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SUSTAINABLE GROUNDWATER IRRIGATION TECHNOLOGY MANAGEMENT WITHIN AND BETWEEN THE PUBLIC AND PRIVATE SECTORS

Guidelines of good practice, based on the experiences of Bangladesh and Pakistan

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REFERENCE MANUAL MANAGEABILITY

Findings of DFID funded research project (R6877) on 'Technology Transfer and Sustainable Rural Development' to develop guidelines of good practice for (a) technology transfer in relation to the full or partial transfer of tubewell irrigation from the public to the private sector, and (b) associated rural development, 1997-1999.

REFERENCE MANUAL - MANAGEABILITY

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1. INTRODUCTION

Manageability of groundwater irrigation technology refers to the management system for the technology, its type, scale and effectiveness in satisfying the needs of water sellers and water users or buyers.
These guidelines will not advocate any particular form of transfer, or any form of management within current sectors. They will illustrate different management options within whichever sector (public or private) for a variety of issues.
The structure of this section is:

- ownership and management distribution of DTWs in Bangladesh and Pakistan;
- presentation of examples of different corporate, group and individual management styles current in Bangladesh, Pakistan and India and to identify key management reasons for successful results;
- ways in which different management options could be used to assist with a variety of situations with which users of force mode wells are faced.

From the survey and project evaluation, key points relating to **the manageability of groundwater irrigation technology, in whichever sector**, have been identified. These include:

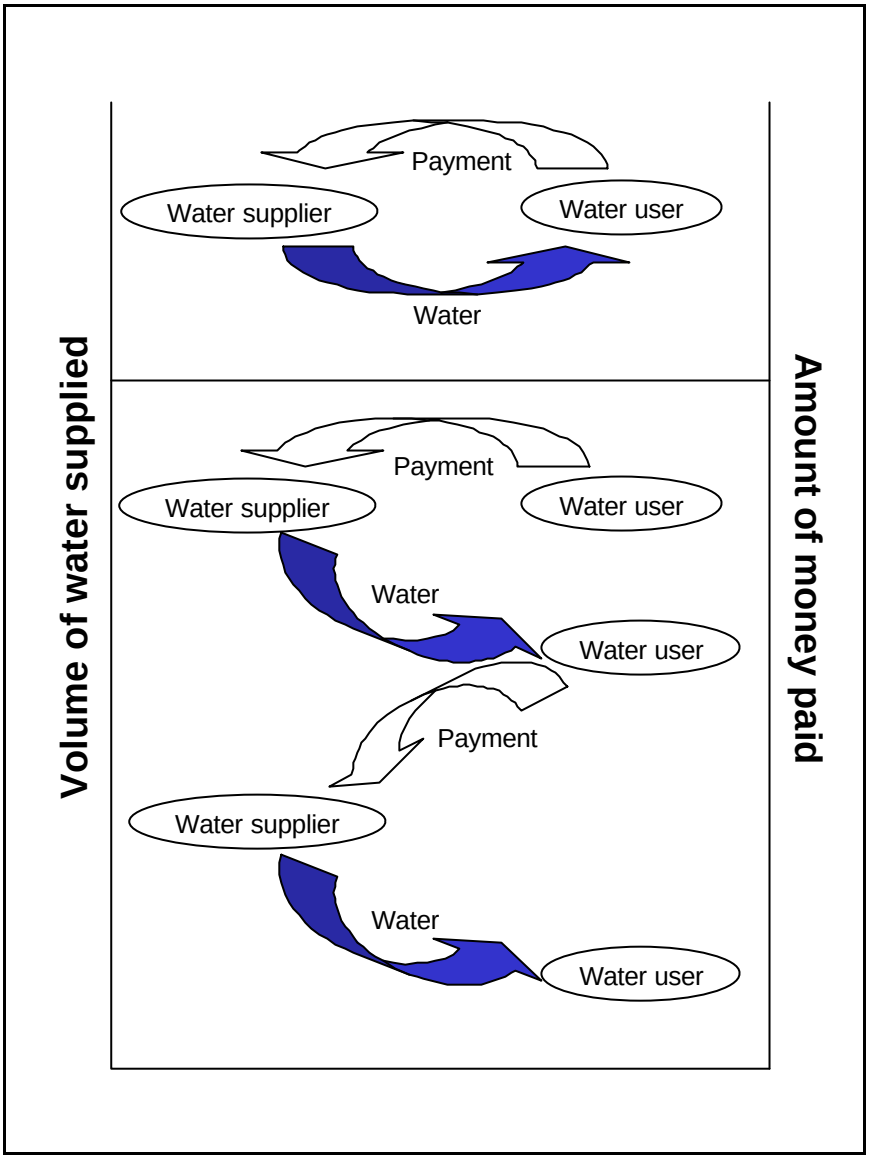
- farmers want reliability and will pay for it, subject to affordability;

Forms of ownership and management:
- corporate
- group
- individual

- ensuring reliability (good maintenance and fast emergency repairs) is easiest when the water and the financial flows reinforce each other so that the management is rewarded for good service, and penalised for bad service. If either of these flows do go in different directions, then so often water supply reliability and cost recovery enter a downward spiral. Box 1 illustrates this for situations where (a) water and financial flows are reinforcing each other, and (b) where initial satisfactory payment is not rewarded by reliable water supply and payments decrease, so causing deterioration in the performance of the well or group of wells.

- management of large groups is difficult, and has time and transaction costs for the people involved. If a large group is necessary, farmers may prefer to purchase a good service, rather than to organise it themselves. However, if there is no good service provider, they may be willing to undertake the organisational burden.

Box 1: Importance of reinforcing water and financial flows



1.1 Forms of ownership and management in Bangladesh and Pakistan

There are three main forms of tubewell ownership and management in Bangladesh and Pakistan. Each of these forms have their own implications for manageability and these are described below. The projects which are evaluated later in this section of the Reference Manual are identified by form of ownership and management.

1.1.1 Well ownership and management in the same hands

Examples of this include government owned and managed wells; NGO owned and managed wells; and farmer owned and managed wells. In each of these cases, the management organisation may either be responsible:

only for water delivery, or

it may have additional functions such as the delivery of credit, advice, inputs, other infrastructure.

In each of the above cases, the organisation may be expected to improve its management system over time, and to strive towards forms that are more efficient for its purposes. Examples that will be given include the North Bengal Tubewell Project central Government owned and managed; the Barind Integrated Area Development Project - government-owned, but evolving to control of independent financial as well as water flows; GKF (NGO) evolving towards becoming an input supplier; and independent wells in Bangladesh and India, evolving towards smaller management committees and effectively a water seller/buyer structure.

1.1.2 Well ownership and management shared by two organisations:

Typically, the well and pump belong to the government, but the conveyance system and water delivery arrangements belong to the farmers.

1.1.3 Well ownership changes hands

In this situation, an organisation is set up either to:

transfer an existing facility to new ownership and management (e.g. Punjab Private Sector Groundwater Development Project), or

assist farmers to develop and manage new wells (PATA project).

The new management typically owns and manages a single well; the preceding management owned and managed a large number of wells. The key issue here is what the farmers are expected to pay in return for ownership of the facility: full price, discounted second-hand price, subsidy, and whether they are expected to make provision for eventual replacement (see *Reference Manual - Affordability*, section 5).

The purposes, functions and the appropriate staffing levels for each of the above forms of ownership and management will differ in each case.

1.2 Previous or current transfers in Bangladesh and Pakistan

Where transfer of ownership has already occurred in Bangladesh, it has taken the form of central government to semi-independent and autonomous regional authority (BMDA), central government to private organisation (GKF) and central government to farmers' co-operatives (the Krishi Samabay Samities – KSS, through BRDB), private groups or private individuals. Where transfer of well ownership has already occurred, or is occurring, in Pakistan it has taken the form of either provincial government to individual farmers (SCARP Transition Pilot Project (STPP) and start of Second SCARP Transition Project (SSTP)) or to groups of farmers (end of SSTP and Punjab Private Sector Groundwater Development Project (PPSGDP)).

When considering **the transfer of wells from Government to other agencies**, success can be measured in two main different ways, depending on the motives for transfer and perspectives of those involved:

wells are no longer a drain on Government financial resources and public money is available for other pressing needs. What happens to the wells after transfer is no longer their responsibility and no longer affects public finances. Whether the farmers want it or not is immaterial.

- performance of the wells improves under the new management for the benefit of farmers and nation, through increased production and income.

The first indicator of success usually requires transfer only to be a one-step process, with no further public involvement. The second measure of success requires considerably more time, energy and resources in the medium term to achieve, but the results often justify the commitment of these inputs.

1.3 Key management functions

The results of the research indicate that the key management functions for increasing success in groundwater irrigation include:

- Selection of appropriate technology, or modification to technology, for the well and pump, given local circumstances.
- Provision for regular maintenance and fast emergency repair or replacement, given that the chief priority of farmers is a service they can rely on. Major replacements can be a problem area for private services.

- Organisation of water delivery according to known criteria. A fair system of rationing and conflict resolution.
- Staff management including incentives for good service, and training.
- Financial management to secure financial resources at least sufficient to pay O&M and organisation of water delivery and, if possible or required, eventual replacement costs and, if possible or required, contribution to other rural development needs.
- Providing all the above at reasonable cost, so as to maximise profit to well-owners and/or farmers (by, for example, minimising staffing costs. State systems are often particularly deficient on this, and there are examples such as in Columbia where economies in this were a high priority after transfer of ownership, (IWMI, 1998)) .
- Clarity and accountability.
- Monitoring ground water quantity and quality and scheme performance.
- Monitoring whether the system as a whole has been effective in raising yields and incomes (ability not just to improve output of previous crops, but to grow more crops per year, or move into higher value crops).
- Monitoring whether there are any additional and noticeable social benefits, particularly if this is part of the mandate of the manager concerned.

2. DISTRIBUTION OF DTW TECHNOLOGY OWNERSHIP AND MANAGEMENT IN BANGLADESH AND PAKISTAN

Before describing, evaluating and suggesting management options, the current distribution of ownership of DTWs in Bangladesh and Pakistan should be presented. The approximate numbers of DTW by ownership are shown for Bangladesh in Box 2 and for Pakistan in Box 3.

A considerable proportion of DTWs has already been transferred from government to private ownership through a variety of measures, and these provide contrasting examples of methods for transfer for the remaining wells.

In Bangladesh there are three main organisations which are involved in corporate ownership and management of groundwater irrigation. These are: (i) the Bangladesh Water Development Board with the North Bengal Tubewell Project around Thakurgaon; (ii) the Barind Multi-purpose Development Authority (a semi-independent autonomous) government body, based in Rajshahi; and (iii) the Grameen Krishi Foundation, which took over wells from BADC, and the BWDB North Bengal Tubewell Project in 1987/88. These three provide interesting contrasting management styles and results, all within the north-west of Bangladesh and these will be considered in detail in the next section. Group ownership of force mode technologies is either on an informal basis or through KSS. Support for groundwater irrigation, in a less direct form, is provided by government departments, research institutes, NGOs, banks, equipment manufacturers and dealers. The main support agencies are shown in Box 4.

In Pakistan, the variety in ownership and management of force mode wells is considerably less. These are either in the hands of the provincial irrigation departments (PIDs) or farmers' groups or individuals as a result of SCARP transition projects. It should be noted that under the transfer of SCARP tubewells many force mode wells have been closed and replaced with suction mode wells.

There are, however, projects which are developing farmer owned and managed groundwater irrigation (not transfer). These include the Balochistan Community

Irrigation and Agriculture Project (BCIAP) and the PATA Project in NWFP, which are both integrated agricultural development projects. The number of organisations supporting groundwater irrigation is considerably less than in Bangladesh' although there is some support from research institutes and NGOs. The main support agencies are shown in Box 5.

(BCIAP will not be evaluated in support of these guidelines because their involvement in groundwater is highly specialised, through involvement with the improvement of kareze distribution systems. A kareze is a hand dug well ('mother' well) bringing an underground spring through a tunnel to the surface ('daylight point'). This traditional engineering practice in the Middle East. For those interested, information on this project and on karezes can be obtained from BCIAP, 231/233 Takatu Road, Block 4, Satellite Town, P.O. Box 255, Quetta, Balochistan, Pakistan, or on e-mail: bciap@infolink.net.pk. The National Rural Support Programme is also providing credit for the construction of new karazes in Balochistan. Further information can be obtained from: NRSP, 46 Aga Khan Road, F-6/4, Islamabad, Pakistan. Fax: 00 92 51 822779.)

Box 2: Approximate Distribution of DTW Ownership in Bangladesh, 1997

Owners	Project	Number	Comments
Public			
Bangladesh Water Development Board	North Bengal Tubewell Project	1,200	All are electric and about 1,000 are in operation
Barind Multi-purpose Development Authority	Barind Integrated Area Development Project	6,345	3,000 are electric, the rest diesel. All of the electric DTWs are operational and about 3,400 of the 4,000 diesel DTWs are in operation
Bangladesh Agricultural Development Corporation		5,000	These were left in the hands of BADC after selling the others - effectively condemned. 2,600 were identified by BADC as repairable, a list cut down to 1,800 by NMIDP. 300 of these have been rehabilitated by NMIDP for sale.
Private			
Grameen Krishi Foundation		565	GKF operated 490 in 1993/4, 434 in 1994/5 and 350 in 1995/6. All those which have been electrified since GKF have taken them over have electric motors but also diesel engines to cover power cuts. (Nos. have declined as uneconomic wells have been closed down)
Bangladesh Rural Development Board	KSS Co-operatives	12,000	BRDB purchased DTWs from BADC, on behalf of the KSS co-operatives at huge subsidy (cost Tk 175,000 with only Tk 6,300 down payment)
Private		7,500	Bought and run by individuals or groups. Some sold and moved - second hand DTW market.

(Sources: World Bank/FAO, 1997; IIMI et al., 1995; UNCDF, 1997; and personal communications)

Box 3: Approximate Distribution of DTW Ownership in Pakistan, 1998

Owners	Project	Number	Comments
(i) owned			
Government - Provincial Irrigation Departments & Farmers groups (CTWs)	Punjab Private Sector Groundwater Development Project (PPSGDP)	4144	Commenced 1997, on-going. Transfer to Community Tubewells (CTWs), involving creation of Farmers' Organisations through Social and After Care Organisers. In SCARP II, III, IV and V.
Government - Provincial Irrigation Departments		> 9000	Still in Government hands, yet to be transferred.
(ii) closed/transferred			
Farmers - individuals	SCARP Transition Pilot Project (STPP)	213	Completed 1992. SCARP wells replaced with 1500 private electric powered wells and 400 diesel wells, in Khanqah Dogram Scheme of SCARP-1.
Farmers - individuals and groups	Second SCARP Transition Project (SSTP)	1346 in Punjab 380 in Sindh	Completed 1997. First 650 SCARP wells replaced, under subsidy, by private wells (many closed following removal of subsidy on electricity). Remainder replaced by CTWs. In remaining area of SCARP-1.

(Sources: Govt. of Punjab, 1997 and 1998).

Box 4: Main organisations involved in groundwater irrigation management in Bangladesh

A: DIRECT OWNERSHIP OR MANAGEMENT

Organisation	Type of organisation	Location on management continuum *	Role	Scale
Bangladesh Water Development Board (BWDB)	Government agency under Ministry of Water Resources	Full state responsibility - O&M paid for by farmers	Groundwater supply for irrigation only. Monitoring & maintenance	Local - Thakurgaon
Barind Multi-purpose Development Authority (BMDA)	Semi-independent autonomous Government body under the Ministry of Agriculture	Full state responsibility - paid for by farmers	Groundwater supply for irrigation, plus roads, electrification, afforestation, pond excavation & pisciculture	Regional - Barind Tract
Grameen Krishi Foundation (GKF)	NGO	Privatised ownership and management plus/minus subsidies - paid for by farmers	Corporate supply of groundwater irrigation plus inputs & credit	Local - Rangpur
KSS and other groups	Co-operatives	Private ownership and management	Management of irrigation	Local

B: SUPPORT FUNCTION

Organisation	Type of organisation	Role	Scale
Ministry of Agriculture (MoA) Ministry of Water Resources	Government Ministries	Administration of irrigated agriculture projects	National
Department for Agricultural Extension (DAE)	Dept. within Ministry of Agriculture	Agricultural Extension and Irrigation Extension services through the Irrigation Wing	National
Bangladesh Water Development Board (BWDB)	Government agency under Ministry of Water Resources	Monitoring of groundwater levels. Data to Water Resource Planning Association for thana based analysis	National
National Minor Irrigation Development Project (NMIDP)	Project under Ministry of Agriculture	Promotion of new technologies in groundwater irrigation	National
North East Minor Irrigation Project (NEMIP)	Project under Ministry of Agriculture	Promotion of groundwater irrigation and development of infrastructure	Regional - Sylhet
Rangpur Dinajpur Rural Service (RDRS) (1), Proshika (2), BRAC (3)	NGOs	Provision of credit and technical assistance for STW irrigation.	(1) Local (2)&(3) national
(1)Agricultural Development, Krishi, Sonali, Janata and Agroni, (2) National Banks	Banks	Provision of credit for groundwater irrigation (1) working with NMIDP (2) working with BMDA	(1) National (2) Regional
Rural Development Academy (Bogra) and Academy for Rural Development (Comilla)	Research institutes	Experimental and action research projects involving the local communities	Local
Manufacturers and dealers	Private companies	Supply of equipment	National

*(see Chapter One - Introduction for management continuum)

Box 5: Main organisations involved in groundwater irrigation management in Pakistan

A: DIRECT OWNERSHIP OR MANAGEMENT

Organisation	Type of organisation	Location on management continuum	Role	Scale
Provincial Irrigation Departments (PIDs)	Departments of Provincial Government	Full state responsibility - O&M paid for by farmers	O&M of SCARP wells	Provincial
Community Organisations	Farmers' groups, created under a variety of projects (see B below)	Private ownership and management	All aspects of well management	Local

B: SUPPORT FUNCTION

Organisation	Type of organisation	Role	Scale
Water and Power Development Authority (WAPDA)	Government agency	Irrigation development (WAPDA and PIDs) to merge and become Provincial Irrigation and Drainage Authorities (PIDAs)	Provincial
SCARP Monitoring Organisation (SMO)	Government agency	Monitoring groundwater levels through analysis of SCARP water level data	Provincial
Punjab Private Sector Groundwater Development Project (PPSGDP)	Development project - Consultants and OFWM (MoA)	Hand over of SCARP wells to farmers in fresh groundwater areas	Provincial
National Drainage Programme (NDP)	Development project - consultants and PIDs		National
PATA Project	Development project - consultants, OFWM and Department of Agricultural Extension (MoA)	Integrated agricultural development linked with construction of farmer owned and managed DTWs. Support for farmers from well planning through to agricultural extension after construction	Local
Balochistan Community Irrigation and Agriculture Project (BCIAP)	Balochistan Irrigation Department, with international assistance	Integrated community, irrigation and agriculture project	Provincial
Aga Khan Rural Support Programme (AKRSP)	NGO	Support for development of lift irrigation	Local
International Waterlogging and Salinity Research Institute (IWASRI), International Water Management Institute (IWMI), Water Resources Research Institute (WRRI), Rice Research Institute (RRI)	Research institutes	Experimental and action research in labs, in field, and with farmers	National/ Provincial
Manufacturers and dealers	Private companies	Supply of equipment	National

3. MANAGEMENT STRUCTURES AND COMPONENTS

3.1 Introduction

The organisations which own and/or manage groundwater irrigation all have different structures and components. Many of these structures and components have positive impacts on the success of ownership and management. Each organisation has its own objectives, mandate, structure and components and so not all features are common to all. Therefore, the management structures of each of the main organisations will be described first, and then the key components and issues relating to success or otherwise will be summarised for comparative purposes.

Individually managed wells, either by a group or by an individual, will be looked at first. The examples used are from India, where comparisons between companies and co-operatives have been made which highlight significant management issues, and from Bangladesh, where the large numbers of farmers per well present many management challenges, and. Corporately managed wells will then be assessed, in three ways:

- Each project will be described using set criteria, with the exception of the PIDs of Pakistan which are too large and diverse to classify here (they will be described in the text);
- Points of particular interest from each project will be highlighted in the table (in ***bold italics***) and presented in the text after the table;
- The projects will be evaluated against set criteria in one table (Box *).

In Bangladesh, 60% of DTWs are already in the private sector, owned and managed by individuals or groups of farmers or entrepreneurs. The organisations managing the remaining DTWs are BWDB (North Bengal Tubewell Project), BMDA (Baring Integrated Area Development Project) and GKF. Although these organisations manage a minority of the DTWs in Bangladesh, they highlight important issues for well management. The farmers from an increasing number of privately/ collectively owned DTWs are also asking to join the more successful projects.

In Pakistan, the main features of the PIDs will be looked at, as will the structures and components of the farmers' organisations for individual wells under PPSGDP and the PATA Project.

3.2 Independent well owning co-operatives and companies - India

These illustrations are based on survey work carried out by Shah et al. (1997) of co-operatives and companies who own and manage wells.

The companies were based in Mehsana district and the co-operatives in Kheda district. The background and contexts for the two forms of organisation are shown in Box 6. Membership of the companies is significantly smaller than for the co-operatives, as is the command area. However, despite the need for the companies to invest in capital costs (which the co-operatives did not have to do) the length of buried pipe line was, on average, 1,000 metres longer in the company command areas. Reasons for these features include:

- companies design systems with the aim of providing a good irrigation service to members, whilst the co-operatives' aim was to reach as many members as possible;
- securing membership of a co-operative requires a small one-time cost of Rs. 51/-, whilst company partnership needs large initial and subsequent contributions to the company requiring careful cost-benefit calculations;
- due to the near cost-free entry, the co-operatives had many nominal members who joined in the hope of future benefits. In both groups, there were active users who bought water but were not members.

Box 6: Background information for co-operative and company managed wells in Gujarat

Organisation type:	**Co-operatives**	**Companies**
District:	Kheda	Mehsana
Groundwater conditions:	Groundwater abundant near the surface	Declining groundwater levels, wells between 600-1200 feet.
Physical conditions:	Light soils, gently undulating relief	Light soils, gently undulating relief
Socio-economic conditions:	Hard workers with good business sense. Vigorous agricultural economies based on lightly irrigated cash crops. Innovative institutional development area.	Hard workers with good business sense. Vigorous agricultural economies based on lightly irrigated cash crops. Innovative institutional development area.
Organisation background:	Co-operatives created to take over wells from the Gujarat Water Resources Development Corporation (GWRDC)	Indigenous informal organisation existing for over four decades. Formed by agreement under the Contract Act otherwise no link with state.
Age of organisations (yrs):	Mean: 2.5 Range 1-6	Mean: 6.1 Range 3-17
Number of members:	24 11-115	16 6-26
Gross command (acres):	163 42-320	114 48-200
HP of the motor:	25 15-38	27 22-40
Depth of well (feet):	439 240-515	583 480-710
Length of buried pipe (m):	1465 400-4200	2427 1750-3500
Capital cost:	No purchase required from GWRDC	Rs. 4.7 lakh Rs.4.2-5.9 lakh

(after Shah, 1997)

3.3.1 Well management under co-operatives and companies in Gujarat

The management structure for both co-operatives and companies is similar. Co-operatives have an elected Chairman, Secretary and paid operator. Companies have an elected manager, who takes on both jobs of Chairman and Secretary under the co-operative system, and paid operator. The difference comes in the design concept of the organisation. The design concept for companies, along with differences from co-operatives, where reported, is summarised in Box 7. There are no strict rules for company design but the basic concepts are similar. Differences tend to be in the detail of such features as bank accounting, profit distribution versus capital accumulation and the payment basis for the operator.

Box 7: Design concept for company managed wells in Gujarat

Feature	Description
Membership	1. Anyone with land in the command area of a proposed well can become a partner. 2. Share-holding is generally similar to land-holding size, but with a normal maximum holding of any one member of 45%.
Share of costs, water and income	1. Capital and subsequent costs are borne proportional to share-holding, as are profits, where distributed. 2. Share-holding has no influence on water use except in times of emergency when the larger share-holders take precedence. 3. All share-holders readily accept these shares because they can determine in precise terms the level of risk to which they are exposed.
Leaving the company	1. Leaving the company is difficult. Even if a partner leaves he usually cannot withdraw his capital until ten years after joining. However, if the partner was in the well's original command he can transfer his shares to another original partner.

(after Shah, 1997)

3.3.2 Indicators of, and reasons for, performance of co-operatives and companies in Gujarat

The survey of the performance jof the wells looked at operating efficiency and economic performance and investigated organisational performance. The main operating and economic findings were that:

- ompanies had a 50% greater operating efficiency than co-operatives (operating efficiency was measured in terms of hours pumped as a proportion of hours electricity available);

water prices were 15% higher for company water users than for co-operative water users. Electricity is charged at a flat rate per HP/year and is twice as much for companies as for co-operatives;

- all companies made a profit and one-third of co-operatives made a loss.
- the companies were able to achieve a considerable amount of capital accumulation, so sustaining the organisation.

The work of Shah (1997) showed that the real strength of the companies was in directly in line with the premise that if "an organisation assures its members of a service they value in a way which is consistent with the member's values and expectations, then:

- the organisation will grow on its own with little or no external prompting;
- it will sustain itself by generating resources; and
- it will sacrifice, change or confront for self-preservation."

The companies had the opportunity to register as a co-operative and receive subsidised power but almost all of them rejected any government or outside interference. Farmers who were members of companies were quoted as saying that the price of losing independence was too great to gain the subsidies - "...we are fine the way we are...we make our own rules...and when we do not like them, we change them...no hassle".

The main reasons for the superior performance of well companies are summarised in Box 8. These reasons lead to robust vigorous organisations because they self-create and self-propagate, actively guard their design sanctity and adapt and self-correct. The members and leaders in particular possess no special talent or leadership skills.

Box 8: Reasons for successful performance of companies in Gujarat

1. Complete autonomy and self-governance.
2. Acceptance of the proportionality concept in capital contribution, water shares, profits and risk taking
3. Implicit acceptance of the manager
4. Willingness to put all powers in the hands of the manager and the managing committee, since they are often local business managers too
5. Costly exit

The companies were unhappy with the many conditions placed on the co-operatives by the corporation (GWRDC), including:

- registration under the Gujarat Co-operative Act compulsory;
- share capital cannot be raised except by the framework stipulated by bye-laws, which means farmers contribute no more than a nominal amount;
- borrowings cannot exceed eight times the share capital;
- funds can only be invested according to the provisions of the Act;
- the manager cannot be dismissed without the approval of the corporation;
- the use of any net profit is tightly controlled under the Act;
- the reserve fund can only be invested with approval of the corporation.
- exit from the co-operative is easy and cheap.

The co-operatives on the other hand were mothered by the corporation - no capital costs, nominal lease rent and subsidised power. Indeed, the main reason for creation of the co-operatives was often to get the subsidies. There were no cases where the co-operatives sought to bring the wells under collective self-management.

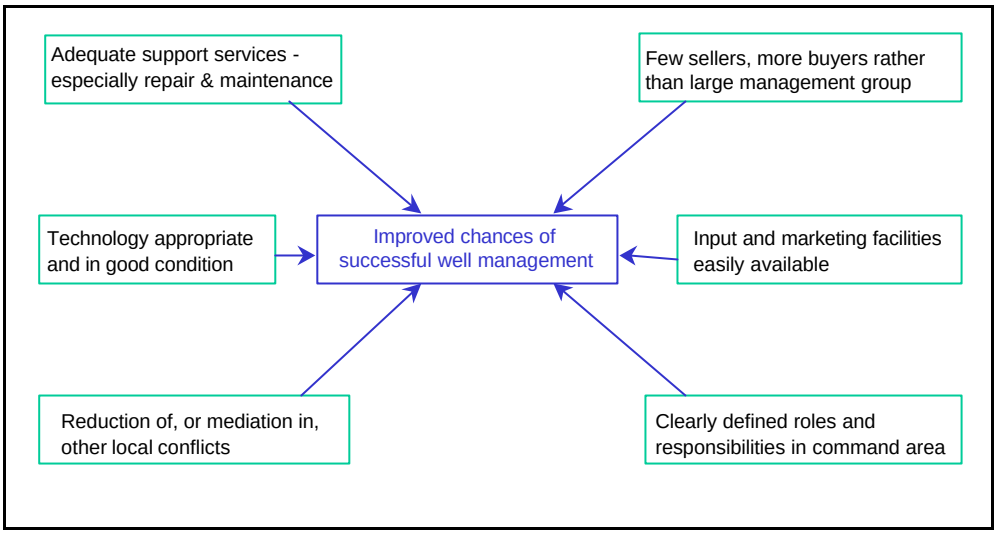
3.4 Independent well owning organisations - Bangladesh

A large majority of DTWs, and virtually all of STWs, are owned and managed as independent units in Bangladesh. They may be purely privately owned by groups or individuals, or collectively owned by co-operatives. Most of the DTWs were in government hands originally and sold either direct to the farmers or through the Bangladesh Rural Development Board (BRDB) with credit arranged with banks. DTWs can be a profitable enterprise, so long as they provide water to a sufficient number of users (who are willing to pay) and a sufficient area. The main management issues which contribute to increased chances of successful well management are summarised in Box 9.

Many of the surveyed ***DTWs still running*** were doing so because:

- the new owners had not paid their capital purchase costs (or debts had been waived).
- the equipment had been reliable with infrequent breakdown.

Box 9: Well management issues contributing to greater levels of well performance



- a small number of committed farmers had taken responsibility for managing the well and had developed what was effectively a water seller/buyer management system. This either happened at the point of transfer or at a later date. Wells were visited which had been performing badly under a large committee. With the help of BRDB smaller committees was set up to take responsibility for management and since then performance has improved considerably.
- the attitude to the well was business-like. DTWs were visited where KSS groups had paid for their well and had purchased another well, selling water to the farmers in the other command area.
- there was little competition from other wells.

The main causes of ***DTWs going out of service***, or performing badly, were:

- one breakdown too far, stretching farmers ability to pay (or collect the money) for repairs beyond their limit. The biggest complaint from farmers for these kinds of well was of a lack of support in terms of spare parts, qualified mechanics and advice.
- where the roles and responsibilities of the farmers in the command area were not clearly defined.

where there were one or more powerful groups, political or otherwise, involved in conflict due to other issues relating to their community.

3.5 North Bengal Tubewell Project - Bangladesh

Owned and managed by Central Government Agency - see Box 10.

Typical image of the North Bengal Tubewell Project area

The North Bengal Tubewell Project (NBTP) is managed by a central Government agency - the Bangladesh Water Development Board (BWDB). This project is therefore effectively a department within a much bigger organisation. The BWDB groundwater scheme around Thakurgaon in the north-west of Bangladesh, was introduced in the 1960's to develop the area, much of which was forested, mainly with bamboo. In the early 1960's nearly 400 DTWs were installed with German funding and a further 830 DTWs were installed in the mid-1980s supported by ADB, at which time the original wells and their conveyance systems were rehabilitated.

The area is remote for Bangladesh and is poorly developed, with limited power resources and far away from Bangladesh's main population centres and markets.

There are a wide variety of social groups, since the area was opened up to locals and migrants, mainly from the Mymensingh area, with the development of the wells in the early 1960's. There is also a wide disparity in the distribution of wealth with some wealthy and many very poor farmers. Power is very much in the hands of the wealthy farmers.

The project does have certain **contextual disadvantages** that have reduced the chances of success for this project:

- the development of DTW technology took place before suction mode technologies were widely used. The command areas of the project DTWs are under serious threat from competition from STWs. This is an area where STWs can function easily.
- farmers on the early well sites were used to a system of free water and the concept of payment for water has been hard to accept on the whole.
- the area is remote from large population centres, thus restricting marketing opportunities and is remote from input (fertilisers, pesticides) sources, the main centre for which is Chittagong at the other end of the country.

Structures and payment systems are detailed in Box 11.

Box 10: North Bengal Tubewell Project description

Project name:	**North Bengal Tubewell Project**
Project status:	Central Government (Bangladesh Water Development Board)
Project function:	Maintain supply of irrigation water
Project activities:	Repair and maintenance, revenue collection, dispute resolution
Project functions - women	None
Project age:	> 30 years (since the early 1960s, some new wells and rehabilitation in the early 1980s)
Project location:	Around Thakurgaon - NW Bangladesh
Physical context:	Light, sandy soils on mainly flat land. Mainly paddy and cash crops grown. Remote from main markets.
Number of wells:	1200
Type of wells:	Deep tubewells, turbine shaft-driven pumps - most of 3 cusec capacity
Project/non-project technology:	Shallow, thick aquifer - easy access for shallow tubewells and many are being installed.
Energy source:	Electricity
Distribution system:	Lined channels
Project/farmer contact:	Only through requests for assistance
No. management system(s):	***One***
Payment system(s):	***Cash paid per unit of land during or after the irrigation season. Payment to elected Committee Secretary who pays into project bank account.***
Historic changes to system(s):	Prior to early 1980s water was free. Charges introduced after rehabilitation.
Water charge:	Tk. 1560/acre (1999 boro season)
Recovery rate (average):	30% of target (target to cover electricity charge, operating costs, operators salary and minor repairs)
Penalty enforcement:	None
Farmers groups:	***Executive Committee elected by farmers, approved by BWDB. Committee Secretary records well use and collects payment.***
Project staff:	800 engineers, technicians and support staff
Project staff - women	None
Staff functions:	Support, repair and maintenance, operator training, ensure revenue collection
Staff training:	None
Staff payment source:	Central Government Revenue Budget - guaranteed whatever the level of performance
Staff incentives/penalties:	None
Operators function/training:	Operators selected and paid by Executive Committee, trained by project staff
Project monitoring:	Electricity bill and annual well income only

Box 11: Systems for management of wells under NBTP

Structure

1. Farmers organise themselves into a Water User's Association (WUA) and elect an Executive Committee. This Committee is then approved by the Superintending Engineer of BWDB.
2. An operator is selected by the Committee, trained by BWDB and paid by the WUA.
3. The Secretary of the Committee is charged with the responsibility of recording well use and collecting the money.
4. Project staff liaise with the WUAs and should ensure equipment is working well and maintained properly. Staff are paid from central Government.

Payment basis

1. Charges are based on a flat rate per unit of land payable in cash at the end of the season.
2. The charge is Tk. 1440/- per acre per year. This includes a charge of Tk. 1200/- (calculated to cover costs of electricity and project operating costs) and a 20% premium kept by the Secretary to cover operators salary, petty repairs and administration costs.
3. The money collected is paid into a bank account.
4. BWDB carry out all maintenance.

3.6 Barind Integrated Area Development Project - Bangladesh

Owned by Central Government
Managed by autonomous Regional Authority - see Box 12

Typical relief of the High Barind Tract

The project area for BIADP is 1.9 million acres (of which 1.44 million acres is cultivable land), with a total population of 5.6 million, covering 25 thanas. So far, 6,345 DTWs have been installed (3003 of which have been electrified - pers. comm., BMDA), in an area with deep aquifers where STWs cannot be used in the majority of the area. Of the 6345 wells, 850 are BADC installed wells (1300 in total were taken over but 500 were sold to individuals, groups or KSS, through BRDB - 50 have since been returned to BMDA at the request of the owners). The project started in 1985 under BADC. In 1991, under Phase II of the project, an semi-independent autonomous body, the Barind Multi-purpose Development Authority (BMDA), was created to implement the project with the authority of the the Ministry of Agriculture. A Board of Directors, headed by the Divisional Commissioner, guides the project which is managed by an Executive Director. So far, about 0.35 million acres has come under groundwater irrigation.

The Barind Tract lies in the driest area of Bangladesh and was one of the poorest parts of Bangladesh. Until the project commenced in 1985 almost all of the project area (84%) produced only one rainfed crop a year. Now two or three crops are produced in much of the Low and Middle Barind.

The Authority is responsible for not only groundwater irrigation, but for pond re-excavation, farm mechanisation, electrification, afforestation and road building. All of these functions have resulted in a marked improvement in the standard of living in the region (Ghafur et al., 1995).

On the irrigation side, the project claims to achieve collection of more than 100% of operation and maintenance costs of the wells, so that there is a large contribution to overhead costs. In 1995/6 BMDA collected a total of Tk. 102.3 million, which covered O&M costs of Tk. 60 million and almost all of the overhead costs, but not the capital costs (FAO/WB, 1997). This figure is expected to rise in 1998/99 to approximately Tk. 150 million (pers. comm., BMDA) because of the increased number of wells, the increased number of farmers (hence, command areas) and the longer hours of pumping in this dry winter/spring. Income per well can be as high as Tk. 1.41 lakh. This Government project requires almost no expenditure from the Government's revenue budget. It should be noted that the hourly irrigation rate was set at a level which was never designed to cover capital costs. Over 95% of due charges are collected and the shortfall comes mainly from the group managed system (see Box 13 below).

The project does have certain **contextual advantages** that have increased the chances of success for this project:

- this was a poor area that had never before received irrigation and the impacts were apparent immediately, so farmers in the area were keen to share in the success;
- there was no history of free water or subsidy, so the concept of paying for water was freely accepted, since there was no other system to compare it with;
- the area is largely unusable by STW technologies, particularly in the Middle and High Barind, so encroachment by these is at a minimum. However, even in areas where BMDA DTWs compete with STWs farmers would prefer to use water from BMDA wells since supply is almost guaranteed year round, larger discharges reach their land more quickly through project conveyance systems, and the cost of irrigation is often less.

Box 12: Barind Integrated Area Development Project description

Project name:	**Barind Integrated Area Development Project**
Project status:	Autonomous Regional Government Authority (Barind Multi-purpose Development Authority)
Project function:	Development Project - irrigation, pond re-excavation, farm mechanisation, afforestation, road building and electrification
Project activities:	Engineering, technical support, training, monitoring, marketing and credit
Project functions - women	None
Project age:	14 years - started 1985
Project location:	Barind area around Rajshahi, NW Bangladesh
Physical context:	Older alluvial deposits overlain with thick clay subsoil. Aquifer deep and narrow. Low Barind - flat and liable to flooding; Middle Barind - fairly flat with occasional flooding; High Barind - undulating and drought prone.
Number of wells:	6345 (850 BADC installed, the rest BMDA installed)
Type of wells:	Deep tubewells, turbine shaft-driven pumps - most of 2 cusec capacity
Project/non-project technology:	Competition from STWs in Low Barind. Middle & High Barind only DTWs
Energy source:	3003 electricity, 3342 diesel
Distribution system:	4800 lined or partial lined channels, 1540 unlined channels, 5 experimental buried pipe systems
Project/farmer contact:	Operator employed by BMDA is the point of contact, daily visits by project mechanics during the irrigation season.
No. management system(s):	***Two - departmentally managed (electric) and group managed (diesel)***
Payment system(s):	Departmentally managed - coupons purchased from project offices and used on a pay as you use basis. Group managed - lump sum cash rental annually, payable in advance.
Historic changes to system(s):	All previously on rental basis.
Water charge:	Coupon system - Tk. 75/- per hour, rental system - Tk. 12000/- per year (discounts for early payment, penalties for late payment)
Recovery rate (average):	95% of target (target is based on all O&M costs and some contribution to capital costs). >100% target for coupon system, 85% for rental system (lower because of non-payment for repairs).
Penalty enforcement:	Coupon system - no pay, no water; Rental system - no payment, no operation.
Farmers groups:	***Departmentally managed - no farmers groups, Group managed - WUAs elected by farmers.***
Project staff:	380 full time technical staff plus about 300 support staff. Contract mechanics at peak irrigation time.
Project staff - women	***Positive discrimination for all operators of electrified wells close to villages, tree nursery and watching staff, power tiller operators***
Staff functions:	Technical assistance to ensure equipment is maintained, collecting payment for Group managed wells, training of operators
Staff training:	***Thorough training in BMDA activities and philosophies.***
Staff payment source:	Currently from Central Government Revenue Budget. Will be paid from BMDA's own income from 1999.
Staff incentives/penalties:	Yes - based on performance (income from wells supported). Derived from travel allowances - additional payments for good performance, withheld for poor performance - paid back in future if performance improves.
Operators function/training:	Operators selected and paid by BMDA. Receive a licence upon completion of training. Only licensed operators employed. License renewed annually.
Project monitoring:	***For each well - no. farmers supplied, area irrigated, cropping pattern, yields, hours well used and well income.***

Training

In addition to project staff, BMDA tries to include the water users as much as possible, by recruiting operators and mechanical assistants from among the water users. These are paid by the project, based on performance, and are only employed if they have a license. This license is issued following completion of training, which is paid for by the operator/mechanical assistant (Tk.50/-), as is the licence fee (Tk.10/-). Accommodation is provided by BMDA. The license is renewed each year, and only upon successful performance in the previous year. Applicants for these posts should be educated to Class VIII but priority given to those with a SSC.

Employment of women

BMDA operates a positive discrimination policy for women operators. Women are employed on electrically powered wells (since the large diesel engines require considerable strength to start and operate) which are not too remote from villages. The Authority strongly supported the women against strong criticism from some male farmers. BMDA argued that the women kept good records and were conscientious and offered to replace any woman operator who did wrong. No women have been replaced as yet.

Information

The office staff monitor the wells and the accounts very closely and identify any problems at short notice. Information is collected, from construction through operation, and stored on a database. The main forms of information for each well include:

- during well construction - information on aquifer (depths, water levels), casing and screen specifications, testing and development, engine/motor specifications, pump specifications, testing and development;
- through coupon purchase - continuous income updates from water users;
- during well operation - for each transaction (coupon payment), time of delivery - start and finish, energy used.
- for each season and for each well - crops grown in command area and yields achieved, total hours of operation and income. All of this information is closely analysed and highlights any issues early, e.g. data for the 1999 boro season shows that water consumption by the end of March 1999 is already as great as it was by the end of June 1998 (BMDA, pers. comm.).

Box 13: Systems for management of wells under BMDA

GROUP MANAGED WELLS

Structure

1. Farmers organise themselves into a Water User's Association (WUA) and elect a working committee, comprising one group leader, one chairperson, one vice-president and an even number of members, usually four to eight.
2. The WUA request a well lease agreement from BMDA and once BMDA has verified the application then the lease is approved. This is done before the well is constructed.
3. The well is located and constructed at a high point within the command area, the land required being transferred to BMDA. Following construction, the handle and shaft are removed and kept in BMDA offices. The handle and shaft are not returned until the irrigation charge has been paid.

Payment basis

1. Charges are based on minimum command areas for different well discharges.
2. Rebates are available for early payment and fines imposed for late payment.
3. The cost of repairs and spares up to one third of the irrigation charge is borne by BMDA. Anything over that is borne by the WUA.
4. All operating costs are borne by the farmers themselves.

DEPARTMENTALLY (BMDA) MANAGED WELLS

Conditions under which wells become departmentally managed

1. Wells which are out of operation for two consecutive irrigation seasons due to factional quarrels.
2. Wells which have not fully paid there dues in the previous two years.
3. Wells with engines which have not worked for a long time due to severe damage.
4. All wells which have been out of use for a long period of time.
5. All wells which have been electrified.
6. The WUA under the group managed system request BMDA to take over the well.

Structure

1. There is no formal structure. Farmers enter into informal contracts with BMDA by paying the well operator for water on a pay-as-you-use basis. Operators are appointed by BMDA and come from local villages/farms.

Payment basis

1. Farmers pay the operator at the time they want the water. If water is needed by more than one farmer at a time, then this is prioritised by discussion, status or by informal payments to the operator.
2. Payment is the in form of a coupon and the charge is calculated on an hourly basis (see Box 10 of 'Affordability').
3. All operation and maintenance costs are borne by BMDA.
4. Details of the full process are shown in Box 12 f the 'Affordability Guidelines'.

POSITIVE FEATURES OF THE DEPARTMENTALLY OPERATED MANAGEMENT SYSTEM

1. The system includes an inherent and thorough accounting system. The three sections of the coupon act as receipts at various stages of the water payment process. Money and water is accounted for by the receipts in the following manner:

   (i) project income has to be accounted for against the coupon stub which is retained at project office;

   (ii) use of water is recorded in detail, since the middle portion of the coupon is given to the operator and the time and energy used for that transaction is recorded by the operator and set against the coupon.
2. The removal of cash from the payment process as soon as possible reduces the chances for corruption. The only time when money can be used for influence is to bribe the operator for first use if more than one farmer wants water at any one time.
3. Each farmer is independent and does not have to rely on neighbours or committees for effective water supply.
4. Since the farmer pays directly for what he uses he makes the most of the water he receives, so increasing the efficiency of the water supplied.

PROVISO

1. It should be noted that this is not a fool-proof system. It still relies on motivated project staff to deliver the goods, to ensure that the equipment is well maintained, and that the accounts are monitored closely and verified.

3.7 Grameen Krishi Foundation - Bangladesh

Owned and managed by NGO (given to NGO on understanding that would pay for them when they became profitable but not happened) - see Box 14

The Grameen Krishi Foundation (GKF) was created as a subsidiary of the Grameen Bank in 1991 and is the only private sector corporate owner and manager of DTW irrigation in either Bangladesh or Pakistan. The DTWs were acquired from BADC and BWDB in 1987/8. A down payment of Tk. 6500/- was made and if the wells were successful, then the remainder of Tk. 168,500/- was to be paid. The BWDB wells were singularly unprofitable, since farmers were unwilling to pay twice as much as they had been under BWDB (they hadn't paid much before hand over), and the wells were returned to BWDB in 1995.

Typical image of the GKF DTW area

The physical environment consists of a geology of deltaic deposits on the Teesta Fan, mostly at about 30m above sea level, with some lower lying areas at about 10m above seal level and a lithology of mainly light soils.

About 50% of the farmers are described as 'poor' or 'very poor' by GKF, with a further 30% described as being in extreme poverty. Wealthier farmers produce sugar cane (mills in the area) and tobacco. Light soils mean many vegetables are grown and GKF are trying to increase the area under alternative crops and reduce the level of paddy production. Amongst the farmers, the share of agricultural employment is split 50/50 between men and women, whilst the split for non-agricultural employment is 85% men and 15% women. The literacy rate is about 50% for men and 25% for women.

The overall objective of GKF is poverty alleviation by "helping the poor, the landless and assetless and poor women in order to enable them to gain access to resources for their productive self-employment, to encourage them to undertake income generating activities for poverty alleviation and for enhancing their quality of life".

GKF carries out many activities in the area, of which the main ones are:

- supply of irrigation water to farmers, paid for by cropshare;
- supply of inputs, seeds and marketing. Inputs are now purchased directly from manufacturers, GKF have agreements with farmers to produce seed, and GKF have contracts with farmers to produce certain crops, such as maize. GKF collect a large amount of produce from their cropshare agreements and send much to Dhaka. They have their own storage facilities and retails outlets, six in the locality and one in Dhaka;
- livestock, particularly dairy, and aquaculture;

demonstration farms to introduce new ideas and technologies to the area;

- credit disbursement;
- Women's Support Programme to include women in the development from GKF's core activities and to provide training on sanitation, hygiene, basic health and nutrition. (UNCDF, 1997).

The specific irrigation objective is the profitable management of DTWs. Their strategy for achieving this has been to:

- rationalise irrigation to wells with bigger command areas and heavier soils;
- reduce pumping costs and expand command areas through electrification (at those wells which have been electrified, the diesel engine is retained for use as emergency backup if electricity fails) and partial buried pipe systems (concrete); and
- diversify its activities (primarily inputs, livestock and credit) to spread overheads (FAO/WB, 1997)

The project has certain **contextual features** that influence the chances of success of the DTWs:

- the physical environment is important, in that some of the wells are located on very light soils and conveyance and excessive water consumption are problematic;
- this is an area where the aquifer is close to the surface, and which can be exploited by STWs relatively easily. Hence, competition from STWs has reduced profitability in some wells.

The number of DTWs operated by GKF has decreased because GKF have taken the decision to close unprofitable wells. Wells are unprofitable largely because (i) farmers resent the comparatively high price for water (particularly in seasons when the price of paddy is high), (ii) farmers are able to, and do, install their own STWs within the DTW command areas, and (iii) some command areas have very light soils and are therefore too small to be profitable.

•Box 14: Grameen Krishi Foundation description

Project name:	**Grameen Krishi Foundation**
Project status:	Non-Governmental Organisation
Project function:	Integrated agricultural development
Project activities:	Irrigation water supply, credit disbursement, inputs, livestock, demonstration farms, Women's Support Programme
Project functions - women	Women's Support Programme - hygiene, nutrition, smallholder agriculture
Project age:	First wells to Grameen Bank 1986/7, GKF set up in 1991
Project location:	Rangpur, NW Bangladesh
Physical context:	Variable but mainly light soils on flat land
Number of wells:	Originally 800 (261 returned to BWDB North West Bengal Tubewell Project) and 565 BADC wells (now about 350 operating).
Type of wells:	Deep tubewells, turbine shaft-driven pumps - most of 2 cusec capacity
Project/non-project technology:	Shallow thick aquifer - many STWs competing in the area
Energy source:	Some electrified (diesel engines retained as back up), rest diesel
Distribution system:	Lined and unlined channels, partial buried pipe systems being installed in more successful wells
Project/farmer contact:	Through Farm Manager - advisor living within the community - one Farm Manager to 1 to 2 wells
No. management system(s):	***3 main systems - one selling water and two renting wells see Box 16***
Payment system(s):	***3 main systems, two crop share and one cash***
Historic changes to system(s):	Free water prior to GKF take over
Water charge:	'Normal' system - 13 mnds(0.52 tonnes)/acre 'Handle-bhara' system - 5 mnds or Tk. 1000/acre, Group managed - Tk. 10,000/- per year for the well
Recovery rate (average):	<100% target
Penalty enforcement:	Persistent or significant non-payment results in well being closed down the following year.
Farmers groups:	Groups only required for group managed system. Other systems are personal contracts between GKF and farmer.
Project staff:	890 technical staff plus support staff
Project staff - women	***Women Farm Managers who do not live in the community. Credit delivery and Women's Support Programme***
Staff functions:	Supply of water, credit, inputs, advice, support and collection of crop share at the end of the season
Staff training:	***Intensive office and field based training upon appointment (motivational work, accounting systems, credit disbursement and recovery, agronomy, well operation, Grameen systems and philosophies).***
Staff payment source:	From GKF funds
Staff incentives/penalties:	Incentives based on profit made on wells
Operators function/training:	Operators appointed, trained and paid by GKF
Project monitoring:	Costs of water supply, no. of farmers supplied, area, cropping patterns and yield

Training

The priority for training by GKF is for the Farm Managers, since they are in the 'front line' of GKF's activities. Farm Managers are responsible for making agreements with the farmers to sell water, inputs and credit, and also collecting the payment at harvest. Selection is based upon high academic standards, with a minimum of 2nd Division HSC. Given the high unemployment rates among graduates and Grameen's high status in Bangladesh, GKF are able to recruit at a high standard. For example, a visit to the Saidpur unit revealed that of the nine Farm Managers, seven had BA degrees (including one MA) and two had HSC. Training is intensive and covers a wide variety of disciplines (see Box 15).

Box 15: Training schedule for the Farm Managers of GKF

1. Upon appointment, briefing at GKF Head Office in Rangpur	3 days duration
2. There then follows intensive field based training on:	
- motivational work, through the Crop Diversification Project;	7 days duration
- accounting systems at a farm level	10 days duration
- credit disbursement and recovery	10 days duration
3. Then training is provided on Grameen Bank's accounting system.	1 month duration
4. The Farm Managers then go to the Rural Development Academy in Bogra for training on DTW operation.	
5. On the job training follows in subjects such as agronomy.	
6. Continuous on the job training , through courses or workshops.	

Staff incentives and penalties

New staff are on probation for one year and if performance is unacceptable, then employment is terminated. Beyond that, GKF is introducing a profit-sharing scheme. The Farm Managers will receive a percentage (probably 10%) of profits made by the farm, and, secondly, all staff will receive a percentage of the profits made by GKF as a whole. For the Farm Manager, this is a significant incentive to sell GKF services and collect the revenue, e.g., one DTW farm visited, made an operating profit in 1997 of Tk. 141,000/-. This was made up of a gross income of Tk. 442,446/- and expenditure of Tk. 301,008 (including depreciation on well and buried pipe system at 5%, and Farm Manager's accommodation at 7.5%).

Employment of women

Given that Farm Managers live by themselves in the villages, GKF recruit men only for these positions. However, wherever possible, GKF will recruit women. For example, in the Saidpur region, of the 99 Farm Managers, six are women, who live locally and are responsible for credit disbursement only. Women are also employed on the Women's Support Programme.

Box 16: Systems for management of DTWs under GKF

GKF offer three types of DTW management system to the farmers, the choice of which is a matter of agreement between GKF and the farmers. These are flexible and can be changed annually, and are:

1. The **normal GKF management system**, where a full irrigation service is provided in return for a share of the crop at harvest (12-13 maunds/acre). 80% of DTWs operated under this system in 1997.

   This is the simplest arrangement and the most popular. GKF collect the crop share at harvest. Having the Farm Manager there all of the time and GKF going to collect the crop cuts down the opportunity for cheating on crop yield and crop share assessment.

2. The **'handle-bhara' management system**, where farmers rent the well on an annual basis for Tk1000/- or 5 mnds/acre and farmers supply their own fuel. 9% of DTWs operated under this system in 1997.

   Crop share is again collected by GKF. This system particularly suits GKF in command areas with lighter sandier soils. Water use is much greater and, therefore, so is fuel consumption, so if the farmers can be persuaded to supply their own fuel it cuts GKF's costs.

   In addition, this requires less intensive input from GKF and so Farm Managers are shared between wells.

3. The **group managed farms management system**, which does require the formation of a water users' group. GKF rent well to group of farmers for Tk10000/- per year. Fuel and other inputs are supplied to the farmers on credit for 20% service charge. Only about 1% of DTWs are operated under this system.

(after UNCDF, 1997)

3.8 Provincial Irrigation Department managed wells- Pakistan

Owned and managed by PIDs

The Provincial Irrigation Departments (PIDs) of Pakistan are responsible for the management of almost all of the force mode wells. This includes the SCARP wells and the 'scavenger' wells of the Left Bank Outfall Drain Project in Sindh.

Typical SCARP well

3.8.1 Project management under Provincial Irrigation Departments

The wells are spread across wide areas, mainly of Punjab and Sindh and the management organisations are Provincial Government authorities. PID staff manage the wells through Irrigation Officers, operate the wells with full-time employed operators and provide repair and maintenance through mechanics at local offices. Payment for water is evaluated through 'abiana', a per acre charge based on crop grown, evaluated and collected by Provincial Revenue Department officials.

In the case of the SCARP tubewells, water delivery is the responsibility of the PID, but collection of revenue is by the Provincial Revenue Department. This means integrated management and good information flows are almost impossible. The chief complaint of the farmers is about the unreliability of promised supply, and therefore, many have gone to the expense of installing their own wells. There is an important difference between having a reliable supply, and an adequate supply to crop all his land with, for example, rice. Reliability is more important than adequacy. If the farmer has a reliable but limited supply, he is able to plan what to plant, and how much of his land to plant.

3.8.2 Management of wells under Provincial Irrigation Departments

The farmers organise themselves in groups and operate the traditional system of 'warabandi', whereby turns for water are allocated to farmers from within the group. This is traditional practice which worked well but which has been put under increasing pressure with population growth, subsequent fragmentation of land and deterioration in the performance of the wells. In many cases the response of farmers has been to install their own private tubewells. Markets exist for the buying and selling of water shares (Strosser, 1997). Field surveys revealed dissatisfaction with the management of the wells.

3.8.3 Indicators of, and reasons for, level of performance of SCARP wells

The SCARP tubewells are subject to the same management conditions as canal irrigation, supplying large areas and numbers of farmers. Many SCARP wells have gone out of action, are operating at reduced discharge, or being under-utilised. Income to the Provincial Revenue Department is low and the O&M of the SCARP wells is a high burden on the Provincial Governments. The main reasons for this, from the point of view of the farmers, are:

- lack of support from PID staff. At none of the wells visited was an operator present, nor did any of the farmers know where the operator was. If equipment broke down it took a very long time for mechanics to respond. If transformers were stolen, the battle to have it replaced was often too great and wells went out of action as result.
- additional charges for support. Money for O&M is meant to cover repair and maintenance of equipment, but invariably, to get anything done requires large unofficial payments.
- disputes among farmers as the system is put under ever greater pressure.

The farmers have responded in many cases by taking matters into their own hands:

- by installing their own private tubewells to take away the need for reliance upon the PID or influence of other farmers;
- by-passing the PID and going to the private sector for repair and maintenance. The farmers said it was more efficient, in terms of time, and was less costly in many cases.

- by making payments to irrigation officials for illegal connections to the surface water system.

The main factors preventing greater success in performance under the PIDs are:

- a cumbersome payment system, that gives scope for under-assessment and payment of 'abiana';
- no connection between payment for water and water received;
- a workforce that is: (i) not closely supervised (for whatever reason, be it geographical or management) and not provided with incentives for good performance, leaving plenty of scope for unofficial practices; and which (ii) has guaranteed employment whatever the level of performance, with no penalties for poor results.

3.9 Punjab Private Sector Groundwater Development Project - Pakistan

Fixed term project transferring ownership of wells from Government to farmers - see Box 17

As a consequence of the large drain on the budgets of Provincial Governments, of O&M costs for SCARP wells, SCARP wells are now being transferred to the farmers. This was started under STPP and SSTP, and is now being carried on through the Punjab Private Sector Groundwater Development Project (PPSGDP) which started in 1997.

In addition to the hand over of wells, PPSGDP is charged with helping to redefine the government's role in groundwater irrigation and developing a monitoring programme and regulatory framework to improve the sustainability of groundwater resources.

Staffing

Each team has Social Organisers (paid by the project, with employment terminating at the end of the project) to assist the farmers in setting up Watercourse Associations (WAs) and Community Tubewell Groups (CTGs). Technical Co-ordinators are present to assist farmers in tubewell planning and budgeting decisions and to make recommendations regarding costs and options for tubewell installations. Some of the Social Organisers have been trained to become Trainer Social Organisers, and these provide training for the elected office holders of the WAs and CTGs at training centres. The training covers office-holders' duties, operation and maintenance of the wells and maintaining records. After-Care Organisers provide assistance following transfer, not only in

Box 17: Punjab Private Sector Groundwater Development Project description

Project name:	**Punjab Private Sector Groundwater Development Project**
Project status:	Directed by Provincial Government (Planning and Development Department) with two agencies, one private (Punjab Groundwater Consultants, PGC) and one Government (On-Farm Water Management, OFWM), implementing
Project function:	Transfer Salinity Control and Reclamation Project (SCARP) - drainage and irrigation - wells from Government to farmers
Project activities:	***Organise farmers into Community Tubewell Groups to take over responsibility for wells, provide after care service***
Project functions - women	None
Project age:	2 years (1997). Follows on from SCARP Transition Pilot Project (STPP - started 1986) and Second SCARP Transition Project (SSTP - started 1994)
Project location:	Central and Southern Punjab, Pakistan
Physical context:	Flat land with light, relatively fertile, alluvial soils
Number of wells:	***Target is approx. 4150 to be transferred (approx. 2800 by PGC and approx. 1350 by OFWM)***
Type of wells:	Deep tubewells, turbine shaft-driven pumps of 3-5 cusec capacity
Project/non-project technology:	Most in areas with shallow aquifers (since SCARPs primary aim is for drainage7) and much competition from private shallow tubewells
Energy source:	Electricity
Distribution system:	Mostly into surface irrigation network - lined channels
Project/farmer contact:	Through Social Organisers (SOs) and After-Care Organisers (ACOs). Approx. 20 visits between SO and farmers before transfer
No. management system(s):	Three transfer options available. 1. take over existing SCARP well 2. take over same well but replacing force mode pump with new suction mode pump and prime mover 3. replace existing SCARP well with new Community Tubewell with suction mode pump
Payment system(s):	Community Tubewell Group collect money and deposit it in discrete bank account prior to transfer of well
Historic changes to system(s):	STPP and first half of SSTP transferred (sold) to individuals. Now to groups
Water charge:	1. Taking over SCARP well - Pk. Rs. 10.,000/- 2. Same well, new pump/ prime mover - Rs.10.,000/- (Rs.20,000/- subsidy) 2. New well, pump and prime mover - Rs.10.,000/- (Rs.30,000/- subsidy) For wells which have been transferred, charge is usually about Rs.5/- per hour
Recovery rate (average):	100% for all wells transferred - wells not transferred unless paid up
Penalty enforcement:	No transfer
Farmers groups:	***Community Tubewell Group, elected by farmers (Chairman, Secretary and Treasurer, and Water Manager), trained by Project***
Project staff:	Approx. 150
Project staff - women	None
Staff functions:	***Organising farmers and providing advice during and after transfer***
Staff training:	Intensive training in social organising of farmers
Staff payment source:	From project funds
Staff incentives/penalties:	None
Operators function/training:	Community Tubewell Group office-holders trained by project in well operation and maintenance.
Project monitoring:	Independent monitoring of project by Project Impact Evaluation Survey team

management of the well, but in group marketing activities, collective procurement of inputs and equipment, new agricultural practices, farmer to farmer visits and liaison with outside agencies.

Targets

There are a large number of wells to be transferred and, therefore, a system of targets for each Social Organiser is in place to ensure that the pace of transfer is maintained. These targets are 2.5 Community Tubewells per month per Social Organiser. These are strenuous, given that it takes between 12 and 25 visits to complete CTG formation and well construction. No system of incentives or penalties is in place.

Management of wells

The transferred wells are managed by the farmers themselves through an elected CTG, consisting of a Chairman, a Secretary and Treasurer and a Water Manager. These office-holders receive training on running the well and the CTG and support from After-Care Organisers.

With the assistance of the Social Organiser, the group decides on a schedule for well use and a system for collection of funds to cover O&M costs. There is no hard and fast rule for how these issues should be decided. Field visits showed that most CTGs had a set rotation system of irrigation, similar to the principle of 'warabandi', and that payment systems were varied. In all cases, the irrigators provided their own fuel, some had an additional hourly charge (usually Rs. 5/-) and some a 'pay as required' system for repairs.

3.10 PATA Project - Pakistan

Government project building new DTWs part-financed and wholly managed by farmers - see Box 18.

As a result of the Project, a thorough set of guidelines have been produced, called the 'Participatory Irrigation Scheme Development Guide Book' (PATA, 1996). The guidelines presented an eighteen step process for scheme development. See 'Guidelines Publications' in the References'

The PATA Project is an Integrated Agricultural Development Project in the NWFP of Pakistan. Groundwater irrigation development formed part of the Land and Water Use Programme which was responsible for installing 150 groundwater irrigation schemes (command areas). The PATA Project was concerned with the development of groundwater irrigation in a 'barani' (rainfed) area and the subsequent change in cropping patterns. This project involved two Government Departments working together. These were the OFWM Directorate of the Agriculture Ministry and the Department of Agriculture Extension, with the assistance of the Dutch Government.

One of the main features of interest, was that the management structure of a Government Department was modified, and additional staff recruited, to suit the

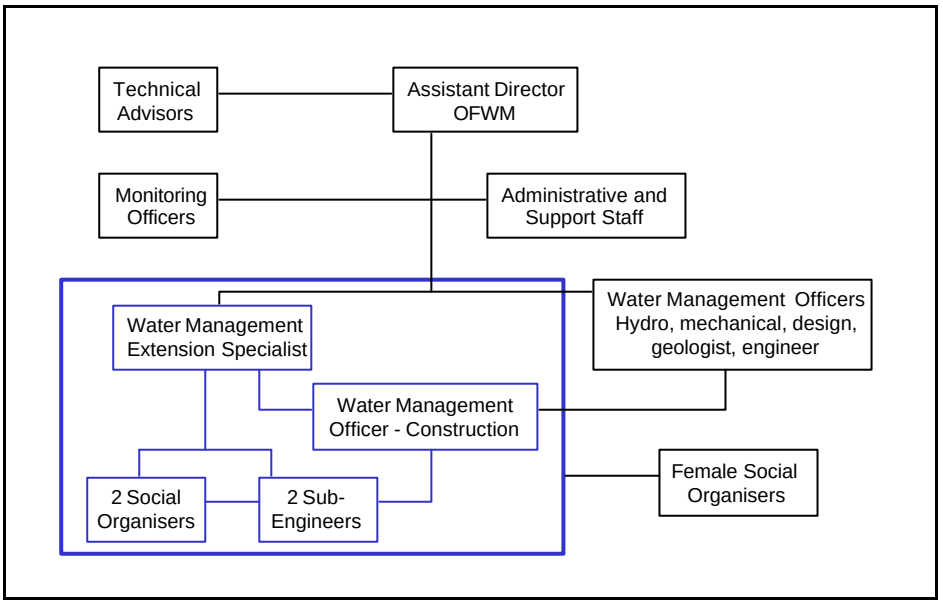
Box 18: PATA Project description

Project name:	**PATA (Provincially Administered Tribal Areas) Project - Land and Water Use Project (LWUP).** (There is also an Agricultural Development Project, ADP)
Project status:	Development Project - Government and Foreign Technical Assistance
Project function:	Development of new groundwater irrigation sources
Project activities:	Installation of wells, irrigated agriculture development (extension), soil conservation, women development
Project functions - women	Women in Development Project (WIDP)
Project age:	13 years (started 1986)
Project location:	Buner, Malakand, Swat in NWFP, Pakistan
Physical context:	Light soils in undulating river valley floor. Rainfed area. Mainly food crops - trying to develop cash crops.
Number of wells:	150 wells planned by end of project
Type of wells:	Mainly deep tubewells, turbine shaft-driven pumps of 1.5-3 cusec capacity
Project/non-project technology:	Deep aquifer. Little scope for STW development in much of the area.
Energy source:	Diesel
Distribution system:	Lined channels
Project/farmer contact:	*Social organisers (working together with engineers)*
No. management system(s):	*Flexible - developed by farmers with help of project*
Payment system(s):	10% of capital cost in cash prior to construction. Upon completion, small cash charge at start of season to cover repairs and maintenance. Small hourly charge for fuel during the irrigation season.
Historic changes to system(s):	None
Water charge:	Capital cost approx. Rs. 4,000/- per acre. Running costs vary - determined by each group.
Recovery rate (average):	No data
Penalty enforcement:	No penalties - just committee and farmer pressure
Farmers groups:	Water User Groups (WUGs) elected by farmers
Project staff:	60 (24 professional and 34 support staff)
Project staff - women	2 female social organisers under LWUP (7 staff in total for LWUP, ADP and WIDP)
Staff functions:	Social organising of groups to take on wells; engineering and technical support; and agricultural extension
Staff training:	All professional staff degree or above, trained in extension, construction and management
Staff payment source:	From Project (if specially recruited) or from Government
Staff incentives/penalties:	None
Operators function/training:	*WUGs trained in scheme management (rules & regulations, pump operation and maintenance, money collection and book-keeping).*
Project monitoring:	Six monthly - water availability & distribution; equipment and infrastructure operation, repair and maintenance; organisation and finances.

requirements of a particular circumstance. This project required more intensive farmer participation than normal, and also the close working together of engineers and water management extension staff. The permanent presence of extension staff in the field was also a priority. The number of water management extension staff was insufficient to cope with the additional work from this scheme and so each extension officer was given two social organisers. The core field team comprised a water management extension officer (field team leader), a water management construction officer, two social organisers and two sub-engineers.

The DAE structure was a simple line of command from the Deputy Director, through Extra Assistant Director and Agricultural Officer to Field Assistant. The areas for each OFMW field team were designed to match with the areas of the Extra Assistant Directors. The organogram in Box 19 shows the project structure.

Box 19: Organisation structure of OFWM field teams - PATA Project



Process of installation

The process prior to ownership is just as important as during operation and management. Pertinent features of the process are summarised briefly in Box 20. The process involves the Assistant Director of OFWM, the Water Management Extension Specialist, the Social Organiser and the Female Social Organiser.

Project/farmer contact

The project staff work with the farmers on a variety of management issues through Equipment Management Meetings (EMMs), Scheme Management Planning (SMP) and Women's Scheme Management Planning (WSMP).

Box 20: Process prior to hand-over of wells to farmers - PATA Project

1. Following site selection (based on physical and social criteria), the roles of the members of the farmers group are clearly defined and elections carried out.
2. Design of the scheme is discussed and agreed within the farmers' group. Parallel meetings held with men and women. Women and men's meetings are informed of results of other meetings, through planning, design and construction.
3. An agreement is signed between farmers group and OFWM. Agreement sets out the rights and obligations of each party. A bank account is opened.
4. A construction committee is elected to oversee the well and conveyance system construction, to sign the quality control form, and to sign the well testing report.

(after PATA, 1998)

Equipment Management Meetings

Technical issues solved on a problem solving basis

EMMs tackle technical issues on a problem solving basis. For a variety of potential technical faults, the farmers are asked and then advised, if necessary, what is wrong and how they would solve the problem. Diagrams, photos and drawings are used to illustrate different problems. Technical tasks to prevent breakdown are introduced and responsibilities for those tasks assigned. The tasks of the operator, who comes from within the farmers' group, are identified and criteria for operator selection established between extension staff and the farmers. Based on this the farmers appoint an operator. The farmers establish their own rules for payment for O&M and book-keeping arrangements are agreed.

Scheme Management Planning

The formulation of rules for scheme management is seen as crucial by the project, both for practical and relevant management, and for developing relations between the farmers. Rules have to be agreed by consensus between the farmers and not imposed by a dominant landowner. SMP is a process (see Box 21) which is thorough and practical. Rules are developed for irrigation periods and rotations and for modifications to these as circumstances require.

Box 21: Scheme Management Planning process under PATA Project

1. Problem formulation
2. Walk around the scheme
3. Categorise the problems (technical, financial, social/ organisational)
4. Check for missing problems
5. Formulation of solutions
6. Agreement on each solution
7. Reformulation of solution to problem if necessary
8. Agreement on the set of rules

(after PATA, 1996)

Womens' Scheme Management Planning

WSMP informs the women of the decisions taken during the men's SMP and discusses the maintenance of the washing place (as part of well design, the women decided in most cases they wanted a clean place where they could carry out washing using the well's water). The women comment on the Internal Agreement created by the SMP, discuss problems and solutions regarding the washing place, and establish a set of rules for the management of the washing place.

Operator training and book-keeping

Upon appointment, the operator is provided with technical training for the engine/motor and pump and with book-keeping training. The Farmers Committee is also trained in book-keeping. Book-keeping training is carried out through learning and doing. Book-keeping takes a variety of forms under the PATA Project. Four books have been developed and are summarised in Box 22.

Box 22: PATA Project's accounting books described

Book	Content
Running costs book	Pumping hours and cost (farmer and operator sign, Farmers Committee check)
	Operating costs - fuel, etc. (operator and Treasurer sign, Farmers Committee check)
Maintenance cash book	Payments from the farmers to the Maintenance or Emergency Funds (Treasurer signs, Farmers' Committee check)
	Expenditure on repairs (Treasurer signs, Farmers' Committee check)
Warabandi overview	For fixing the irrigation sequence, maximum time per farmer per turn and the cost
Maintenance overview	Summary of hours irrigated and maintenance carried out

3.11 Project evaluation

The projects are evaluated against set criteria in Box 23 and the lessons learned are presented in the 'management Guidelines' below.

3.7 Project Evaluation

Project name	NBTP	BIADP	GKF	PPSGDP	PATA
Appropriateness of technology	Area suitable for STWs and therefore much competition. Restricts command areas and potential income. Only energy source is electricity - in an area with many power shortages this creates major supply problems.	Only realistic technology for this deep thin aquifer. Modified well designs to increase discharge.	Area suitable for STWs and therefore much competition. Restricts command areas and potential income. Energy source is mainly diesel (electricity replaced some diesel engines - keep diesel as back-up).	Smaller discharge CTWs replacing the large discharge SCARP wells at point of transfer. More appropriate for farmer management. In some areas it reduces the vertical drainage capacity and threatens an increased risk of water-logging.	Only DTWs can be used in this area. However, technology capital costs very high - need production of high value crops. Farmers' willingness, capacity and capability to do this not included in the needs assessment. Many have not moved to cash crops.
Provision of repair and maintenance facility	Repair and maintenance a long and often costly process. Not given priority.	Absolute priority given to maintenance and emergency repair. 1 mechanic for 25 wells - each well visited every couple of days. No water supply, no payment from farmers under coupon system.	Repair and maintenance a priority - by project staff.	Responsibility of the farmers themselves through use of the private sector. Many misteries to repair pumpsets.	Provision lies within the local private sector. Technology imported.
Organisation of water delivery	Water delivery organised by groups themselves through Water Users Committee. No guarantee of water rights - depends on decisions of the Committee with little or no recourse to outside agency for help.	Informal and flexible. Individual arrangement between farmer and authority. If water wanted by more than one farmer at any time, then some unofficial payment to the operator may influence the order in which farmers receive water. Water rights determined by value of coupon purchased and presented to the operator.	Water delivery informal and flexible. GKF Farm Manager lives on site to oversee and help resolve any disputes.	Entirely in the hands of the CTW group.	The decision of the farmers themselves through the WUGs. The project helped considerably in guiding the farmers as they developed their own rules & regulations.

Financial management	NBTP	BIADP	GKF	PPSGDP	PATA
O & M	Not covered by income, not even the minimum required (only 30% of the electricity bill covered).	All O & M costs covered by project income	Mostly covered - by income from water supply, plus income from input supply and credit disbursement.	Farmer's own responsibility. No project costs	Farmer's own responsibility - no payment for, or provision of O & M by project.
Overheads	Not covered	Nearly all overheads covered by project income	Mostly covered - by income from water supply, plus income from input supply and credit disbursement.	Not covered - project funds (international/national funding).	Paid direct by Government or Project.
Capital replacement	Not covered	Well depreciation costs included in hourly water charge	Not covered - wells not paid for in the first place - handed over by BADC	Farmers pay some of the new capital costs but much of it subsidy through project funds.	Not covered. Farmers pay 10% of initial cost of capital - rest is effectively subsidy.
Other rural development	Not carried out by project. Other Government rural development support comes from DAE and DPHE, not paid from this project.	No contribution to other rural development except staff salaries for drinking water, afforestation and pond re-excavation projects.	Mostly covered - by income from water supply, plus income from input supply and credit disbursement.	After-Care Organisers help farmers to link with outside agencies for irrigated agriculture and related subjects. No payment or, hence, income.	Three projects running in tandem (LWUP, ADP and WIDP) all financed by Government or Project - no charge to farmers.
Cost reduction	No staff relocated or relieved of duties to cut costs or for disciplinary reasons.	Staff recruited as needed since project inception. Half the mechanics are contract staff used as needed	Staff recruited as required.	Staff recruited as required.	Additional staff (to those of AED and OFWM) recruited as required.
Clarity and accountability	Little accountability. Committee Secretary collects money from farmers and is meant to pay it into a bank account. No receipt for farmers and no enforcement of payment or penalties for non-payment by project.	Coupon system is a simple system for farmers and provides accountability at several	Contracts directly between GKF and farmers, payment (crop share) collected by GKF.	One off payment in the bank.	One off capital payment. Farmers develop their own payment and accounting systems - clear and accountable through written records.
Payment enforcement	None	Water only supplied upon payment - 'pay-as-you-use'	Threats of legal action. Well closure if payments not sufficient.	No transfer until the money has been paid into the bank.	Capital cost payment before construction. O & M down to social pressure.

	NBTP	BIADP	GKF	PPSGDP	PATA
Staff management	Salaries paid from Central Government Revenue Budget - paid whatever the level of performance. No incentive or penalty schemes.	Staff salaries are soon to be covered by project income so increasing incentives to provide quality service. Further staff financial incentives and penalties are based on % of target income and are paid or taken off travel allowances. Penalties are held and are recoverable by improved performance.	Salaries paid from project income (some from international funding). Incentives based on well operating profits.	Staff employed for Social Organising to take over wells and for After-Care, nothing else. Staff paid by the project - on contract and no incentives.	Staff used in the development of the project and to some extent in continuing support through Government advisory agencies (AED and OFWM). No incentives. Salaries paid either by Government or by project funding if recruited for the project only.
Effectiveness of system	Wells run when electricity allows so most farmers receive some water. Most farmers dissatisfied and project income is low.	Highly effective in terms of farmer satisfaction, staff morale and cost recovery	Given competition from STWs, system is effective. Farmers almost guaranteed water and payment is supervised by GKF. The crop share system and levels are such that irrigation water is expensive and where the farmers can get cheaper water from elsewhere they do. Only wells profitable to GKF stay open. The numbers are declining fast (350 now, 565 operating ten years ago).	Highly effective in terms of numbers of wells transferred from Government to farmers. No long term support beyond transfer. Too early to comment on implications of this. Farmers appear keen to take over wells and pay their contribution willingly.	Effective irrigation water supply. Income not yet increased enormously due to lack of movement towards higher value crops.
Additional benefits		Related projects on drinking water supply, afforestation, fine rice cultivation, road building for market access	Many from related activities - inputs, credit, demonstration farms, Women's Support Programme	None	Three projects cover more than just irrigation water supply - agricultural extension, soil conservation and Women in Development

4. MANAGEMENT GUIDELINES

4.1 Introduction

The evaluation of the management of schemes and individual wells in the public and private sector, and in wells which are being transferred, shows that there are certain features which can lead to improvements in groundwater irrigation performance. These project and well management features will be summarised in general terms and their contribution to individual management challenges will be proposed in the guidelines. However, there are features in the background and context of projects and wells that influences their management success in the public or private sector, or in transfer of management.

4.2 Background and context influences on successful management

Some of the backgrounds and contexts of the wells looked at in the literature and by field survey seem to have a considerable impact in the success of well management. This is useful information for the transfer of management and has been summarised in Box 24.

Considering and reconciling the influences shown in Box 24 is important when considering options for management transfer. For example, much has been spoken about the restrictions on transfer associated with dependency upon Government. However, dependency may in itself not be a bad thing if the well is being transferred to a less centrally managed agency. It is a hindrance upon management change if the history is one of financial dependency and the water users are being asked to contribute where they didn't before. If it is a dependency upon a service for which the water users are prepared to pay then it may be an aid to transfer, since the water users may not look elsewhere for their water.

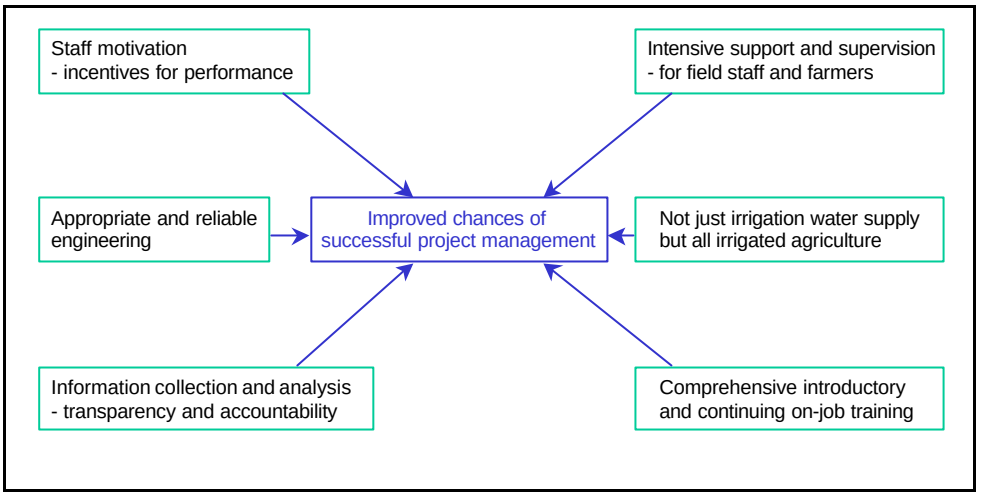
4.3 Project management structures and components - guidelines

For projects concerned with several hundred wells or more, there are certain management features which have either tackled some of the issues listed above or which have contributed to improvements in groundwater irrigation management. The guidelines relating to general features of management are shown below. The general features include motivation, support/supervision, transparency and accountability, thorough training, engineering, and related management/development (Box 25).

Box 24: Influence of background and context on project and well management

Feature	Aid to management	Hindrance to management
History, (including existing management)	1. Where ***no previous irrigation*** farmers are more prepared to accept responsibility and to pay when see benefits. 2. Where ***no previous subsidies*** or services for irrigation provided free of charge, these are not expected so much. 3. A. Where ***migration*** occurs it can create unity amongst immigrants who use wells and these wells may easier to change. B. In areas where family members have ***gone away to work*** in large numbers, they often return with more money, new management ideas and technologies and create a more receptive audience.	1. Where there ***is a history of irrigation*** farmers tend to be more set in their ways, whatever the existing mode of management. 2. Where there has been a ***history of financial dependency***, then changes in financial management are often resisted. 3. ***Migration*** may interfere with local irrigation markets in cases where the indigenous population have one practice (e.g. free use of well to friends and neighbours) and the immigrants have new practices (e.g. selling of water to neighbours).
Culture	Certain areas in most countries are known for their own personalities, strengths and weaknesses. 1. Strong areas when considering management transfer are those known for: - ***progressive farming*** (often close to centres of agricultural/development training); - ***innovative irrigation equipment manufacture*** leading to innovative thinking in irrigated agriculture; - ***self-supporting communities***; - areas with ***lower levels of social conflict***. - ***good levels of literacy/numeracy*** 2. Close to markets (where volume of, and changes in, demand are quickly responded to) - benefits of irrigation greater. Areas with strong entrepreneurial spirit can be either an aid or a hindrance, depending on the type of transfer. 3. ***Independent entrepreneurs may make good single owner/managers***; 4. ***Collective entrepreneurs (businesses) may make good transferees.*** The influence of the relative status of water buyers and sellers where selling is in private hands is important. 5. Placing management responsibility or ownership in the hands of the wealthier is not necessarily bad - educated, ensure cost recovery, influence with outside agents.	1. Weaker areas when considering management transfer are those known for: - ***traditional cautious farming*** with few changes made in any sector of agriculture; - ***no manufacturing of irrigation equipment***, often leading to shortage of spare parts, lack of choice and lack of creative thinking in irrigation in the area; - ***communities heavily reliant*** on outside assistance ***financially***; - areas with a ***lack of cohesion*** and a history of conflict. 2. Remote from markets restricting the incentives for new or improved cropping and benefits of irrigation are more marginal. 3. ***Independent entrepreneurs may disrupt joint ownership programmes*** 5. Where there are wealthier/higher status water buyers then often refuse to pay poorer or lower status sellers.
Physical environment	1. Where aquifers allow only more expensive wells e.g. deep, thin. Fewer alternatives to managed well. Increases cohesion; 2. Close to markets - reducing transport costs.	1. Easily accessible aquifers can often cause problems in well management where competition erodes command areas. 2. Remote from market - higher transport costs.

Box 25: Project management issues contributing to greater success in irrigation management in any sector



Each well being transferred or facing a change in management has its own unique set of circumstances and a key component of any successful management system is flexibility. Flexibility should be either be (i) inherent within the management system (e.g. through individual contracts between seller and individual buyers as with BMDA) or (ii) be present in dealings with individual wells (is in the PATA Project where rules and regulations are determined by the farmers themselves, with project support). A fixed set of rules and conditions for all wells being transferred may work for some wells, but is unlikely to work for all.

Indications of good practice are given in the 'Guidelines' on:

- Staff motivation through financial reward and penalty
- Staff/farmer supervision and support
- Transparency and accountability
- Training
- Engineering
- Related management and development

4.4 Well management - guidelines

For wells that are in the private sector, owned by a group, the structure of management is pretty much the same across the continent. Someone needs to be in charge since the well will not take care of itself and this someone is either the owner, a self-appointed manager or an elected manager, with or without a self-appointed or elected committee. It is usually better if the person in charge is from a wealthier background with a higher level of education and more confidence and

authority to deal with outside agencies. It is also usually better if the well is run when seen as a commercial enterprise and there is a clear seller/buyer system in place. So long as the scope for extortion is restricted, the market created by this system can usually assist in effective use, i.e. if the price is too high or supply is not reliable farmers will not pay and will look for other sources of water or reject irrigated agriculture.

The latest groundwater development project in Pakistan, the PATA Project has tried to address the problem of conflict by carrying out rapid rural appraisals of beneficiary groups, prior to development, and rejecting potential sites where (i) there is a history of conflict in other areas of the community, (ii) there is a dominant individual or clan, and (iii) there is not sufficient interest in the project.

5. GUIDELINES FOR MANAGEMENT TRANSFER

The transfer of groundwater irrigation has often been carried out for 'negative' reasons, i.e. for the Government to release itself from the heavy financial burden of O&M and support services for wells. The transfer has not been demand led, it is not something that the farmers either requested or necessarily wanted, it was forced upon them. In this situation, it is not surprising that in many cases the attitude of farmers has been unenthusiastic and uncommitted. As in any society, there are those who are dynamic and/or commercially minded, looking for opportunities for improvement or financial gain in all they do, and there are those who lack drive and/or initiative and depend upon others for guidance or support. In the culture of Bangladesh and Pakistan there is also a long history of clan and political loyalties which can and often do lead to conflict in all areas of society. When dealing with large technologies with the need for a large number of people to pay for it, these factors can, and often do, play a significant role in the management of the technology.

To increase the chances of successful and sustainable transfer:

- as with many new projects introducing new technology, farmers should first be made aware of proposals and be consulted. Given that they will be managing the wells post-transfer, it would be useful either to know how they would like it to be done (if at all), or, if they don't know, to propose measures and note their response.
- transfer is more often than not occurring because the wells are not profitable. The reasons for this need to be clear, not just as a whole, but for individual wells. It could be because of failings in the

management system, the revenue collection system (and leakage within it), or that the technology is not appropriate. Knowing this will assist in decisions taken as to what will be transferred and how it will be transferred. With the benefit of hindsight, the transfer of many of the DTWs in Bangladesh was the transfer of a technology that was not suitable for farmer management in many situations (although in other situations it was appropriate).

- the transfer needs to be demand led as much as possible. This demand may be present already or it needs to be generated through information and persuasion. Where demand cannot be generated then maybe the option is closure or use of a different technology.
- any transfer project should be flexible, recognising that whilst the technology may be uniform in design, the contexts in which it is
- operating are extremely varied. Options should be given to the transferees as to the way they want to proceed.
- transfer should not be a one-off action. The wells have received support in the past (be it of variable quality) whether through conflict resolution, technical assistance or financial assistance. For many groups, taking on the management of the technology is a new and problematic experience. Intensive training can overcome many of the problems, but practical support and advice is often required, whether it is ensuring that spare parts are available or technical assistance is provided on demand. These would not be free services but they need to be present, whether through the public or private sector.
- many of the transfer projects have been and continue to be large scale, involving the transfer of hundreds or thousands of wells in a short period of time. This places enormous pressure on the staff and the system of those agencies carrying out the transfer and reduces efficiency and attention to the needs of the transferees. Despite this, in terms of numbers of wells transferred many projects have been, and are extremely successful. However, it should be recognised that these are major and long term changes it is surely right to make sure that it achieves sustainable development in the future rather than an immediate reduction in public sector financial commitments.