Bangladesh

Case Study of Management of Three Deep Tubewells in Tangail, Bangladesh

M. H. Rashid,[41] M. A. K. Mridha[42] and Ian K. Smout[43]

ABSTRACT

THE OPERATION OF irrigation systems on three deep tubewells in Tangail District, Bangladesh, was monitored from 1989 to 1991. These systems used buried cement concrete pipe to distribute water from the tubewells, to irrigate diversified crops during the dry season.

This paper focuses on the management of the deep tubewells and the irrigation systems. Each tubewell was installed by the government agency (the Bangladesh Agricultural Development Corporation or BADC) following application from a cooperative of villagers (*Krishak Samabay Samity or KSS*), that took out a loan to purchase the tubewell. In principle the KSS owned and managed the tubewell, but in practice it was dominated by a few prominent individuals.

The paper describes the membership of KSS on each tubewell, their participation in the management of the system, the management structure and KSS meetings. It also describes the financial arrangements made for operating the tubewell. Budgets were prepared each season, but not followed. Varying records of loan repayments of the three KSSs are also discussed.

The utilization rates of all the tubewells were disappointing, averaging 3.88 hours per day at a discharge of about 35 lps compared to the design of 56 lps. The irrigated areas were typically less than half the design (40 ha), and irrigation intervals were high. The reasons for this poor performance were found to be a combination of social, managerial and agro-economic factors, and these are discussed in the paper.

The management and operation procedures are compared with the recommendations of the Irrigation Management Programme (IMP) and possible improvements are discussed. These include moving to systematic irrigation of fields fed by the same branch, instead of the current erratic distribution of water under the farmers' fuel system.

This case study illustrates some of the difficulties of Farmer-Managed Irrigation Systems (FMIS) where farmers' resources are unevenly distributed, particularly in the complex technical and management environment of deep tubewell irrigation.

The study was undertaken as part of a UK/Bangladesh research project on buried pipe distribution systems for surface irrigation which was funded by the Overseas Development Administration, UK.

---

41 Principal Scientific Officer and Head, Irrigation and Water Management Division, Bangladesh Agricultural Research Institute.

42 Scientific Officer, Irrigation and Water Management Division, Bangladesh Agricultural Research Institute.

43 Lecturer, Water Engineering and Development Centre, Loughborough University of Technology, UK.

INTRODUCTION

In Bangladesh, irrigation water is mostly distributed by earthen open channel systems. However, in areas with undulating topography and light textured soils, earthen open channel systems are found to be inconvenient and inappropriate both technically and economically. Under this situation a buried pipe distribution system (BPDS) was considered to be a better solution. BPDS was introduced in Bangladesh about a decade ago. Since then, a number of buried pipe (BP) systems, mostly cement concrete (CC) pipelines, have been installed by several organizations.

Tangail Agricultural Development Project (TADP) is one of the few organizations which has been constructing BP systems for the Krishak Samabay Samitis (KSSS) which are farmers' cooperatives. TADP with assistance from the German Agency for Technical Cooperation (GTZ) has been working in the eastern part of Tangail District for promoting irrigated agriculture using deep tubewell (DTW) with BPDS. To date it has constructed a total of 79 BP systems, both full and partial. Most of these schemes have been encountering leakage, as well as operational and management problems. Unfortunately, no dependable studies so far have been made to evaluate the system performance and put forward recommendations for further improvement. Under the circumstances, this case study was carried out on three BP schemes installed by TADP at Taltoplapara, East Kutubpur and Shaplapara during 1989 and 1991. This study was undertaken jointly by the Bangladesh Agricultural Research Institute (BARI) and the Loughborough University of Technology (LUT), UK, with funding from both LUT and the Overseas Development Administration (ODA), UK. The overall objective of the study was to carry out a detailed case study of constructional, operational and management experiences of irrigated agriculture with BPDS. The specific objectives were to study (i) the technology of BPDS, (ii) the water management and agronomic practices under BPDS, and (iii) the operational and management aspects.

This paper contains the study results mostly related to the third objective and a part of the second objective.

METHODOLOGY

The study area falls under Madhupur Tract which has silty clay loam soil, undulating topography, annual rainfall of about 2,100 mm, mean monthly temperature of 11 to 39^{o}C and relative humidity of 49 to 88 percent. November to April is the water deficit period. Diversified crops were grown, mainly rice (transplanted aus, aman and boro), wheat, water melon, soybean and banana; and the cropping intensity of the area was 233 percent.

Discharge from the DTW and at the outlets were measured using cutthroat flumes and 90^{o} V-notch. Operational procedures were observed in the field and relevant data were obtained from the pump log books and the block registers. Data recordings in the log book and the register were routinely checked by the project staff. Data related to socioeconomic and management aspects were collected partly by interviews, partly by checking the scheme records and partly by direct field observations. Additional information was collected from TADP reports to supplement the project data.

RESULTS AND DISCUSSION

Water Users, KSS Membership and Management

The three schemes had an average of 62 water users (Table 11.1) of whom 68 percent were KSS members who were irrigators. Another survey of TADP (Mayer 1991) on 40 schemes showed an average of 59 water users per scheme of whom 60 percent were KSS members.

Each KSS possesses a six-member management/standing committee, first formed at the time of registration and then elected, for the overall management of the schemes. But in practice, the president and the manager act as the chief executives. Table 11.1 shows that on the average only 40 percent of desired weekly meetings were held with poor attendance of the water users. The main issues discussed were the seasonal budget, loan situation, fixation of irrigation charges, oil charges, driver's salary, etc. In most (50 to 80 percent) cases, the manager was the chief decision maker.

Table 11.1. Information on KSS management.

Parameters	Schemes		
	Taltolapara	East Kutubpur	Shaplapara
1. Water users a) KSS members (during study)	42	44	42
b) non-KSS members	19	19	20
2. KSS meeting			
a) desired number	20	20	20
b) held: i) number	10	8	6
ii) percent	50	40	30
3. Members present per meeting (%)	15-20	10-56	29-56

Note: KSS = *Krishak Samabay Samity.*

Ownership of Deep Tubewell

Each deep tubewell was sunk by the Bangladesh Agricultural Development Corporation (BADC), a government agency, following the application from a KSS after downpayment, which was made out of cash or loan to buy the tubewell. The BPDS was installed by the TADP and handed over to the KSS at subsidized cost to be paid in instalments. In principle, the KSS owned and managed the tubewell and the BP system, but in practice, it was dominated by a few prominent individuals.

Water Charges

All the three KSSs practiced "own fuel" system. Therefore, water charges included oil cost, repair and maintenance, staff salary and instalment of DTW and BPDS. Usually, this total cost was distributed over the total irrigated area and water rate was charged as Taka (Tk) per decimal (Table

11.2). There were many defaulters in water charge payments. Maximum water charge (85 percent) was collected at East Kutubpur, Bangladesh Rural Development Board (BRDB), with the help of the police. Police actions made the farmers anxious about the loan payments and some of them repaid them by selling out lands, which could have serious social consequences. The main reasons for not paying the water charges in time were the lack of responsibility and sincerity toward the KSS, lack of coherence in the group, factional problems, crop failure and, in the case of some farmers, financial inability to make payments.

Table 11.2. Information on financial aspects.

Parameters	Schemes		
	Taltolapara	East Kutubpur	Shaplapara
1. Water charge			
a) system	Cash payment	Cash payment	Cash payment
b) rate (Tk/decimal)			
i) rice	2	5.50	4
ii) nonrice	1	1.75	2 and 1
c) collection (%)	70	85	64
2. DTW loan			
a) amount due (Tk)	1,43,640.00	1,84,680.00	1,43,640.00
b) amount paid			
i) Tk	92,512.00	89,819.00	68,210.00
ii) percent	64	48	47
3. BP loan			
a) amount due (Tk)	31,552.80	27,700.00	26,190.00
b) amount paid (Tk)	0.00	0.00	0.00

Note: Tk 1.00 = US$38.8 in 1992.

A survey by TADP (Mayer 1991) on 40 schemes indicated that 23 percent of KSS farmers practiced the cash payment system, 17 percent the sharecropping system and the remaining KSSs were using sharecropping for certain crops and cash payment for other crops.

Loan Situation

Table 11.2 shows that none of the schemes recovered their due loans completely. The reason for nonpayment of loans was either because the farmers did not pay water charges in time or because the money collected was used in personal business of the manager, or both. The government policy of exempting agricultural loans up to Tk 5,000.00 was another reason for the nonpayment of loans (Rashid et al. 1992). Table 11.2 also shows that no payment was made against the buried pipe loan by any of the schemes. Whenever an instalment was due, the management raised the question of repairing the leaks of buried pipes and avoided payment.

Pump Operation and Water Distribution

Very low pump operation was observed (12 percent of advised) and 3 to 4 outlets were used each day. The main reasons for this low utilization were the poor management, own fuel system, high fuel cost, smaller command area and non/under-irrigated diversified cropping (as it was not obligatory to grow irrigated crops within the command area).

The very limited number of outlets (about 20-21) of two cusec capacity was found inadequate for the prevailing field situation. This resulted in long earthen field channels and caused higher conveyance losses (Rashid et al. 1990). The condition of most of the field channels were poor. Generally, they were undersized, uncompacted, irregular in shape and had very low banks. About half of the channels were constructed during the irrigation period on a very temporary basis. Overflow of irrigation water above the banks was a regular feature. Yet under own fuel system it was difficult to divide the flow between the farmers. No maintenance work was observed during the study. One cusec outlet operating two at a time should have been more appropriate.

Because of own fuel system water was supplied to farmers according to the sequence of arrival at the pump house. This led to frequent switching between pipelines and resulted in unnecessary losses of water by repeated filling of the pipelines. This problem can be solved following the line rotation. Farmers are to be grouped outletwise, i.e., water supply to the farmers under an outlet should be completed and then moved to the next outlet. Under own fuel system, different grade fuels were used which created trouble for the engine. Switching over to project fuel system may be beneficial.

Pump and Outlet Discharge

Tubewell discharges of the schemes were found to be in the range of 29 to 39 lps compared to the design discharge of 56 lps and that of outlet was found in the range of 27 to 31 lps (Table 11.3). These variations were due to own fuel system, low channel capacity and change in the depth to static water level.

Average conveyance loss in the pipeline was found to be 0.37 lps/100 m by tank test and 0.57 lps/100 m by inflow-outflow method, and the rates for the earthen channel were found to be 7.56 lps/100 m by inflow-outflow method. Conveyance losses on eight schemes in Tangail District were reported to be 0.33 lps/100 m by tank test and 0.69 lps/100 m by inflow-outflow method in the pipelines and the measurement was 7.69 lps/100 m by inflow-outflow method in the earthen channel (Rashid et al. 1992).

Irrigation Practices

No scientific or recommended irrigation scheduling was followed and the large variation in irrigation intervals was noticed. In general, the practiced irrigation interval was longer than the recommendation for most of the crops. The reasons for the large interval were the use of own fuel system, high fuel cost, waiting for rainfall, the low collection of oil charge and the shortage of operating funds. Water adequacy (supply/demand) was determined for boro rice and was found to be less than 1 (Table 11.3) which meant under-irrigation. Area under irrigation by farm category is shown in Table 11.4.

Repair and Servicing

Pump servicing and pipeline repairing costs are shown in Table 11.3. None of the schemes practiced preventive maintenance and breakdown repairing was observed everywhere, as a result pumps were performing poorly (usually running at lower speed and discharging less). All schemes experienced leakages in the pipelines. Too many leakages at East Kutubpur (41.02 leaks/100 m length of pipeline) were due to bad quality pipes (hand made) as well as due to bell-mouth sockets and spigot joints used in this scheme.

Table 11.3. Pump operational information.

Parameters	Scheme			
	Taltolapara	East Kutubpur	Shaplapara	Remarks
1. Pump operation				advised
a) hours/day	4.49	2.22	4.92	20
b) days/month	18	16	17	26
2. Discharge (lps)				designed
a) pump	31	39	29	56
b) outlet	27	31	27	-
3. Conveyance loss (lps/100m)				
a) pipeline				
i) tank test	0.50	0.29	0.33	
ii) inflow-outflow	0.58	0.68	0.45	
b) earth channel				
i) inflow-outflow	8.56	6.82	7.30	
4. Leakage repaired (number)				
a) pipe body	28	184	10	
b) joint	145	541	34	
c) total	173	725	44	
d) per 100 m	7.9	41.02	2.37	
5. BP repairing cost (Tk/year)	1,450	9,000	650	
6. Pump servicing cost (Tk/year)	800	10,250	4,600	
7. Water adequacy (supply/demand)	0.93	0.95	0.89	

Note: Tk 1.00 = US$38.8 in 1992.

TADP's survey (Mayer 1991) on 40 schemes reported that only 48 percent of the DTWs were serviced during *rabi* season; in all cases lubricating oil was changed (average 3.8 times); fuel filters were changed in 72 percent of the cases, 60 percent of the DTWs had at least one breakdown during 9 days on average; 37 percent of the repairs were carried out by BADC, 27 percent by TADP (on-the-job training program), 26 percent by KSSs themselves (local mechanics, pump operators, etc.), and the rest of the 10 percent by Upazilla Central Cooperative Association (UCCA) mechanics.

Table 11.4. Area under irrigation by farm category.

Farm category	Cultivated land per farm (ha)				Total
	High land	Medium-high land	High land	Medium-high land	
Landless	0.05 (80)	0.01 (20)	–	–	0.06 (100)
Marginal	0.19 (63)	0.07 (21)	0.02 (7)	0.03 (9)	0.31 (100)
Small	0.25 (41)	0.12 (20)	0.18 (30)	0.05 (9)	0.60 (100)
Medium	0.76 (59)	0.17 (13)	0.11 (9)	0.24 (19)	1.28 (100)
Large	1.12 (34.5)	0.15 (4.5)	0.58 (17.5)	1.42 (43.5)	3.27 (100)
All farm	0.47 (43)	0.10 (9)	0.18 (16)	0.35 (32)	1.10 (100)

Note: Figures in parentheses indicate the percentage.

Command Area

The irrigated command area varied considerably from year to year in the range of 9 to 29 ha compared to that on intended command area of 40 ha. In general, this does not appear to be a shortcoming in the BP system, rather this was because of poor management and inadequate extension services. The reasons for low command areas were the poor KSS management, own fuel system, non-rotational water distribution, lack of leadership in the KSS, reluctance of large farmers to cultivate all their lands and farmers' preference of other businesses to agriculture.

Land Utilization and Land Ownership Patterns

Different uses of land under the three schemes in the rabi season of 1989/1990 are shown in Table 11.5. Figure 11.1 shows the land ownership pattern and acreage owned by the different classes of farmers as indicated by TADP from their survey of 40 schemes.

Cropping Pattern and Crop Diversification

Diversified cropping pattern of the area constituted mainly of rice, wheat, water melon, soybean and banana and the cropping intensity was as high as 233 percent. Under these three schemes wheat was the major crop followed by boro rice during the rabi season. However, a different picture is shown by a TADP report (Mayer 1991) on 40 schemes in the area (see Figure 11.2). Table 11.6 shows the crop diversification in the areas.

Table 11.5. Land utilization pattern under three schemes in the rabi season, 1989/1990.

Parameters	Scheme		
	Taltolapara	East Kutubpur	Shaplapara
1. Irrigated cultivation			
a) Total (ha)	18.87	9.25	20.66
b) Percent	43.43	22.25	49.70
2. Non-irrigated cultivation			
a) Total (ha)	1.97	2.54	2.12
b) Percent	4.54	6.10	5.12
3. Area available for cultivation			
a) Total (ha)	5.33	3.90	4.39
b) Percent	12.25	9.39	10.58
4. Orchard			
a) Total (ha)	0.25	0.08	0.25
b) Percent	0.57	0.20	0.60
5. Forest			
a) Total (ha)	0.70	1.89	1.99
b) Percent	1.61	4.55	4.78
6. Pond			
a) Total (ha)	0.18	–	0.14
b) Percent	0.42	–	0.33
7. Fallow			
a) Total (ha)	16.60	23.90	12.01
b) Percent	37.18	57.51	28.89
8. Total land under scheme			
a) Total (ha)	43.46	41.56	41.56
b) Percent	100	100	100

Note: Area unavailable for cultivation includes mosque, homestead, bazaar, etc.

Use of Inputs

TADP survey on 40 schemes revealed that 64 percent of the farmers used fertilizer and pesticides, 35 percent fertilizer only, and 3 percent pesticides only; 76 percent of the crops grown were HYV (rice mainly); 6 percent of the farmers used tractors for plowing; and 7 percent applied improved in-field irrigation techniques (mainly field preparation for vegetables).

Figure 11.1. Land ownership pattern by different classes of farmers in TADP areas.

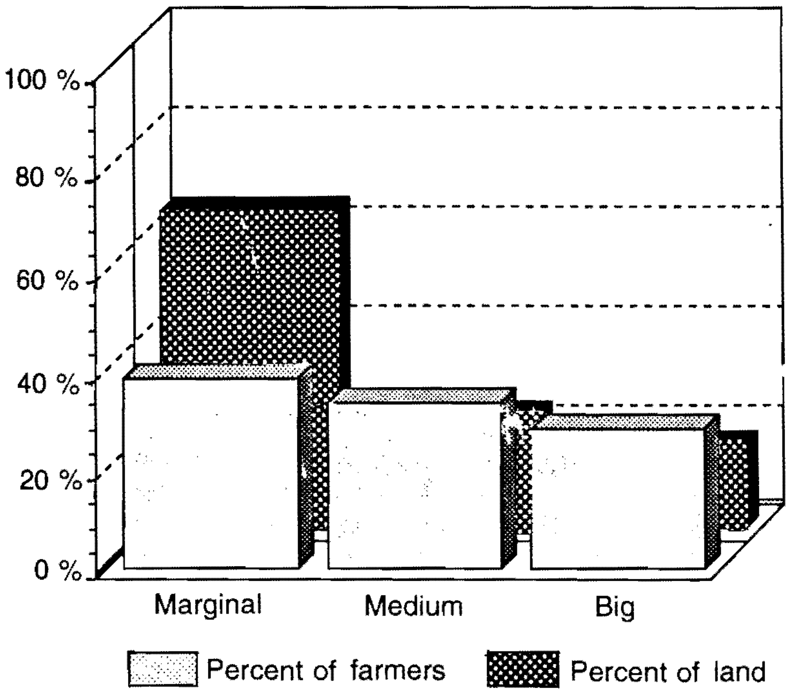

Figure 11.2. Crop diversification in TADP areas.

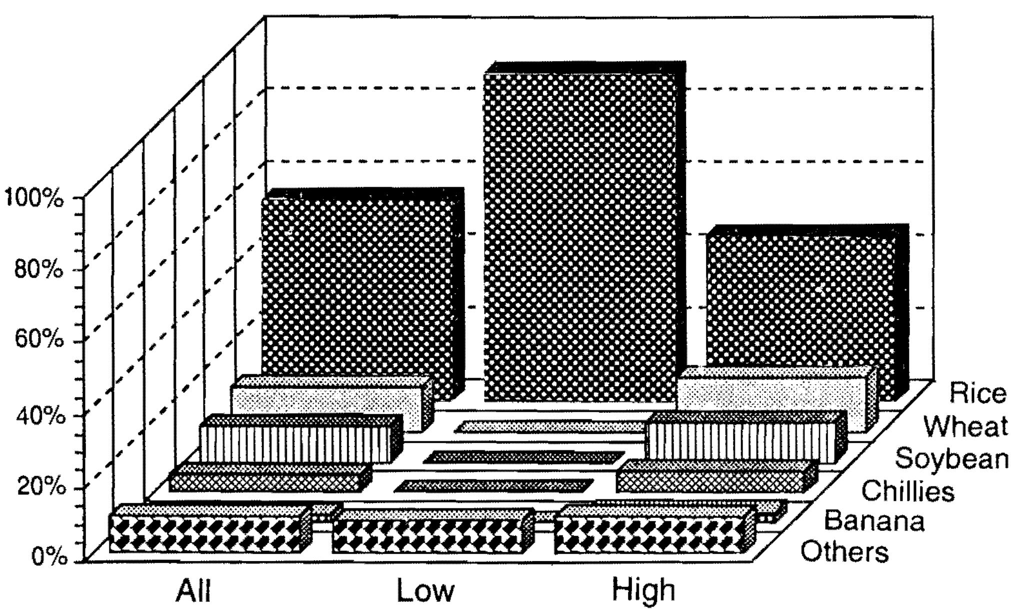

Table 11.6. Crop diversification.

Number of different crops	Command area (%)		
	All	Low land	High land
0	4	0	6
1	23	80	14
5	23	20	23
10	40	0	46
12	10	0	11

Extension Services

Extension services were inadequate. Out of the government departments and the donor agencies, only TADP was found active in the project areas. For the improvement of the schemes effective extension services (both in agronomic and in water management aspects) and effective scheme management were judged to be essential.

CONCLUSION AND RECOMMENDATIONS

The study area contained varied topography and dispersed housing. Under the situation, BP systems were found to be effective for distributing irrigation water over the command area.

The average irrigated area was only about half of the intended command area. The inefficient management system and inadequate extension services were the reasons for this low irrigated area but not the shortcomings of the technology. Extremely low pump operation (3.88 hours/day and 17 days/month) and too many fallow lands (about 40%) were observed. To improve the economic performance of the BP systems, these constraints need to be overcome.

Two cusec outlets and their limited numbers (20-21) were found inadequate under the prevailing operational and field situation. One cusec outlet, one for each 2 to 3 acres (1 acre = 0.40 ha), and operating two at a time would be more appropriate.

Instead of own fuel system, project supply fuel and line rotational water distribution system can enhance engine life, reduce conveyance losses and increase pump operation and hence command area. Routine preventive maintenance should be practiced.

Effective extension services, both in agronomic and in water management aspects, are most essential to make the buried pipe schemes more attractive and profitable.

Bibliography

Rashid M. H.; M. A. K. Mridha; Ian K. Smout and Robert V. Bentum. 1990. Research into buried pipe distribution systems for irrigation. Interim Report: 1989/1990 irrigation season. UK: Bangladesh Agricultural Research Institute (BARI) and Overseas Development Administration (ODA).

Rashid M. H.; M. A. K. Mridha; Ian K. Smout and Robert V. Bentum. 1992. Research into buried pipe distribution systems for irrigation. Final Report: 1989/1991. UK: BARI and ODA.

Mayer M. 1991. Command area development: Review of rabi season 1990/1991. Bangladesh: Tangail Rural Development Project (TRDP).