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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

Principal author: David Sutherland [dcsutherland@wsatkins.co.uk]
Project manager: Peter Howsam [p.howsam@cranfield.ac.uk]

REFERENCE MANUAL
AFFORDABILITY

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

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REFERENCE MANUAL - AFFORDABILITY

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1. INTRODUCTION

When considering the economics of groundwater irrigation it is important first to identify the main interested parties. There are three main interested parties:

- the farmer or water user
- the well owner or operator, and

The first two parties essentially use the equipment to make a profit and are chiefly interested in financial returns. The two parties may be the same people or groups of people, or different people or institutions, each with their own interests. These parties must be rewarded for the extra work and/or capital investment which irrigation incurs by a better income than they would achieve without it. However, small farmers may not be profit maximisers. They may be willing to take a smaller profit than the maximum if this reduces risk. One could say they pursue a min-max strategy, maximum profit combined with minimum risk. One of the chief attractions of irrigation to farmers is that it reduces climatic risk.

While irrigation reduces (although it may not totally eliminate) climatic risk, it may in certain circumstances have its own risks. Particularly in the case of groundwater pumped systems, there is the risk of interruption to pumping through breakdowns in the supply of either fuel or spare parts. This immediately highlights the importance of security in these systems, and the premium that farmers may be willing to pay for it.

With government, things are a bit different. It may be most concerned with economic returns. It may decide that a policy objective, such as food security, is so important that it is willing to provide subsidies in order to induce certain behaviour. The problem there is that subsidies can eventually run away with money that might be better used in other ways (as shown by the Common Agriculture Policy in Europe). However, this is a bigger problem with less well off countries) but they can also send distorted signals to the farmer about appropriate choices, e.g. on electricity pricing.

As the ownership and management of groundwater irrigation moves from more public to more private agencies, the profitability of tubewells and private sector financial support for groundwater become increasingly important. There are many cases throughout South-East Asia where public groundwater irrigation has either

been heavily formally subsidised or where cost recovery has been very poor, indirect subsidy being the result. Indeed, in many instances this is still the case for many government run groundwater irrigation projects (with a few notable exceptions). After transfer of groundwater irrigation to a more private sector based agency, be it a corporation or the farmers themselves, this subsidy or financial support is usually lost (although there may be some subsidy in the transfer price), and wells will only operate if they are profitable or, at the very least, cost effective. Bangladesh in particular, and Pakistan, provide many examples of wells which have closed down soon after transfer to the private sector because they were not cost-effective.

These guidelines will provide examples of good practice relating to: general tubewell economics; irrigated agriculture in the small-scale private sector (farmers - individuals/groups); irrigated agriculture in the corporate sector (government or private agency); economic factors at the point of transfer from one sector to another; and economic risk management.

2. GENERAL TUBEWELL ECONOMICS

This section looks at the costs and benefits of groundwater irrigated agriculture, and ways in which changes can be made to the operation and management of groundwater irrigation to improve its profitability and fuel and water efficiencies.

Capital outlay is often the biggest problem for poorer farmers and the lower this can be kept the better.

Suction mode technologies are in plentiful supply and there is often a degree of choice for the farmers. Field surveys indicate that the most popular reason given for the farmer's choice of technology is the fact that it is the cheapest. This is despite, when asked which technology they would prefer, indicating a preference for higher quality more expensive pumps and engines. Capital outlay is often the biggest problem for poorer farmers and the lower this can be kept the better, despite the fact that in the long run a more expensive, but more fuel and water efficient, pumpsets will often result in overall cost savings. These guidelines look at the trade off between capital and recurrent costs, particularly in environments which are changing rapidly (such as falling static water levels), and provide suggestions on how the public and private sector can provide support to potential purchasers.

Force mode technologies are more expensive and in many cases less readily available. Given that this is a larger investment many potential investors give

greater consideration to pump/engine/motor performance, reliability, repair facilities and spare parts.

In Bangladesh, whilst only 57% of the 4.5 million ha available for groundwater irrigation is irrigated now, nearly all of the 2 million ha available for STWs is irrigated (NMIDP, 1997). Whilst deep setting of wells accounts for 0.9 million ha more, future development will require the use of deeper set wells and force mode technologies.

In many cases a change in groundwater conditions may require an upgrade in standard of technology or a change in technology, say from suction to force mode. In Bangladesh, for example, whilst only 57% of the 4.5 million hectares potentially available for groundwater irrigation is presently irrigated, nearly all of the 2 million hectares available under STWs is already irrigated (NMIDP, 1997). Whilst deep setting of wells will account for a further 0.9 million hectares, future development will require the use of deeper set wells and force mode technologies.

2.1 Tubewell costs - constant groundwater levels

When considering the transfer of groundwater irrigation from the public to the private sector, the main issue in terms of tubewell is the subsequent operating costs of the technology. The issue of capital costs and economics at the point of transfer is discussed separately in section 5 below. This section will concentrate upon operating costs, especially energy costs, the ways in which operating costs can be minimised and ways in which support for privatised groundwater irrigation can contribute to reducing costs of irrigation.

There are two main issues relating to operating costs - energy source and savings in the use of energy. Other variable costs, such as operators/linemen salaries, spare parts and inputs for irrigated agriculture are usually dependent upon market conditions or forces and, as such not so easily influenced by the farmers.

The first major decision regarding operating costs is that of energy source. The capital costs of electrically powered equipment and diesel powered equipment may not differ by much on the whole but energy consumption and unit costs of energy is often less for electricity. This is often dependent upon macro-economic issues such as government pricing/taxing/subsidy policies, and more efficient motors.

Diesel is usually purchased in the market place and the farmers pay the market price, the amount paid depending on the amount used. Electricity is usually subsidised and is less costly than diesel but, in addition, in many situations in the sub-continent, electricity is paid for at a flat rate (either per pumping device or per unit of horse power). For example, in a survey of pump owners in North Bihar, Shah (1995), found that those using electric motors were paying the same amount per year whether they were irrigating for 200 or 500 hours, leading to a large wastage of electricity.

Many farmers entering or already in the business of groundwater irrigation are

Where farmers can exercise more control over costs, and where they have limited knowledge of how to save costs, is in the correct selection and use of all components of the well.

almost obliged to use more expensive diesel as the energy source because of the lack, or unreliability, of electricity supplies (either preventing irrigation through lack of power or through the burn out of three-phase electric motors). This is a major economic decision over which the farmers largely have no control. Reliability in supplies can only be guaranteed through the use of a more expensive energy source - diesel. Where farmers can exercise more control over costs, and where they at present have little knowledge of how to save costs, is in the selection and use of all components of the well (well, pump and conveyance system).

In many cases, the sale of groundwater irrigation water is a marginal enterprise.

In many cases, the sale of groundwater irrigation water is a marginal enterprise. Box 1 provides an illustration of the scale of annual returns for different types of well in Bangladesh, based on data collected by IMMI/BAU (1995), NMIDP (1997) and analysis by FAO/WB (1997), and for shallow tubewells in North Bihar, India based on data collected by Shah et al (1995). They show that the less costly investments such as STWs and unlined and lined DSSTWs provide greater returns over investment but that the returns are not large. Many technologies operate at break-even point or even at a loss. Some of the striking figures are the high annual operating costs as a percentage of capital costs for the suction mode technologies (27-95% in Bangladesh) and the high percentage of the operating costs that are accounted for by fuel costs for all technologies (66-86% in Bangladesh). This suggests that the profitability of groundwater irrigation could be markedly increased through minor technical improvements to reduce energy consumption.

High annual operating costs as % of capital costs for suction mode technologies and high % of operating costs taken up by fuel costs for all technologies.

2.2 Tubewell costs - changing groundwater levels

Many assessments of financial or economic performance of wells, including those in Box 1 above, are based on constant water levels. This is fine for comparative analysis between technologies or accounting for changes in input/output prices year on year. However, most types of pump perform differently in different conditions. The amount of discharge from all pumps is influenced by the head (height from which water is lifted or pushed) against which it is pumping. When pump performance is evaluated it is done so by measuring changes in discharge with changes in head, to produce a pump performance curve. Discharge decreases with increases in head. One pump may produce greater discharge than others when pumping against low values of head, whilst another may produce greater discharge than others for higher values of head, and another may outperform others for all values of head. Box 2 provides examples of performance curves for different

Most makes of pump perform differently in different conditions.

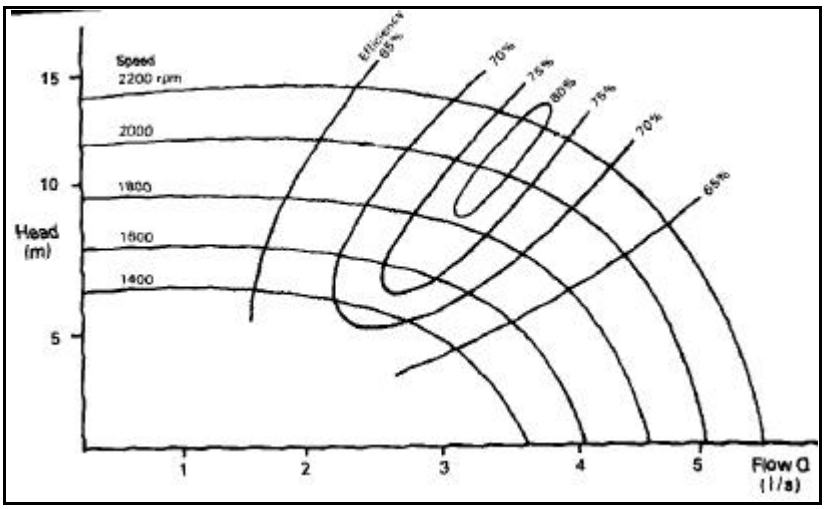
specifications of a given pump.

Box 1: Financial analysis of different types of well in Bangladesh and India

Well type	Horse power (HP)	Capital costs (Tk, *IRs*) *	Well costs as % of capital costs	Pump & prime mover costs as % of capital costs	Annual energy costs (Tk, *IRs*) *	Margin as % of investment	Operating costs as % of capital costs	Energy costs as % of total operating costs
Bangladesh								
STW-1 diesel	5	12900	13%	87%	5372	25%	57%	73%
STW-2 diesel	10	17700	14%	86%	9859	19%	68%	81%
STW-2 elec.	7	26200	10%	90%	5820	36%	27%	81%
DSSTW diesel	10	19000	18%	82%	15117	8%	95%	84%
DSSTW elec.	7	27500	13%	87%	8821	37%	38%	84%
DSSTW diesel	12	35300	20%	80%	17443	-11%	57%	86%
DSSTW elec.	7	32800	21%	79%	10176	24%	36%	86%
FMTW elec.	12	229000	28%	72%	14406	-6%	10%	66%
FMTW elec.	7	195000	23%	77%	12768	2%	9%	70%
DTW-1 diesel	30	597500	24%	76%	51480	-8%	11%	79%
DTW-1 elec.	20	483500	30%	70%	41870	0%	11%	82%
DTW-2 elec.	20	246000	45%	55%	41870	6%	21%	82%
India								
***STW** diesel*	*5*	*15650*	*22%*	*78%*	*1500*		*12%*	*78%*
***STW** diesel*	*6.5*	*15950*	*20%*	*80%*	*3150*		*23%*	*86%*
***STW** diesel*	*5*	*15550*	*28%*	*72%*	*2036*		*17%*	*76%*
***STW** diesel*	*5*	*18300*	*25%*	*75%*	*2471*		*17%*	*78%*
***STW** diesel*	*5*	*13300*	*22%*	*78%*	*5429*		*54%*	*76%*
***STW** diesel*	*5*	*25550*	*24%*	*76%*	*5400*		*25%*	*86%*
***STW** diesel*	*5*	*10750*	*51%*	*49%*	*5329*		*60%*	*82%*
***STW** elec.*	*5*	*24000*	*40%*	*60%*	*1080*		*5%*	*84%*
***STW** elec.*	*5*	*13650*	*31%*	*69%*	*1200*		*12%*	*73%*

* Tk = Bangladesh Taka, IRs = Indian Rupees (data from FAO/WB, 1997; IIMI, 1995; NMIDP, 1997; Shah, et al, 1995)

Box 2: Examples of pump performance curves showing the relationship between head, discharge, speed (rpm) and efficiency for a given centrifugal pump



(after Fraenkel, 1997)

In situations where static water levels can change significantly during the irrigation season, this has major implications for irrigation costs. Costs can be incurred in two main ways:

(i) longer pumping time to achieve the same volume of water required Þ increased operating costs, and

(ii) increased workload for the engine/motor to extract water from greater depth Þ increased maintenance and spare part costs and reduced effective life of the engine/motor.

The extent of the change in both of those costs depends upon the pump's performance as water levels change. Water levels fall considerably during the irrigation season in many parts of Bangladesh (although year on year water levels remain largely unchanged), whilst in many parts of Pakistan, water is being 'mined' and static water levels are falling year on year. It is very difficult to assess the impact of these changes in water levels upon performance because very few of the locally made pumps are tested. Pump testing is an issue which should be given priority for technical and economic evaluation of much of private sector groundwater irrigation in Bangladesh and Pakistan

Pump testing is a priority issue technical and economic evaluation and improvement of much of private sector groundwater irrigation in Bangladesh and Pakistan.

Once a database of which pumps perform most economically over which ranges of static water level, then this information can be used:

(i) by trainers, NGOs and farmers to select the most appropriate pump for their particular circumstances; and

(ii) by manufacturers, to market their products in areas for which their pumps are particularly suitable; and

(ii) by whatever pressure group (public or private) may wish to push for higher standards of manufacture.

3. IRRIGATED AGRICULTURE IN THE SMALL-SCALE PRIVATE SECTOR (FARMERS - INDIVIDUALS/GROUPS)

This section looks at situations where wells are in the hands of the farmers themselves and not owned and managed by any organisation , whether public or private. Revenue from both farming and pumping accrues to the well owners and transaction costs are, in theory, reduced. However, there are still transaction costs

incurred where there are a large number of users.

3.1 Financing of irrigation

A great deal of the finance of groundwater irrigation is by farmers' cash, either their own or borrowed from family or friends. Little credit is available to farmers either in Bangladesh or Pakistan. Despite the cheapness of many of the smaller technologies, the lack of credit restricts the numbers who can own tubewells. There are cheaper forms of irrigation available to the smallest of landholders or leaseholders, such as the treadle pump, but these technologies are not included in these guidelines.

(An explanation of the treadle pump and its use has been prepared by the Rangpur Dinajpur Rural Service in Bangladesh - RDRS (Orr et al, 1991 - see 'Guidelines Publications' the references for details))

The lack of ability to mobilise capital not only restricts the number of entrants to private tubewell ownership, and ownership is seen as a key contributor to increased groundwater irrigation (Strosser, 1997), but also tends to result in farmers buying the very cheapest technology available. Whilst this may have the lowest capital costs this can often lead to higher total costs over a period of time, and in great inefficiencies within the supply of groundwater. Rather than comment in detail on how farmers mobilise capital personally, these guidelines will concentrate on the provision of credit for groundwater irrigation. Reasons for low credit delivery at present will be summarised and some suggestions made for how this could be improved. The guidelines will also explain and suggest the extension of Rotating Savings and Credit Associations (ROSCAs) into the agricultural community.

The lack of ability to mobilise capital not only restricts the number of entrants to private tubewell ownership, but also results in farmers buying the cheapest technology available.

3.1.1 Current situation regarding credit in groundwater irrigation

The main reasons why banks and NGOs, even those whose basic remit is credit delivery in rural areas for agriculture, are not greatly involved in supplying finance for groundwater irrigation are summarised in Box 3. The reasons include both reluctance on the part of lenders and of the borrowers.

As yet unpublished figures for Bangladesh reveal the extent of the problems which have caused banks and NGOs to think twice about getting involved in groundwater irrigation. The total outstanding debt for irrigation equipment as at March 1999 was over Tk 1000 crore (Tk 10 billion) of which over 90% was overdue. Much of this is attributed to the sell off of DTWs in the 1980's, with large amounts of credit made available, much of which could not be paid back, and to the waiving of debts by Governments in the past.

Box 3: Reasons for low levels of formal credit delivery for groundwater irrigation

Type of organisation	Reasons
NGOs	1. Many NGOs disburse small amounts of credit (micro-credit) and capital purchase of mechanised irrigation technology is beyond credit limits. It should be remembered that irrigated agriculture requires not only irrigation technology but other expensive investments, such as HYV seeds, fertilizers and pesticides. 2. Many NGOs target the landless or very smallest landholders for whom mechanised irrigation is largely not an option. In Bangladesh some credit is provided but it is largely linked to the organisation and development of irrigation groups. The main NGOs involved in this, accounting for 83% of involvement in NGO target group managed irrigation enterprises in 1992, were BRAC (37%), Proshika Manobik (22%), RDRS (10%), Comilla Proshika (8%) and Gonashastha Kendra (6%) (van Koppen et al, 1996). The level of involvement in this field has fallen since 1992. Some of the NGOs working with landless irrigation groups have struggled to make it a success and have largely pulled out. 3. Many NGOs require monthly or weekly repayments which, if investing for a whole growing season before returns, prevents or severely restricts this option. 4. Irrigation may already be provided by the NGO (at a price) and credit only provided for associated expenditure (e.g. GKF). 5. Further constraints to effective credit delivery in general have been summarised by Wood et al (1997) and include: • the lack of investment opportunities for the poor and, especially, the landless; • the disadvantaged position of women, who bear the additional cost of securing access to markets and information; • the inability of many NGOs to operate in disadvantaged areas; • the absence of market demand for services provided by poor borrowers; • restricted multiplier effects in agriculture and industry; and • natural hazards.
Banks	1. The banks see groundwater irrigation as a high risk investment, particularly in Bangladesh and particularly with the more costly force mode technologies. Many banks have had their fingers burned in the past and the reluctance of farmers to pay back loans has not been helped by government actions in the past to exempt defaulters from repayment of loans. Other reasons for non-repayment have included use of loans for purposes other than irrigation equipment, providing no return, and breakdown of irrigation equipment. 2. The transaction costs for many banks in credit agreements and debt recovery for customers spread across rural areas are high. 3. Many farmers see the procedures for obtaining loans as complex. An example to illustrate this comes from the Loan Manual of BKB (from IIMI/BAU, 1995) where documents required included (i) copies of records of land right, (ii) original deed of conveyance and up-to-date rent receipt, (iii) where property has been acquired through inheritance, original records of rights, names, ages of all heirs, map and up-to-date rent receipt, (iv) properties acquired through gifts require original deed and up-to date rent receipt, (v) photograph of applicant, (vi) certificates from the chairman/members of the union council to prove an applicants permanent residence in the locality. 4. Farmers have had some problems with some bank staff in the need to make unofficial payments to secure a loan (IIMI/BAU, 1995).

3.1.2 Guidelines for improving credit supply for groundwater irrigation

Farmers interviewed in the questionnaire survey indicated a preference for reliability and quality in their pumping equipment, but are constrained by:

- lack of capital themselves (constraining their ability to buy quality), or
- lack of long term credit, or
- extreme variation in the price of crops, which may render a high capital cost and long pay-back period unattractive, even if credit is available.

Irrigation often requires complementary short-term credit to finance investments in new seed, fertilisers, etc. These are smaller investments, but the poorer farmer may require credit for these as well.

Farmers are also quite realistic about the likelihood of having to repay credit. If past experience has shown them that a certain institution (generally a government, sometimes an NGO) is very lax about collecting repayments, they will borrow from it quite happily - it is as good as a gift. If an agency is known to be strict on repayments, and in a position to enforce sanctions against non-payment, then they become careful on the rate of return they will get from taking the credit, and refuse it if they think there is a risk of failing to be able to pay, and incurring the sanction.

Examples are given of how effective procedures and methods have been used to extend capital provision for groundwater irrigation technology or for associated development needs. These examples come from Bangladesh, India and Pakistan. In a survey carried out by BAU/IIMI (1995) into support services for privatised irrigation, bank staff said that key improvements to the performance of commercial banks were (i) simplifying and streamlining the process of application, and (ii) that staff should receive incentives for credit delivery (to reduce the likelihood of 'unofficial' payments). The Boxes below show examples of how measures have improved credit delivery or increased pump ownership. Most of the examples are not for credit for irrigation equipment, since for reasons cited above there are not many examples, but contain ideas which could be applied to credit for equipment.

The examples of more effective credit delivery schemes are:

- the Free Boring Scheme of Eastern Uttar Pradesh and North Bihar in India, which has streamlined application procedures (albeit for subsidies rather than credit) with considerable success over other projects. This

	is compared with the procedure in North Bengal which is also for subsidy rather than credit (Box 4). • the National Rural Support Programme in Pakistan, which has adopted principles of social organisation, tried and tested by the Orangi Pilot Project (set up by Akter Ahmed Khan who created the Academy of Rural Development in Comilla, Bangladesh) in Karachi and the Aga Khan Rural Support programme, to deliver credit to farmers, both men and women (Box 5). Credit has primarily reached the poorest farmers, something which many previous credit programmes in Pakistan have failed to do. Credit has been disbursed for irrigation equipment by NRSP and repayments have been very high. Full details of the credit disbursement and recovery procedures are available in the 'Credit Administration Manual' printed by NRSP. Contact details are in the reference section under NRSP, 1998. • GKF in Bangladesh which sells groundwater to farmers but which also delivers large amounts of credit for agricultural and other rural enterprises, with claims of 100% repayment (Box 6). • The National Bank in Rajshahi, Bangladesh, which has worked with the Barind Multi-disciplinary Development Authority to go to the farmers in the Barind, through mobile banking (Box 7). The guidelines look at several aspects of financing including: • Features increasing success in credit disbursement and pay-back • Alternatives to credit in financing groundwater irrigation

Box 4: Comparison of successful and unsuccessful capital mobilisation schemes in India

Free Bore Scheme **Type of scheme:** pump subsidy-loan scheme **Location:** Eastern Uttar Pradesh and North Bihar	**Minor Irrigation policy of North Bengal Terai Development Programme** **Type of scheme:** pump subsidy-loan scheme **Location:** North Bengal
Procedure: 1. Farmer goes to a pump dealer with photograph, land and caste documents. 2. Pump dealer delivers engine and pump set to the farmer and takes the farmer to the Minor Irrigation (MI) office to get subsidised pipes on the same day. 3. Farmer arranges bore digging with local rigging operator. Completed and paid for by farmer within in week (500 rupees) - paid back at a later date. 4. A few days later the pump dealer collects the farmer and takes him to the bank to complete the loan formalities, All the farmer has to do is sign. The loan (determined by NABARD at a unit cost of 15,000 rupees) is sanctioned and received by the dealer towards the cost of the pump. 5. A few day later an official from the MI office visits the farmer to see that the work has been completed and to collect information on the bore (depth, geological information, costs). 6. Boring subsidy is received after a few months.	**Procedure:** 1. Applicant gets his name registered with the Gram Panchayat, along with documentation. 2. Gram Panchayat has to agree to forward application to BDO and a member has to personally recommend the applicant to the BDO. 3. The application is discussed at bi-monthly meetings of the bank, Gram Panchayat and Panchayat Samiti member to assess the eligibility and credit worthiness of the applicant. If approved, then the application is forwarded to the bank. 4. The bank claims the subsidy from the DRDA. 5. The loan is paid only after the subsidy is received. 6. The bank issues the Delivery Order to the farmer who can then go and claim his diesel pump. The whole procedure, if completed, takes about a year.
Reasons for success: 1. Nothing to do with quality of development administration but with positive dealer dynamics. 2. Large number of manufacturers and dealers working with a growing market. Competition is so strong that dealers go out looking for applicants. 3. Dealers take over the process, with which they are familiar and know how to get things done. No 'transaction' costs to the farmer. 4. Dealers offer a 'package of services' to the farmers for which they pay. Dealers are faced with fixed costs, for which the farmer pays (between 700-1800 rupees), including keeping bank officials in good humour and ensuring MI officers clear their cases. 5. Farmers are happy to pay the premium to the dealers to cut through the red tape. The services offered by the dealers are highly valued. The interests of dealers and manufacturers are in tune with those of the farmers	**Reasons for lack of success:** 1. Complex procedure. 2. Long time period between application and receipt of equipment. 3. Decision to forward application not in the hands of the farmer.
Rationale for the scheme: Failure of DTWs, community management of large MI schemes and buried pipe line schemes. The aim is to 'put a pump in the hands of a small farmer with the least hassle, delay and transaction costs'.	
Indicator of success: 70-80% of the one million new wells and pumps in the area in the last decade have been by FBS.	**Indicator of success:** 100% dissatisfaction with the scheme by farmers. Very few new wells and pumps under the scheme

(after Shah, 1997)

Box 5: Credit programme of National Rural Support Programme (NGO) in Pakistan

Features of NGO:	1. Not a 'credit only' NGO. Credit one of four main interventions. The other three are social guidance, technical assistance and establishing linkages with development and donor agencies. 2. NGO facilitator and advisor, not prescriber.
Principles of credit delivery	1. Poor are proven to be credit-worthy. 2. Peer pressure is an effective ingredient within an organised community. 3. Social collateral is an effective ingredient and this collateral needs to be developed through training and technical assistance.
NGO structure:	1. Head Office - Islamabad (seven departments - Human Resource Development, Natural Resource Management, Social Sector Services, Monitoring Assessment and Planning, Finance and Accounts, Physical Infrastructure and Technology Development, Rural Credit and Enterprise Development) and six regional offices. Much power delegated to regional offices. 2. Regional staffing comprises: Regional Programme Officer, Regional Professionals for all the main areas of work and Social Organisers.
Recipients' structure:	1. All work is done through Community Organisations (COs), created and supported by Social Organisers (SOs). 2. From within each community an Activist is selected. The activist is a key player in all programmes, including credit delivery and recovery. The activist is an honest, motivated and respected member of the community and acts as the go-between to the community and the NGO.
Features of credit programme:	1. Part of integrated programme of rural development. 2. Social collateral is used as the main force for ensuring proper use and recovery of credit, as opposed to complicated legal documentation. 3. Credit is extended to individuals through the CO and only the actual recipient of the credit is counted as the beneficiary. 4. The Credit Programme is directly linked with a programme of skills enhancement to ensure proper utilisation of skills. 5. An Activist in each CO is trained as a credit manager to enable COs to manage further lending at an independent local level. 6. Terms and conditions are flexible. They are negotiated and can be modified at any time if justified. Repayment schedules are also flexible. All are equivalent to an annual interest rate of 18%. 7. The field staff (SOs and Activists) take the lead in implementing the credit programme. The Activist receives 2% of repayments as reward for his efforts. The SO is paid as part of Head Office overheads. 8. Credit policies are designed in partnership with COs and not enforced. 9. Credit and account keeping is done by Regional Credit Officers and checked by Head Office Accounts staff. 10. Ceilings of credit are kept low to ensure that the maximum number of poor people receive credit. The ceilings are considered too low for wealthier people to be concerned with. Limits are Rs. 15,000 for agricultural inputs, Rs. 30,000 for working capital for enterprise development, livestock development and Small Infrastructure and Enterprise Development. 11. Repayment terms are flexible, payable monthly, quarterly or annually over a two year period. 12. Capital formation in the villages is a high priority, so a certain level of saving (amount is flexible but often in the region of 25% of loan amount) is set as a pre-requisite for access to credit.
Indicators of success:	1. Rapid growth of credit disbursement. 2. Participation of commercial banks, through provision of capital to NRSP, showing confidence of the commercial sector in the system. 3. Almost 100% recovery of due amounts.

(NRSP, 1997a and 1997b)

Box 6: Credit programme of Grameen Krishi Foundation (NGO) in Bangladesh

Targets for credit delivery:	1. Small and marginal farmers (0.5 to 3.0 acres of land) since Grameen Bank and many other NGOs work with those with under 0.5 acres. 2. Landless people in areas where Grameen Bank and others do not operate.
NGO structure:	1. Head Office - Rangpur, Secretariat - Dhaka. Governing body/Chairman, Managing Director, six Heads of Department. 2. Regional staffing comprises: Farm Managers (one per DTW), Unit Managers (made up of 8-15 farms) , Regional Managers (made of 10-15 units). 3. In each Unit, two or three of the Farm Managers have special responsibility for the credit programme, i.e. for disbursement and recovery. Each Farm Manager is responsible for 'selling' credit.
Recipients' structure:	1. Based on the Grameen Bank system. Groups of five men or women, with typically ten groups at a location forming a 'centre'. A Chairman is selected from each group. 2. The 'centre' acts as a point of contact for weekly meetings with the Farm Manager.
Features of credit programme:	1. Part of multi-functional programme of rural development. Credit is supplied in addition to its well established system of input supply and irrigation water in return for share of crops. 2. Credit is organised through the Farm Manager who lives in a village near the DTW to which he has been assigned. 3. A Central Welfare Fund has been set up by GKF to provide grants in times of emergency. A group savings account is set up for each group, from which group members may borrow to meet any abnormal cash needs, such as weddings or funerals. 4. Within each group, each member has to make a compulsory personal savings contribution of Tk. 2 per week to the group savings account, plus a Tk. 2 contribution to the Central Welfare Fund. 5. When loans are disbursed, through the Farm Manager responsible, 5% is deducted ("group tax") and held in the group savings account. In addition, borrowers of over Tk. 1000 contribute 0.5% of their loan to the Central Welfare Fund. 6. Repayments start the week following disbursement. For every Tk. 1000 borrowed - Tk. 20 plus Tk. 2 service charge repaid every week. Repayment is completed in 50 weeks and so the service charge amounts to an annual interest rate of 20%. 7. Loans were given to men and women but now GKF have decided to provide credit to women only. This is because they find women more reliable and because they find women easier to find - men often travel away in search of employment. 8. The major categories for loans include animal husbandry (40% of loans to men, 60% of loans to women), post harvest rice production (husking) and trading (40% of loans to men and 35% of loans to women). Other more minor categories include machinery (sewing machines and hand tubewells), services (rickshaws and tubewells) and grocery shopkeeping. 9. Farm Managers are paid from Head Office overheads but it is also intended that they should receive 10% of profits from the well.
Indicators of success:	1. Rapid increase in the number of groups and money disbursed Groups: 1994/5 - 1587 1995/6 - 4672; Money disbursed: 1994/5 - Tk 12,744,000 1995/6 - Tk 61,601,000 2. Loan repayments 100% on time.

(after UNCDF, 1997; Jordans et al.1997)

Box 7: Co-operative venture between National Bank and Barind Multi-purpose Development Authority to introduce credit scheme

Features of the project:	1. Joint venture between a commercial bank and a government development authority. 2. Staff of both organisations working together, no duplication and skills being complemented.
Features of credit programme:	1. Committee for each DTW set up with 9 members - 7 farmers (4 landowners and 3 sharecroppers), 1 BMDA staff member and 1 National Bank staff member 2. Credit applicants selected and approved by the committee and credit terms agreed. 3. Committee set up a loan account with the Bank. 4. Money for irrigation paid to BMDA direct from bank account. 5. Input (seeds, fertilizers, pesticides, machinery) suppliers appointed by the committee. 6. Money for inputs paid to suppliers direct from committee loan account. Therefore, no cash transactions involving farmers. 7. Repayments collected at committee meetings, farmer members responsible for recovery, supervise by BMDA and Bank staff. Repayment terms are flexible - mostly after harvest and extensions can be approved if farmer is storing crop to wait for a better price. 8. Close relationship already exists between farmers and BMDA staff and so knowledge of each other and trust has already been establish. 9. Farmers do not have to travel to arrange and pay credit - loaners go to the farmers. No transaction costs for the farmers. 10. Future plans to develop mobile banking and take banking to the farmers
Indicators of success:	1. Rapid rise in disbursement. 2. Claims of 100% recovery.

(after National Bank, 1995)

3.2 Water markets

True water markets do not currently exist in the sub-continent, since no groundwater rights are in existence.

True water markets do not currently exist in the sub-continent, since no groundwater rights are in existence. Pump owners do not charge for water (the water is not theirs to sell) they charge for the service of raising and delivering the water to the user (Palmer-Jones, 1998). Charges are made to cover costs of the service and the technology required to deliver the water and people purchase these services. The term used for this transaction is generally water markets, so this will continue to be used here.

The great advantage of having a different organisation or individual own the water equipment and sell the water delivery service is that it/he/she may be in a better financial position than the small farmer. Because large sums are involved, they are more attractive as bank customers, and are generally more able to deal with outside agencies, such as the Government than a clutch of small farmers. They are also better able to finance the larger and deeper types of groundwater extraction equipment. The main types of water seller include:

- a better off farmer who has been able to buy a pump and has some surplus water to sell

- an entrepreneur, or an entrepreneurial group, whose main business is selling water to others, rather than as a subsidiary to farming. In the case of shallow wells, these can be a quite poor group of landless people (with NGO programmes to promote and support this).
- an NGO that has taken over government wells, or supplied its own
- a parastatal organisation that has been given a degree of commercial independence.

Water markets are imperfect:

- water sellers have only a limited number of potential customers (in the command area of the well)

- water buyers usually have only one supplier (though not always)

The problem in water markets is that water sellers have only a limited number of potential customers, who must be in the command area of the well. Similarly, the water buyers have generally only one potential supplier, though where there are lots of farmer owners with small surpluses, he may have some choice. This means the market is bound to operate imperfectly.

In a perfect market, supply and demand is seen as the principle factor in the price set for a product. This is not seen so strongly in water markets. In Bangladesh, Pakistan and India there is only limited evidence of price changes due to changes in supply or demand. For example, prices tend to remain constant throughout the irrigation season, whether water is easily accessible or not. There are several reasons for the reduced impact of supply and demand on price, including:

- most water sellers are selling excess water, i.e. they take what they need and then sell what is left over. The prime motive for farmers to purchase a pump is to irrigate their own land.
- what is being paid for and supplied is the technology. Prices are more closely linked to the prices of technology and fuel. If fuel prices rise, then water prices will usually rise. Many prices change most markedly based on whether water buyers supply their own fuel or not.
- multi-faceted relationships within the farming community. Members of the community have to operate and co-operate on many issues, of which irrigation water supply is just one.
- high transaction costs in establishing networks of buyers and sellers.

3.2.1 Groundwater markets in Pakistan

The main features of the groundwater markets in Pakistan are summarised from the

work of Meinzen-Dick (1996), Strosser (1997) and from field surveys and. questionnaires carried out in support of this project, see Box 8

Box 8: Groundwater markets in Pakistan

1. It is generally the wealthier farmers who own groundwater irrigation equipment. In 1991 88% of all private tubewells were owned by farmers with more than 12.5 acres. This is because of their ability to mobilise resources, credit, and government connections for electricity.
2. As a consequence of large land ownership, water sales are low. This differs much between provinces (NWFP - 31.5% of owners selling water, 20.9% in Punjab, 3.7% in Balochistan and 1.2% in Sindh).
3. Almost no farmers buy equipment to sell water, they buy to irrigate their own land and only sell the excess.
4. Groundwater volumes for sale are generally unreliable and unpredictable because it is often linked to the availability of surface water from canals.
5. The influences on the development of groundwater markets are:
    - physical environment - particularly rainfall, water quality and water depth
    - surface irrigation - supplies of canal water directly affect need for groundwater
    - farm characteristics - particularly farm size of owners, and degree of farm fragmentation
    - rural development - particularly in areas of education and literacy, and population density
    - agricultural production - cropping patterns (although this is a two way process - groundwater markets can directly influence cropping patterns too).
6. Meinzen-Dick found the most significant positive influences on tubewell density were cropping pattern (rice zones) and population density, and the most negative influence to be availability of surface water.

(after Strosser, 1997, and Meinzen-Dick, 1996)

3.2.2 Groundwater markets in Bangladesh

Many of the influences on groundwater markets in Pakistan are also present in Bangladesh. However, there are four main additional features in Bangladesh:

- groundwater irrigation is almost the only form of irrigation. It is not supplementary to surface irrigation.
- land-holdings are significantly smaller than in Pakistan and the need to sell water to make a profit on investment is greater.
- during the main irrigation season (boro) a high percentage of the land is farmed by share-croppers, so there are many more buyers available.
- the opportunities for the landless to enter the market as water sellers appears to be greater, provided a degree of entrepreneurial spirit is present or they are supported by an NGO. This is because of the large number of farmers with small land-holdings who are unable to afford irrigation equipment but want to receive water and are willing to negotiate with potential water sellers over land for installation and conveyance systems and terms of payment.

The decision as to what payment system is adopted is usually down to those with power in the command area.

3.3 Payment systems

Evidence suggests that, in the case of privately owned wells, the decision as to what system is adopted is often down to those who have power in the command area (who may be sellers or buyers), although in many cases separate agreements may be made between the seller and the buyer and that differing methods may operate within one command area (e.g. Wood & Palmer-Jones, 1990; Meinzen-Dick, 1996). This is particularly the case in a buyers' market where the water user may be in a position to dictate terms. The payment system adopted often depends upon the sellers' and users' perception of risk and the factors which influence their perceptions.

Three main times to pay for water: before the irrigation season, after the harvest following the irrigation season and during the irrigation season ('pay as you use').

There are basically three main times to pay for water: before the irrigation season, after the harvest following the irrigation season and during the irrigation season ('pay as you use'). In addition there is also the issue of whether only one lump sum payment is made, before, during or after the irrigation season, or whether the payment is made in instalments. Each of the timings have benefits and risks associated with them, for both the water supplier and water user. The currency used in the payment for water is closely related to the timing of the payment and so these two features have been combined in the guidelines below.

The main currencies are cash, crop-share and coupons. The guidelines give advice on payment before, during and after irrigation season.

3.4 Land and water rights

The important difference regarding land rights is between owner and tenant or share-cropper. Owners get the full benefit of irrigation, tenants have to pay a rent and share the benefit. The benefit, even when shared, may still be attractive, if the supply is reliable. Owners may accept a slightly lower rate of return than tenants.

Where people have water rights, i.e. certain control of over a supply of water, they can trade this. They can sell the right to the water to some-one who values it more highly than they do. However groundwater is usually common property, and governments should normally regulate its use, since the market will not be able to (Carruthers & Clark, 1981). This leads to the desirability of some kind of licensing system, to ensure that water is not being mined. Whether this is within the capacity

of the government is another issue. For shallow wells it could be done by the local authority.

3.5 Alternatives to new tubewell purchase

There are two main alternatives to purchase of new tubewells. These are hiring of irrigation equipment and purchase of second-hand wells. The first refers to suction mode technologies (for STWs) and the second refers to force mode technologies (for DTWs).

3.5.1 Hiring of irrigation equipment

There is no strong history of hiring of equipment for suction mode technologies for STWs in either Bangladesh or Pakistan. However:

- in Bangladesh, hiring of low lift pumps (LLPs) in the Khulna district (south Bangladesh) in particular is common practice. In this case LLPs require no personal investment in a well, since water is extracted from rivers or ponds. In addition, most land preparation is done by power tiller, since field and farm sizes do not warrant tractors. A large majority of power tillers are hired rather than purchased, either from project authorities or from private dealers.
- in Pakistan, an informal form of hiring of equipment exists. This is where farmers may be allowed to use someone else's well and pump provided they use their own energy source (mainly with power take off (PTO) - tractors).

There is scope for increasing the use of suction mode pumpsets through hiring.

There is scope for increasing the use of suction mode pumps through hiring. This would apply mainly to the smaller land owners or sharecroppers who are unable to afford pump sets. The use of a pump would still require a well, but as Box 1 illustrates, the cost of a well is considerably less than the cost of the pumpset. For the sample included in Box 1, the average percentage of well capital costs to total capital costs is 24% in Bangladesh and 29% in India. In addition, these capital costs would be incurred less frequently than those for the pumping equipment. The pumping equipment would only be on a pay-as-you-use basis and so expenditure may be infrequent or rare, say in times of drought. Promotion of this is something that should be encouraged amongst traders, since if they can promote this idea successfully, they may make more money out of hiring than out of selling.

There is evidence in Bangladesh of a growing second-hand DTW market.

3.5.2 Purchase of second-hand equipment

The cost of a new DTW, in the region of Tk7,00,000, is prohibitive for the private sector in agriculture. However, there are many unused or under utilised DTWs in Bangladesh which have been transferred from government (BADC) to farmers in the past under a variety of schemes. There are still areas (close to the major markets, such as Dhaka) and cropping systems (high value vegetable and salad crops) which are conducive to profitable agriculture, and areas recognised to be home to progressive, co-operative farmers, such as Bogra. The second-hand DTW market is relocating wells from areas of poor profitability to these more profitable areas.

Some of the larger contractors are buying second-hand DTWs (including the casing and screen, where possible) and relocating them where requested by farmers. New screens are often required and where this is the case, the brass screens are being replaced by PVC screens. Reconditioned prime movers and pumps are also supplied by the contractors. The cost of a second-hand well is usually in the region of Tk1,75,000 (see Box 9).

Box 9: Breakdown of costs of second-hand DTW

Component	Cost (Tk)
Purchase of second-hand DTW	65,000
Retrieval cost	10,000
Transporting to new location	10,000
Reconditioned engine/motor	20,000
Reconditioned pump and gearhead	20,000
Re-drilling cost	30,000
Contractor's profit	20,000
Total:	**175,000**

(after FAO/WB, 1997)

Given the growing demand for this service, and given the number of disused DTWs in Bangladesh and India, and the number of SCARP tubewells being withdrawn from service in Pakistan, this is an issue which merits further consideration.

4. IRRIGATED AGRICULTURE IN THE CORPORATE SECTOR (GOVERNMENT OR PRIVATE AGENCY)

4.1 Introduction

KEY attitudes for successful cost-recovery:

TRUST and CONFIDENCE

On the part of buyer and seller

The research has identified two key attitudes amongst water selling organisations and water users that lead to a higher level of success in cost recovery. These are mutual trust and confidence. If water users have confidence in the guaranteed supply of water throughout the irrigation season, then they are prepared to pay for it, even to pay a premium for it. In many cases, non-payment of irrigation charges results from disruption to water supply and a consequent loss of yield (income). The research also suggests that if water sellers are confident that they will receive payment for supply, then greater efforts are made to ensure sufficient supply. This confidence stems from trust between the water seller and the water supplier. In many cases, this trust can be gained directly from the payment systems used. This section will attempt to show a variety of ways in which different payment systems can influence the level of trust between buyers and sellers and, hence, increase the level of cost-recovery. This applies equally to wells in the public or private sector and to wells going through the process of transfer from the public to the private sector where a new payment system under the new regime is being considered.

One of the main problems with public/ government operated systems is the lack of direct links between the quality of the supply, and the income received, or staff performance and salary.

One of the main problems with public/government operated systems is the lack of direct link between the quality of the supply, and the income received. Irrigation officials generally get paid whether or not they maintain the supply. The legal payments from the farmers go to the Central Treasury, not to the Irrigation Officials. In practice many officials' income may depend greatly on unofficial payments, from wealthier farmers, which they receive if the supply is generally poor and erratic - hence the incentive system is such as to encourage bad service rather than good. Because service is bad, trust and confidence is lacking and the full benefits or irrigation are not received, and the government does not receive the economic return it might have expected. Hence it fails to be able to afford to give irrigation services adequate revenues to motivate staff and provided them with operational requisites, and hence the service deteriorates again. For this reason governments are now looking at how to stimulate private provision, and to transfer some government services to the private sector, or, alternatively, to devise systems under which parastatal organisations operate under more normal commercial terms

(i.e. their revenue depends on their receipts).

The main forms of organisation involved directly in the ownership and management of groundwater irrigation in Pakistan are Provincial Irrigation Departments and in Bangladesh are government agencies, such as BWDB and BMDA, and NGOs (such as GKF). Each of these types of corporate agency have a different economic objectives for, and approaches to groundwater irrigation.

From field observations and a review of the literature, the main issues needing attention are water pricing, currency of payment, effective cost-recovery, and the nature and enforceability of agreements between organisation and water users.

4.2 Water pricing

4.2.1 Setting the price

The level of the water price within the corporate sector can depend very much upon the objectives of the organisation. Objectives in water pricing include:

- recovery of energy costs,
- recovery of all operation and maintenance costs,
- contribution to well replacement costs,
- profit maximisation, and
- as a policy instrument for controlling the level of water use.

All objectives are legitimate but it is important to be clear about the objectives, to set financial targets consistent with the objectives, and to set the price accordingly. Those organisations which have been more successful in achieving their objectives are those who have a clear water pricing strategy which is transparent and which the farmers understand.

Benefits and problems with water pricing not necessarily because of the price charged but because of the lack of communication to the farmers of the reason for the price charged and information on where the money is going.

Within the corporate sector in South-East Asia a wide variety of water pricing methods are used, each with their own particular benefits and problems, often not necessarily because of the price charged but because of the lack of transparency and communication to the farmers of the reason for the price charged. In addition, communication to farmers of the use that the income is being put to has been shown to be effective in gaining the confidence and compliance of farmers in paying. This is particularly important in cases where farmers may historically have been used to a highly subsidised water charge or to an inefficient organisation where powers to

enforce payment have been limited or not exercised, and cost-recovery under a new privatised/decentralised system becomes more important.

In Pakistan, the corporate sector in groundwater is largely restricted to the publicly owned SCARP tubewells which usually supplement surface irrigation water. In this case the water charge is based on the system of *abiana* where charges for each farmer are based on area irrigated and type of crop grown. This is a system which is widely recognised to be open to abuse since the figures on which *abiana* is based are agreed between the farmer and the Provincial Irrigation Department official (*patwari*). The main abuse is in the underestimation in area of more highly charged crops. It has been suggested (Strosser, 1997) that a flat rate based on area should be charged, irrespective of crop grown. In the case of the other main group of corporately owned wells, the 'scavenger' wells of the Left Bank Outfall Drain Project, farmers are not required to pay for water use but to contribute to O&M of the irrigation and drainage channels from the wells.

In Bangladesh, where groundwater irrigation is not generally supplementary to surface water irrigation, bases for water pricing in the corporate sector depends very much on the organisation's status and objectives. In the case of the North Bengal Tubewell Project (run by BWDB - central government) the price of tubewell water is designed to cover the electricity bill, the operators salary and petty repairs, and payment is in cash.

The Barind Multi-purpose Development Authority (BMDA - independent government agency) calculates an hourly water charge based on the electricity bill, plus all operating costs, depreciation, repair and replacement charges, paid by coupon.

The Grameen Krishi Foundation (GKF - non-governmental organisation) which took over the ownership and management of in excess of 500 DTWs from BADC. The basis for water pricing is maximisation of profits and different bases for charging have been developed which suit different DTW contexts. There are three main types of system:

Type A: 'normal' system where in return for a full irrigation service (assured water supply through the irrigation season) a share of the crop is given at harvest (fixed yield of 12-13 maunds/acre) collected from farms by GKF (90% of DTWs).

The projects most successful in collecting revenue are those that do not deal directly in cash.

Type B: 'handle-bhara' system where farmers rent the well for Tk1000/- or 5 mnds/acre and farmers supply the fuel themselves (9% of DTWs).

Type C: GKF rent well to group of farmers for Tk10000/- and provide fuel and credit for 20% service charge (1% of DTWs).

In general, GKF have found that the Type A system is more profitable (for GKF) for DTWs with command areas over 40 acres and that for DTWs with command areas under 40 acres the Type B or C systems are more profitable. The Type B system is seen as particularly appropriate where command areas have excessively sandy soils, since irrigation time and fuel consumption is greater, and the 'handle-bhara' system reduces GKF's liability for fuel.

4.2.2 Communicating pricing basis to water users

Communication to the farmers of the basis for water price levels, and the use of the income, has been strongest in the case of BMDA. BMDA have also managed to arrange with central government that all revenue will remain in the hands of the Authority with none returning to the Government, so keeping it in the region. This has been stressed to the farmers and has been well received. In the case of GKF, the farmers generally accepted the levels set for irrigation water both verbally and in their continued use of GKF DTW water, despite strong and increasing competition from STWs in the area. However, using the crop share basis means that the financial price is effectively variable and in seasons when the price of paddy is high, there is resentment at the value of product being given to GKF. Close interaction between GKF project staff and the farmers keeps the level of discontent to a minimum. However, a visit to the project in May 1999 revealed that an increasing number of farmers were installing STWs and that the number of unprofitable GKF DTWs closing was increasing.

4.3 Currency for payment

The three projects from Bangladesh shown above all use different currencies for payment and illustrate the benefits and risks associated with each form of currency. Those most successful in collecting revenue are those that do not deal directly in cash. GKF have an payment option which is by cash but much prefer crop share which results in much higher levels of cost-recovery. Cash can be an elusive commodity which may not always be available and which can disappear easily,

especially if effective accounting systems are not in place. The descriptions and guidelines are based mainly on the experiences of the three projects shown above, but also draw from more general observations of the three forms of payment in the corporate sector. The guidelines provide advice on:

- Payment in cash
- Payment during the irrigation season using the coupon system
- Payment after the irrigation season on a crop-share basis

4.4 Effective cost recovery

Those organisations which are successful in cost-recovery are so largely because of the nature, structure and motivation of the organisation and their staff.

Many of the guidelines relating to effective cost recovery lie in the nature of corporate management and are therefore found in the 'Manageability' section of the guidelines. Indeed, those organisations which have been more successful in collecting money have been so largely because of the nature, structure and motivation of the organisation and their staff. The guidelines for effective cost recovery are shown in Box 10 and include some of the points mentioned above, where relevant (details regarding context, risks and benefits are shown above).

4.5 Nature of agreements

Even if a conflict goes to a court of law, and even if the court of law adjudicates according to the law, there may not be the will or structure in place to compel those in the wrong to co-operate.

Unless agreements are enforceable, they are often not worth the paper they are written on. Experience from independent well user groups (for example from the KSS co-operative groups in Bangladesh) suggests that if a group is functioning successfully, for whatever reason, the farmers see no need for written agreements. Problems are sorted out informally or formally at user group meetings. If a well user group is facing major conflicts or problems, then written agreements will only be implemented if the terms of the agreement are strictly adhered to. Even if a conflict goes to a court of law, and even if the court of law adjudicates according to the law, there may not be the will or structure in place to compel those in the wrong to co-operate.

In the corporate sector, where an organisation is supplying irrigation, the water supplier has the potential to compel water users to adhere to an agreement either through pressure, recourse to the law, or by closing the well. The need for agreements concerning payment in return for irrigation will also depend upon the nature of the payment system. In the case of the coupon system, the organisation agrees to provide water for irrigation and the water user's agreement for use and payment is inherent in the purchase of the coupon. Water is only supplied upon

payment to the operator.

Box 10: Economic guidelines of good practice for effective cost recovery for organisations

Guideline	Explanation
1. Set price of water to be profitable but not extortionate	A price needs to be set to cover costs but if the price is set too high water users may be unable or unwilling to pay, whatever the penalties for non-payment are. If the price is based on a detail analysis of costs and is too high, the well may either be uneconomic and alternative technologies should be considered, or ways in which the costs can be reduced should be looked at.
2. Explain to water users why they are being charged the price they are and what they will receive for that price.	If water users are informed of why they are being charged the price they are, and where the money they pay is going, they are often more willing to pay up.
3. Remove cash from payment process at the earliest possible point	Payment in cash is normal in most developed countries, because it is much more convenient for both payer and receiver. However, in countries where the temptations to corruption are high, and levels of literacy and numeracy are low, the coupon system is advantageous. Cash is an elusive commodity which can easily disappear if there are too many stages at which it is transferred (e.g. water user $\rightarrow$ water-users representative $\rightarrow$ bank or project) and which can be used for any number of purposes. Coupons can only be used for irrigation and money is transferred to the organisation before irrigation with the coupon acting as a receipt for payment. Crop share involves no money transfer at all. The main problem may tampering with crop share. Hence guideline 4.
4. Maintain high corporate control over the payment process and control of revenue	Corporate control may be through collecting money prior to irrigation and only allowing irrigation on proof of payment, such as through the coupon system. It could also be by having staff placed close to the water users and supervising cost recovery to ensure full and (in the case of crop share) uncontaminated payment.
5. Make provision for detailed accounting procedures at any time payment is made	Whether payment is made before, during or after irrigation, any payment should be accounted for. Accounting systems should be as tight as possible to prevent 'leakage' of money from the system. For example, in the case of the coupons, the coupon acts as a receipt of payment and any coupon sold at organisation offices will have money received which project staff will have to account for. Well (and, hence, energy) use is accounted for against coupons received from the water users. Any time not set against coupons has to be explained by the operator. In the case of crop share, an agreement is drawn up prior to irrigation for a given weight of crop. These are accounted for, for each water user, in organisation offices. When crop share is collected, the due amount from each farmer is compared to the agreement. Any shortfall can be chased up.
6. Ensure payment is encouraged or enforced through implementation of incentives and penalties	Many water users may try to avoid their financial responsibilities however satisfactory the above systems may be. If irrigation is paid for in advance, then discounts for higher levels of payment may be made. If payment is made after irrigation, then water users may simply refuse to pay, for whatever reason. Penalties for non-payment need to be enforceable and enforced if payment is to be ensured throughout the organisation area. These may be legally enforced penalties such as confiscation of property or crop share, or closure of the well. Organisation staff should also be subject to incentives and penalties.

Written agreements have been introduced by GKF in Bangladesh, who draw up contracts under four arrangements: (i) the supply of water alone, (ii) the provision of inputs (seeds, fertiliser, pesticides), (iii) supply of water plus inputs (iv) contract farming arrangements whereby GKF leases land or comes to a profit share agreement with the farmer with GKF providing all inputs, labour and management for the crop. These are signed written contracts either with individual or groups of farmers and are enforced.

Written agreements are not essential. The important thing is a generally recognised agreement, and a sanction.

Written agreements are not essential. The important thing is a generally recognised agreement, and a sanction. The sanction may simply be neighbourly disapproval if people go back on verbal agreements, or something stronger, such as the cutting off of supply (e.g. removal of the handle) or judicial punishment. The latter should always be a last resort (lawyers are notoriously expensive and not entirely reliable). As society becomes more literate, written agreements are advantageous, as there is less room for misunderstanding about terms and sanctions.

5. ECONOMIC ISSUES AT THE POINT OF FULL OR PARTIAL TRANSFER FROM PUBLIC TO PRIVATE SECTOR

There are key economic factors which need to be considered at the point of transfer from a more publicly owned to a more privately owned groundwater irrigation technology. Central to this is the financial basis on which transfer is based:

(i) whether the new owners of the technology should be asked to contribute to the full capital cost of the technology (either full replacement cost or current depreciated value) or whether there should be some form of subsidy or support from government, and

(ii) whether the new owners should be asked to pay the whole sum immediately or by credit.

Those wells sold direct to private groups/ individuals appear to have faired better than those sold to the co-operatives.

The outstanding debts which banks in Bangladesh are faced with illustrate the problems that have been encountered from previous financial arrangements at the point of transfer. DTWs in Bangladesh were sold off by BADC, either directly to individuals or groups or through BRDB and the KSS co-operative system under credit arrangements. Those which were sold direct to private groups/individuals appear, on the whole, to have done better than those sold to the co-operatives. The

DTWs were sold off in three phases and each phase reduced the subsidy and increased the capital cost (Tk. 40,000, Tk. 60,000/- and Tk. 1,75,000/-), and those sold earlier also appear to have generally done better.

The wells that have performed better following transfer on the whole have the following characteristics:

- closer to large markets.
- owned by commercially minded individuals or small groups who purchased because they wanted to, had clear plans for the well, and had cropping patterns which were high in value.
- were, for whatever reason (often intangible - local culture, personality), able to maximise the number of contributing farmers. The repayments on a Tk. 1,75,000 loan are more easily shared amongst 100 farmers (Tk. 1,750 per farmer, plus interest) than amongst 25 farmers (Tk. 7,000 per farmer, plus interest).
- either had equipment that broke down infrequently, or relatively easy access to a mechanic and spare parts. The credit repayment, for most farmers, was a big burden and additional expenditure on repair and maintenance was often not affordable. Most of the wells that are now out of operation first went out of operation due to breakdown and a lack of resource mobilisation to pay for repair.

The Punjab Private Sector Development Project in Pakistan has taken into account the considerable drain on resources of capital investment in major technologies (in this case the SCARP tubewells) and has given the farmers the option of closing the SCARP well and taking on a cheaper technology or retaining the SCARP tubewell. The farmers have almost entirely gone for the former option. The farmers also have to pay in full, up front, before the technology is handed over. No further payments are required. There are two reservations about this system. Firstly, a valuable technical asset has been withdrawn from service and provision should be made to ensure that this asset, the motor in particular, is used elsewhere. Secondly, direct subsidy was provided in support of the farmers' take over of the well. The farmers have to form a farmers' organisation and as a group deposit Rs. 20,000/- in a bank account and the government will provide the other Rs. 10,000/- needed to purchase the new well. Experience, particularly in India, has shown that farmers

will often co-operate with projects and form organisations solely to get the subsidy.

6. ECONOMIC RISK MANAGEMENT

Irrigated agriculture is a risky investment, since there are so many factors which can unpredictably and dramatically alter its profitability. The Government can, to a greater degree, afford to incur losses from irrigation, but those in the private sector are far more vulnerable.

The main threats to profitability in irrigated agriculture are output prices, energy supply and the weather. The last year in Bangladesh illustrates many of the risks faced by farmers in sustaining irrigated agriculture:

- an unusually heavy monsoon in 1998 lead to extensive and prolonged flooding which dramatically reduced the production of the *aman* (summer - rainfed) crop.
- rice prices increased significantly due to shortages, so a larger than usual number of farmers decided to grow the *boro* (winter irrigated) rice crop.
- in some areas, however, farmers have been so badly affected by the monsoon that they have been forced to sell their irrigation equipment to raise cash.
- since the end of the monsoon there has been a drought and irrigation demands on power supply have been considerable and there has been considerable damage to electric motors, primarily due to low voltages.

Following the harvest of spring 1999, the larger than usual volume of production (and reserves of internationally donated rice given after the terrible monsoon) means that the price of rice is now very low.

At each point the farmers have lost out and with the harvest of spring 1999 many farmers will make a loss on the enterprise. In these circumstances irrigated agriculture does not appear to make financial sense. However, a boom and bust effect ensues because production will fall next time around, with many farmers choosing not to irrigate and rice prices will once again rise.

A boom and bust effect exists in groundwater irrigation in many of the monsoon climatic countries.

The farmers make their own economic risk assessments in choosing whether or not to irrigate, based on the risks highlighted above. The nation, however, needs production to grow, and to continue to grow, given the large growth in population (and larger growth in urban population) forecast. Conventional insurance is not an

option because the extremely high risk (indeed more than risk - there is an element of certainty about bad weather events), and the enormous number of farmers at risk, would make premiums prohibitive.

NGOs are trying to mitigate some of these problems through encouragement of savings as part of their credit arrangements (see NGOs and credit above), but this is one area where the private sector cannot cope with the enormity of the problem. A variety of measures available to the Government could be used judiciously to reduce the volatility of rice prices, including more consistent intervention price setting, increased storage and the development of electricity resources. With no national agency co-ordinating a major sector of the economy, measures at mitigation (and research into mitigating measures) or lobbying are severely restricted.