

MANAGEMENT FUNCTIONS INVOLVED IN TUBEWELL  
IRRIGATION IN BANGLADESH: IMPLICATIONS FOR  
SUSTAINABLE GROUNDWATER DEVELOPMENT

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ABSTRACT

In Bangladesh irrigation by deep tubewells (DTWs) and shallow tubewells (STWs) has been the major form of groundwater irrigation. In 1989-90 tubewell irrigation covered about 63 percent of total irrigated area of the country. With the large scale privatization of tubewell irrigation, there has been a proliferation of irrigation management systems. The main management systems are DTW-rental programme of Bangladesh Agricultural Development Corporation (BADC), Farmers' Cooperatives managed DTW programme of Bangladesh Rural Development Board (BRDB), private management of DTWs and STWs, and management of DTWs and STWs by landless and marginal farmer groups supported by non-government organizations (NGOs). Despite technical and financial constraints, irrigation managers, tubewell owners or irrigating farmers under all management systems perform their parts of the management functions well within limit. Further improvement for sustainable groundwater irrigation necessitates the government and irrigation - supporting agencies to play key roles in improving the supply and distribution of irrigation equipment, diesel, electricity, credit and other inputs and in ensuring market for irrigated crops.

INTRODUCTION

In Bangladesh tubewell irrigation as the major form of groundwater irrigation is expanding rapidly. Both the number of irrigation tubewells and the area irrigated by tubewells have increased remarkably in the last decade<sup>2</sup>. For example, the number of deep tubewells (DTW) in operation rose from 9795 in 1979-80 to 25693 in 1989-90 and the area irrigated by DTWs increased from 0.24 million ha to 0.53 million ha during the same period (Hamid 1991). As regards shallow tubewells (STW), the number in operation rose from 10,662 in 1979-80 to 278,000 in 1989-90 and the area irrigated by STWs increased from 53,266 ha to 1.25 million ha during the period (Hamid 1991; Planning Commission 1990). In 1989-90, groundwater irrigation by DTWs, STWs and HTWs (Hand Tubewells) together accounted

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<sup>2</sup> Major types of irrigation tubewells are Deep Tubewells (DTWs) which lift water by diesel or electrically operated turbine pumps and have nominal discharge capacity of two cusecs. Shallow tubewells (STWs) extract water from well by suction mode pumps and have an average discharge capacity of about a half cusec.

for about 63 percent of total irrigated area of the country. It is expected that by the end of the Fourth Five-Year Plan period (1990-95), the number of DTWs and STWs will rise to 35,000 and 500,000 respectively to irrigate additional areas of 0.2 million ha and 9.5 million ha respectively (Planning Commission 1990).

With the large scale privatization of new DTWs and STWs accompanied by the turn over of the old DTWs controlled by the Bangladesh Agricultural Development Corporation (BADC) to private ownership and management, a number of irrigation management systems have evolved. The main management systems are BADC controlled DTW - rental programme (the programme is now officially non existent, but there are still several thousand DTWs which remain unsold and are being operated any how); Farmers' cooperatives managed DTW programme by the Bangladesh Rural Development Board (BRDB); privately owned and managed DTWs and STWs; Grameen Bank management of DTWs as business, and DTWs and STWs managed by landless and marginal farmer groups organized by NGOs such as PROSHIKA and Bangladesh Rural Advancement Committee (BRAC).

These management systems have different forms of organizing irrigation and thus have varying demands for management functions from different agencies involved in irrigation development, from tubewell owners/managers and from irrigating farmers. The variations in management functions or sharing of management responsibilities by these different actors in irrigation activities have strong influence on the performance of irrigation equipment. These have also important implications for the level of support services needed from collaborating organizations such as those related to the import and distribution of irrigation equipment and diesel or supplies of electricity and credit.

The purpose of this paper is to focus on the irrigation management functions under different tubewell management systems and then discuss how inadequate functioning of irrigation supporting agencies does adversely affect farmer management of tubewell irrigation.

## IRRIGATION MANAGEMENT FUNCTIONS

In this section, management functions involved in different irrigation management systems are discussed<sup>3</sup>. Table 1 shows how the management functions are distributed between irrigation agencies, irrigation managers and irrigating farmers under the major management systems. These are discussed below:

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<sup>3</sup> One special type of DTW management is BADC's Barind Integrated Area Development Project (BIADP) which provide tubewells to informal farmer groups who are required to pay an irrigation charge to BADC based on estimated command area.

<sup>4</sup> It is not intended in this paper to dwell on the comparative analysis of irrigation performance between management systems, although its importance is well recognized. Some comparative analyses of performance, which show no significant difference in productivity and equity performance of tubewells, are available in (Palmer-Jones and Mandal 1987; Mandal 1987; Hakim, et al. 1991).

Table 1: Management Functions under Different Irrigation Management Systems

Management Systems	Agency Functions	Managers' Functions	Farmers' Functions
Rental (DTW)	Siting and installation, routine repair and maintenance, rent collection	Acquisition of TWs, irrigation groups, arrange cash for O & M, diesel/electricity, water distribution, water fee collection	Field channels, payment of water fees
KSS (DTW)	Siting and installation, routine repair, training	Formation of KSS, acquisition of TWs, arranging KSS loan, diesel/electricity, water distribution, O & M, water fee collection	Participation in KSS meetings, field channels, payment of water fees
Private (DTW/STW)	Installation of DTW	Contracting command area plots, contractual arrangement, arrange cash for O & M, water distribution, water fee collection	Field channels, payment of water fees, arrange diesel in case of farmers fuel system.
NGO (DTW/STW)	Formation of groups, acquisition and installation, credit, training, extension	Contracting command area plots, contractual arrangement, water fee collection	Field channels, payment of water fees.

DTW = Deep tubewell; STW = Shallow Tubewell; KSS = Farmers' Cooperative Society; NGO = Non-Government Organization.

### DTW-Rental Programme

Under this programme BADC as the lead agency was responsible the distribution, siting, installation and maintenance of DTWs against a fixed yearly rental charge payable by the irrigation managers. The manager used to collect water from the irrigating farmers but they were alleged to have defaulted payment of rental charges to BADC. BADC as the principal support service agency took the responsibility of supplying oil, fuel, spareparts and mechanic services for repair and maintenance of pumps and engines. Tubewell managers, on behalf of the irrigation groups, were responsible to organize groups, arrange cash for the purchase of diesel/mobil, schedule on-farm water distribution and collect water fees from farmers. Farmers responsibility was to construct and maintain field channels to facilitate water distribution from the main canals to the individual plots and pay water fees to managers usually in two to three installments. This programme is now officially discontinued as a part of irrigation privatization programme, but there are yet several thousand old DTWs left to be sold out. These tubewells are being operated by members of the erstwhile nominal management committee or by other farmers, but whether or not any rents are paid to BADC is not clear at all.

### KSS-DTW Programme

Now that BADC - DTW rental programme is discontinued management of DTWs through farmers' cooperatives (KSS) under the umbrella of Bangladesh Rural Development Board (BRDB) has been one of the dominant programmes. In this programme, BADC is responsible for providing technical supports such as siting, installation, routine repair and training on irrigation management. The KSS managers, like managers under other management systems, take the responsibility to organize farmers' cooperatives, arrange cash for the purchase of diesel, mobil spareparts, pay fees for electricity connections, schedule on-farm water distribution and collect water fees. But the KSS managers have the extra task to initiate application for KSS loans and negotiate disbursement of loans to KSS members. KSS farmers beside taking care of field channels and of payment of water fees to the manager, are obligated to participate in KSS meetings, which in general mean paper work for satisfying official requirements.

### Private DTW Management

BADC is responsible for installing DTWs. Tubewell owners/managers take the whole range of functions such as contracting farmers for command area plots, negotiation with participating farmers, making contractual arrangements for water delivery, arrangement of cash for diesel, mobil, electricity and for repair and maintenance of tubewells, appointment of pump drivers or drainmen (those who actually look after canals and on-farm water distribution), scheduling plot to plot water distribution, and collection of water fees. In case of tubewells run on crop-sharing as the system of payment for water, tubewell owners have to engage extra labour to harvest and collect from fields the share of paddy that are paid as water charges. Farmers' functions are to construct and maintain field channels and pay water charges. In case of crop-share payment system farmers have to inform the tubewell owners of the time of harvesting their plots so that the latter can also deploy labour to collect their shares of the crop.

## NGO-Management of DTWs/STWs

NGO-management of DTWs/STWs, which accounts for an insignificant proportion of total irrigated area of the country, is a recent approach involving groups of landless and marginal farmers to own and manage tubewells (NGO management also includes irrigation by low-lift pump (LLP), Treadle Pumps and Rower Pumps). In these programmes, NGOs provide different levels of supports for formation of groups, acquisition and installation of tubewells, credit for the purchase and operation of tubewells, training and extension advisory services. The members of the NGO groups controlling the tubewells have to bear all the responsibilities to operate and manage tubewells, deliver water to farmers' plots, and collect water fees at rates charged generally in the locality, but some NGO groups (e.g. PROSHIKA landless irrigation groups) are known to have introduced or popularized one-fourth crop-sharing as a system of payment for water, which is now widely practiced in the country.

## **ROLE OF KEY IRRIGATION SUPPORTING AGENCIES**

The discussion in the preceding section reveals that the functions of irrigation managers and farmers remain more or less same in all management systems, but the functions of the irrigation-related agencies vary. Field experiences show that irrigation managers/tubewell owners or farmers perform within limit their parts of the management functions satisfactorily. But their success in tubewell management is limited by a number of other functions to be accomplished by the key supporting agencies which are beyond the control of farmers and irrigation agencies. Some of these other functions, which are key to sustainable groundwater development, are discussed below:

### Acquisition and Distribution of Irrigation Equipment

Although operation of tubewells and on-farm water distribution are the sole responsibilities of irrigation managers/farmers, the import and distribution of irrigation equipment are the responsibilities of the government and private agencies. Decisions about (a) what type of engines or pumps are to be imported; (b) from which country; and (c) at what prices, all are therefore beyond the control of tubewell managers/owners or irrigating farmers. Government agencies and private traders often import and distribute irrigation equipment which are not of the right type or quality nor are normally demanded by farmers (Palmer-Jones 1989). Consequently, mismatching between tubewell components and mechanical breakdown occur, actual discharges of pumps are reported universally lower than rated discharges, and finally actual working life of machines turns out to be shorter than claimed (Dutta and Mandal 1989). The situation aggravates when import restrictions are imposed for any reason (e.g. import ban on certain type of STW engines together with the squeeze of agricultural credit by the Bangladesh Krishi Bank was in large part responsible for the drop in STW sales in the mid eighties).

This warrants two types of interventions: (a) all possible initiatives should be taken by the government and private sectors to organize local manufacture of tubewell engines and pumps, in collaboration with foreign manufacturers; and (b) until local manufactures can meet full demand, unnecessary restrictions on import of irrigation equipment should be removed but financial disciplines in dealing with imports must be maintained. Imports of irrigation

equipment have been liberalized in recent years, which improved availability of equipment in the market, but one often hears about the complaints against some of the very cheap and small Chinese engines.

### Supplies of Diesel and Electricity

Tubewell irrigation is small scale and operation and maintenance of equipment are apparently within the control of tubewell owners/managers. But the effective management of tubewell irrigation is totally dependent on imported diesel/mobil or on electricity which is also produced through imported fuel and supplied through imported distribution lines. Spareparts are also largely imported, although a number of low cost-low quality spareparts are locally produced.

A number of problems are generally encountered in the supply of diesel and electricity to irrigation tubewells as follows: (a) scarcity of foreign exchange restricts the import of diesel and equipment; (b) import and distribution of diesel are often disturbed by international affairs (e.g. gulf war crisis aggravated diesel supply problem in 1991 irrigation season) as well as by interruptions in domestic distribution system (e.g. shortage of diesel supplies in North Bengal districts due to reduced navigation in Baghabari and Chilmari ferry terminals in the current 1992 irrigation season). Such diesel crises resulted in sudden rise in diesel prices and ultimately reduced the irrigation coverage by tubewells and affected yield of Boro paddy; (c) there are frequent occurrences of electricity failure and load shedding during April, the hottest month requiring maximum pumping. The low-cost electricity transmission lines (using local materials) are especially prone to damages by Nor'wester during the peak irrigation time; (d) above all, cash constraints of tubewell owners/managers and farmers limit the purchase of diesel or of electricity, which ultimately affect the utilization of tubewells and paddy yields adversely.

### Availability of Cash for Tubewell Irrigation

The operation of tubewells involves huge cash expenses in terms of the purchase of diesel, mobil, electricity, spareparts and mechanic services. Even though the tubewell owners/managers can defer a part of the payments for drivers or lineman's salary until harvest of paddy that is irrigated, 60-70 percent of total O & M costs has to be paid in cash, a larger part being spent on diesel, electricity and water distribution system at the beginning of the tubewell operation (Table 2). Irrigating farmers need cash not only for payment of water fee but also for the purchase of seed, fertilizers and insecticides. Field experiences show that major parts of the cash requirements of tubewell owners or farmers are met by borrowing from non-institutional credit sources charging exorbitant interest rates. The other ways to cope up with cash constraints are: mortgaging out land and forward sale of irrigated paddy at low prices.

Cash constraints have profound influence on contractual arrangements for payment of water. For example, tubewell owners facing cash constraints go for a management system which specifies that tubewell owners will charge a fixed cash as machine rental but the irrigating farmers have to use their own diesel (Table 3). Field evidences suggest that although this system reduces pressure for cash arrangement by tubewell owners/managers, this turns out to be a highly inefficient way of managing tubewells. This system leads to underutilization of pump capacity (because cash constrained farmers may end up with under-irrigation)

and rapid damage of engines (because low quality diesel might be used).

To see cash constraints from irrigating farmers' point of view, crop-sharing arrangements are accepted as system of payment for water. This arrangement should be seriously considered because payment for water charges as one third or one-fourth share of crop figure out to be much higher than fixed cash payment per unit of land (Table 3). Crop-share arrangement for payment of water charges has elsewhere been termed as an instrument for exploitation (Miah 1989). However, in cash constraining situation, especially where there is also risk of crop failures due to floods or drainage congestion, crop-share arrangement for payment of water charges acts as credit arrangement for irrigated paddy production. This implies the necessity of provision for efficient institutional credit free from bureaucratic rent seeking. The other way to relax cash constraints is to increase irrigation returns to tubewell owners and irrigating farmers by ensuring incentive prices of paddy at harvest through the effective implementation of paddy procurement programmes.

## CONCLUDING REMARKS

Deep tubewells and shallow tubewells are managed under a variety of systems, each requiring specific management tasks to be performed by the irrigation-related agencies such as BADC, BRDB and NGOs. The tasks assigned to irrigation managers or irrigating farmers in all different systems are performed reasonably well. Despite technical and financial constraints, irrigation managers or tubewell owners deal with management problems relating to farmers' cooperation, contractual arrangement or water fee collection with relative success. But this does not mean that government should pull out altogether from the farmer - managed irrigation sector. There are still problems of low capacity utilization of tubewells, low yield and low returns to groundwater irrigation. The areas where government or irrigation supporting agencies have key roles to play for sustainable groundwater irrigation are: (i) import, manufactures and distribution of irrigation equipment; (ii) supplies and delivery of diesel, electricity and other inputs (iii) provision of credit for the operation and maintenance of tubewells and for the production of crops; and (iv) ensuring market for output, which will increase returns to irrigation.

Table 2: Operation and Maintenance Costs of DTWs and STWs, 1990

Technology	Taka per tubewell for HYV Boro paddy irrigation				
	Diesel/Mobil/ Electricity	Repair	Field Channels	Salary & Misc.	Total
<u>Chandina</u>					
STW (Diesel)	7204 (44.3)	2267 (14.0)	886 (5.5)	5875 (36.2)	16232 (100.0)
STW (Electricity)	8508 (48.3)	1644 (9.3)	1691 (9.6)	5791 (32.8)	17634 (100.0)
DTW (Diesel)	22685 (44.8)	10671 (21.1)	2730 (5.4)	14558 (28.7)	50644 (100.0)
DTW (Electricity)	20400 (54.6)	1330 (3.6)	3200 (8.6)	12413 (33.2)	37343 (100.0)
<u>Jhenaidah</u>					
STW (Diesel)	4998 (35.5)	2586 (18.4)	740 (5.3)	5756 (40.8)	14080 (100.0)
DTW (Diesel)	22319 (48.9)	6436 (14.1)	4114 (9.0)	12762 (28.0)	45631 (100.0)
DTW (Electricity)	32448 (61.5)	200 (0.4)	10500 (19.9)	9600 (18.2)	52748 (100.0)

Figures in the parentheses indicate row percentages

Source: Field Survey, 1990



Table 3: Estimated Water Charges by System of Payment

Payment System	Taka/ha			
	Chandina	Ghatail	Jhenaidah	Thakurgaon
<u>Diesel DTWs</u>				
25% Crop-share	-	6188 <sup>a</sup>	-	-
Cash (Managers' fuel)	4048	3458	3490	-
Cash (Farmers' fuel)	-	-	1772 + Fuel	1112 + Fuel
<u>Electric DTWs</u>				
25% Crop-share	-	6188 <sup>a</sup>	-	-
33% Crop-share	-	-	-	6861 <sup>a</sup>
Cash	3808	3293	3959	370
<u>Diesel STWs</u>				
25% Crop-share	-	6188 <sup>a</sup>	-	-
Cash (managers' fuel)	4808	4116	6405	2865
Cash (Farmers' fuel)	-	-	-	2058 + Fuel
<u>Electric STWs</u>				
25% Crop-share	-	6188 <sup>a</sup>	-	-
Cash	5097	3293	-	2525

<sup>a</sup> Value of straw and the cost of collecting paddy from the field were not considered in the calculation.

Source: Field Survey, 1990.

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