	10.4
11	2.9	5.8	
12	8.1	3.1	
13		4.6	
14		4.0	
15		4.0	
Average	6.12	5.5	10.3

Table 10.3. Productivity of water in selected sites in Bangladesh during the dry season of 1989 and 1990.

Location	G-K (kg/ha-mm)	NBTP (kg/ha-mm)	Rajshahi (kg/ha-mm)
1	2.95	3.95	3.4
2	3.01	3.76	3.5
3	3.44	3.93	5.8
4	3.15	4.13	4.4
5	3.25	4.07	3.1
6	3.75	3.79	4.3
7	4.85	3.70	6.9
8	4.78	3.84	6.9
9	3.22	3.60	3.8
10		3.80	7.5
11		3.53	5.1
12		3.13	5.5
13			4.9
14			5.4
15			4.9
Average	3.60	3.77	5.5

Notes: G-K = Ganges Kobadak Project.
NBTP = North Bangladesh Tubewell Project.

Table 10.4. Irrigation achievement and target of irrigation coverage under different systems in Bangladesh (in percent, and total in thousand hectares).

Program	1972/1973	1977/1978	1979/1980	1984/1985	1989/1990	1994/1995
Gravity (%)	5	6	6	8	7	10
LLP (%)	45	48	41	29	25	23
Trad. (%)	43	32	29	14	10	4
DTW (%)	6	12	17	17	16	15
STW (%)	1	1	6	31	40	47
HTW (%)	–	1	1	1	2	1
Total (%)	936	1,133	1,413	2,484	3,090	4,790
increase over 1972/1973 (%)	–	21	51	165	230	412
HYV rice coverage (%)	–	–	–	27	38	46

Source: Third Five-Year Plan and Fourth Five-Year Plan (draft).

Notes: LLP = Low lift pumps. DTW = Deep tubewells.
STW = Shallow tubewells. HTW = Hand tubewells.
Trad. = Traditional methods like doon, swing basket, etc.

Percent increase in total irrigated area during 1994/1995 as compared to 1972/1973 is projected to 412 percent (total irrigated area would thus be 4.8 million hectare). Shallow tubewells will cover the maximum (47 percent) irrigated area during 1994/1995. Most of the increase in total irrigation coverage will be through increased number of irrigation units (Table 10.5). It can be observed from Table 10.5 that percentage increase in number of irrigation equipments during 1994/1995 over 1977/1978 would be 104, 370, 3,859 and 650 percent for LLP, DTW, STW and HTW, respectively. That shows a significant increase in numbers. However, irrigation coverage per unit of these irrigation modes over the period indicates practically no change in per unit irrigation coverage under LLP and DTW during 1977/1995, and in shallow tubewells during 1984/1995 (Table 10.6). These observations point to the fact that the irrigation development strategy of Bangladesh is still based on the creation of new facilities rather than improving performance of the existing and newly created facilities.

Table 10.5. Irrigation development status under different programs (number of irrigation units) in Bangladesh.

Program	1984/1985 (%)	1989/1990 (%)	1994/1995 (%)
LLP	31	63	104
DTW	128	303	370
STW	1,119	1,484	3,859
HTW	400	650	650

Source: Third Five-Year Plan and the Fourth Five-Year Plan (draft).

Notes: LLP = Low lift pumps. DTW = Deep tubewells.
STW = Shallow tubewells. HTW = Hand tubewells.

Table 10.6. Irrigation coverage per unit of irrigation mode in Bangladesh during the study period.

Program	1977/1978 (ha)	1984/1985 (ha)	1989/1990 (ha)	1994/1995 (ha)
LLP	14.9	15.0	13.0	14.5
DTW	18.2	24.3	16.7	20.0
STW	0.8	5.0	6.3	4.5

Source: Third Five-Year Plan and Fourth Five-Year Plan (draft).

Notes: LLP = Low lift pumps. DTW = Deep tubewells.
STW = Shallow tubewells.

CONCLUSION

Irrigation facilities in Bangladesh are highly under-utilized. Irrigation coverage per unit discharge is low. Even during the dry season, facilities are operated for a less number of hours which can easily be doubled. Present operating hours of deep tubewells vary from about 5 to 10 hours per day which could readily be increased to 16-20 hours per day. Water productivity and yield levels are also low, and could be increased with locally available technology. Efforts should be made to irrigate entire flood-free areas and target cropping intensity for these areas should be about 300 percent. A production target of 10 tons/ha grain should be fixed for flood-free irrigated areas for justifying investments in irrigation and for making the country self-sufficient in food production.

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