

Grameen Bank Tubewell Irrigation Program: A Case of Management Transfer in Bangladesh

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INTRODUCTION

A large proportion of irrigation in Bangladesh involves tubewells pumping from groundwater sources. Early development of tubewells in the 1960s and 1970s was through government agencies, primarily the Bangladesh Water Development Board (BWDB) and the Bangladesh Agricultural Development Corporation (BADC). While later groundwater development, particularly of shallow tubewells (STWs, relying on centrifugal pumps), was mostly through sales to private individuals and groups, most of the earlier deep tubewells (DTWs, using submersible pumps) of the two agencies remained under some form of public ownership into the 1990s. BWDB has run several hundred wells in its North Bangladesh Tubewell Project (NBTP) and BADC through the 1980s owned roughly 12,000 DTWs which it rented to farmer groups.

In the late 1970s, however, a program of irrigation management transfer was begun and BADC's rental wells were made available for ownership transfer to individual farmers, formal and informal farmer groups and non-government organizations (NGOs). The Grameen Bank (GB), a quasi-NGO which built its reputation in a major credit program for the rural poor and disadvantaged, became actively interested in tubewell irrigation in 1985 and has since become the biggest single purchaser of public tubewells. As of February 1994, it owned 940 formerly public wells.

A study of the transfer process from public agencies to the Grameen Bank and an examination of GB's irrigation management system (which was subsumed under the Grameen Krishi Foundation, GKF, in 1991) as it has evolved can provide useful lessons for possible similar endeavors both in Bangladesh and abroad. The objectives of this paper are to: a) look at the process of ownership/management transfer from government to GB; b) examine the GB/GKF management system and its evolution as Grameen has tried to build on its strengths and learn from the successes and failures it has experienced; and c) evaluate aspects of the performance of GB's irrigation program in terms of efficiency, equity and sustainability.

Both secondary and some primary data sources have been available for this paper. The primary data were collected under a study conducted by the International Irrigation Management Institute (IIMI) in 1991 on IMT from BWDB to the Grameen Bank. The secondary sources include GB official reports and papers as well as discussions with GB officials.

BACKGROUND

Agriculture dominates the economy of Bangladesh producing nearly 36 percent of the country's output, providing employment to three-fifths of the civilian labor force and earning a significant portion of the country's foreign exchange (BBS, 1992). Problems affecting agricultural development include land scarcity and tenure arrangements, climatic hazards, inadequate credit, insufficient irrigation facilities and poor rural transport. Of these, perhaps the biggest constraint to agricultural investment is the heavy pressure of population on agricultural land resulting in an average farm size of only 0.93 hectare (BBS, 1992) generally fragmented into many tiny plots. Further, roughly 25 percent of land is operated under a tenancy arrangement in which the tenant commonly receives only half of the crop but must provide all of the inputs.

Irrigation has long been recognized by the Government of Bangladesh (GOB) and others as the leading input for the development of agriculture. Accordingly, the GOB in the 1960s and 70s started to install irrigation facilities under public sector management and ownership and provided irrigation services to farmers at highly subsidized prices.² Irrigation in the country does include a few major surface schemes (covering only 6 to 7 percent of irrigated area) but irrigation investment has been dominated by both public and private development of such minor irrigation technologies as motorized deep tubewells (DTWs), shallow tubewells (STWs) and low lift pumps (LLPs) together covering almost 80 percent of the irrigated area. Remaining coverage is through traditional technologies and modern manual pumps.

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²In the early years of irrigation development subsidies on different systems of irrigation ranged from 34 to 100 percent (de Vylder and Ausplund, 1979).

Total irrigation coverage in the country in 1990-91 stood at 2,805,349 hectares (IIMI, 1993) which is about 31 percent of the net cropped area and roughly 42 percent of the potential irrigable area.

The early emphasis on deep tubewell (DTW) technologies owned and managed by government agencies shifted in the mid 1970s. The introduction of the smaller shallow tubewell (STW) technology did not lend itself to direct public management so almost all STW development was through distribution to private individuals and groups--though public agencies did stay involved in sales and distribution for some time. Public sector management of DTWs was also found problematical as command area coverage was low, huge subsidies were required and the rate of development was slow (GOB/World Bank, 1982). As a result of these economic considerations as well as of certain political conditions, from the late 70s new DTW installations were made only for sale to private groups, individuals and NGOs and most of the older DTWs which had been rented to groups were offered for sale (Osmani and Quasem, 1985). This sale did not really take off until the 1990s when the government made a concerted effort to dispose of its remaining rental wells.

GRAMEEN BANK IRRIGATION PROGRAM

The Grameen Bank entered the irrigation sector in 1983 through its landless pump group program whereby landless groups were enabled to sell irrigation water as a business. The Grameen Bank itself had grown out of an experimental program of Professor M. Yunus of Chittagong University in which it was attempted to develop an institution owned by the rural poor which would provide to its members easily accessible credit without tangible security and which would undertake social and economic development activities for those members, many of whom were landless. The Bank was formally founded in 1983 and now operates 1,200 branches throughout the country.

The GB landless irrigation program, concentrating on DTWs, encountered a number of managerial, social and technical problems threatening its sustainability (Mandal, 1991). At least partly due to these problems GB changed its strategy in 1988 and began an irrigation program under its direct ownership and management. GB now owns 940 DTWs which it purchased from public agencies under the government's turnover program. Besides these DTWs, GB also owns and operates about 300 STWs which were purchased from public and private sources. Initially GB implemented its irrigation program through an agricultural project run by the Bank. In 1991 it formally set up a separate entity, namely, the Grameen Krishi Foundation (GKF), to take responsibility for the operation of the irrigation and agricultural program.

Goals of GB's irrigation involvement included: a) sharing agricultural sector development with the poor; b) applying GB's management and organizational strengths to utilize existing irrigation assets to create revenue for GB and income generation opportunities for its landless members; c) developing improved models for the management of DTWs on a self-sustaining, cost recovery basis; and d) increasing the overall food production in the project areas. For its part, the GOB was impressed with the performance of the Grameen Bank in other areas of rural development and was convinced that GKF ownership and management of DTWs would achieve the twin objectives of efficiency and equity. So the GOB chose GKF as a prominent buyer of its DTWs.

GKF purchased its tubewells from two public agencies--the Bangladesh Agricultural Development Corporation (BADC) and the Bangladesh Water Development Board (BWDB). The BADC DTWs are equipped with shaft driven turbine pumps driven by diesel engines and nominally rated at 57 litres per second (l/s) with a minimum target command area of 24 hectares. The BWDB wells are powered with electric motors and are rated either 60 l/s or 90 l/s. Target command area for a 60 l/s pump is 40 hectares and that for a 90 l/s pump is 60 hectares. STWs, which are mainly used by GKF to provide backup service to DWTs, are pumped by centrifugal pumps and powered by diesel. They produce discharges of about 10 to 15 litres per second and so cover smaller area relative to DWTs.

GKF Management Approach

The GKF approach to irrigation management differs a great deal from the management systems followed by public agencies in Bangladesh. The administrative structure provides for intensive on-site management inputs. Each DWT, which is known as a "farm", has one regular staff member whose designation is Farm Manager (FM). Besides the FM some seasonal employees are appointed for each farm. Eight to fifteen farms make a unit which is headed by a unit manager who is assisted by other staff. Ten to fifteen units comprise one region headed by a regional manager. At present the GKF Irrigation Program operates through seven regional offices. The regional and project offices are provided with human and material resources to support the irrigation program. Many highly motivated and qualified field officers (having M.A. or M.S. degrees) as well as other supporting staff, FMs and seasonal workers actually live in the villages associated with the DTWs. The program is designed to provide seeds, fertilizers, pesticides, extension services and crop production and marketing facilities to farmers--in addition to water. GKF management provides these inputs as well as tubewell repair and maintenance services in exchange for a contracted share of the crop. With the exception

of some limited participation of farmers in water distribution and conflict resolution, GKF does not generally involve farmer participation in its irrigation management functions.

PERFORMANCE OF THE GKF IRRIGATION PROGRAM

Turnover Progress and Operational Status of the DTWs

Of the 3,959 DTWs offered by GOB for sale to GKF in the greater Rangpur and Dinajpur districts, GKF bought 805 wells--574 from BADC and 231 from BWDB. Of these it purchased 24 in 1988-89, the year of the start of its program, and 781 in 1989-90. All of these DTWs were new or had been reconditioned and they were purchased at 29 percent of their unsubsidized cost. After 1989-90 GKF did not purchase any more wells in Rangpur-Dinajpur districts. In other parts of the country GOB still had more than 9,000 DTWs for sale by the late 1980s, out of which GKF purchased from BADC 220 in Tangail District and 107 in Rajshahi District. Of the Tangail wells GKF has sold 85 to farmers and it has closed its Rajshahi operation totally by returning the wells to BADC. Thus GKF now has a total of 940 DTWS taken over from public agencies.

In the Rangpur and Dinajpur areas GKF operated all of its 24 DTWS in 1988-89, the first year of its operation. After that, with a large rise in the number of its wells, a significant proportion of GKF's wells were not in operation during each of the following years (Table 1). The highest number of wells operated in these districts (618 out of 805 or 77%) was in 1990-91--while the number was down to 496 (62%) in 1992-93. In Tangail GKF operated only 18 of its 135 wells in 1992-93.

Area Irrigated

In the Rangpur-Dinajpur area, the average area irrigated per GKF deep tubewell during the *boro* (winter-spring irrigated rice crop) season in the five years (from 1988-89 to 1992-93) rose as high as 18 ha (1989-90) and as low as 13 ha (1992-93), showing a declining trend (Table 1). This achievement was lower than the rated capacity of the wells but higher than the performance of the DTWs managed by the public agency (BWDB) in the area. As reported in an IIMI study (Hakim and Parker, 1991a) the area's BWDB managed wells irrigated, on average, 10.6 and 12.7 hectares respectively in 1987 and 1988. When crops irrigated in all seasons of a year are considered GKF tubewell performance improves in appearance. Full year average irrigation coverage per DTW was 20.4 hectares in 1991-92 and 35.7 hectares in 1992-93 (Table 1).

Crop Yield

Data on *boro* paddy yield do not show a clear trend. Per hectare average yield was 3,392 kilograms (kg) in 1988-89, fell to 2,652 kgs in 1989-90 and rose to some extent in 1990-91 (Table 1). In 1991-92 the yield was the highest among all reported years (4,227 kg) but fell again in 1992-93 to 3,870 kg. The yield performance of GKF in the area, by and large, mirrors that of wells managed by BWDB. Ghani and Mondal report that in 1991 *boro* average yield per hectare in BWDB wells was between 3,400 to 4,500 kg. (Ghani and Mondal, 1991). However, there is potential for further increase in yield.

Irrigation Fee

GKF collects its irrigation fee in kind. When farmers take only water it charges about 1,100 kg of paddy per hectare or one fourth of total produce, whichever system is agreed upon during negotiations. If farmers take fertilizers and pesticides as well as water, GKF charges about 1,850 kg of paddy per hectare or one third of the total produce. In the Rangpur-Dinajpur area GKF generally charges a fixed amount of paddy which is either 1,100 kg or 1,850 kg per hectare depending on whether farmers take only water or water plus inputs. The GKF irrigation fee rate is equal to that of privately managed DTWs but is twice what is charged by BWDB. At the current market price of paddy (US\$134/MT) the per hectare GKF irrigation fee for water (using the fixed amount system) is US\$150³ while the comparable new BWDB fee is US\$75. BWDB, of course, subsidizes the irrigation costs of the farmers.

In the Dinajpur area GKF fee collection efficiency seems to have increased substantially over the years. In 1991 when a small IIMI study was done fee collection efficiency was reported to be 50 percent of the total. In 1993 the efficiency had risen to 97 percent.

³The current exchange rate of Taka 40 per US Dollar will be used throughout this paper.

Quality of Irrigation Services

In 1991 when an IIMI survey was made of former BWDB wells taken over by GB, the researchers' informal discussions with farmers during field visits revealed that farmers, especially small and tenant cultivators, were generally satisfied with the quality of irrigation services provided by GKF management. They were also appreciative of the responsiveness of the GKF staff. Farmer opinions, however, were somewhat more mixed when gathered through structured interviews (Hakim and Parker, 1991a). The majority of farmers then reported that they did not always get an adequate quantity of water and that water was sometimes not received at the proper times. When asked to compare GKF service with what they had experienced under BWDB, though, the majority of farmers reported water timeliness, adequacy, predictability and equity as being the same or better under GKF management than it had been under BWDB. GKF officials have also reported in discussions that since 1991 the quality of irrigation services of GKF has improved markedly--a fact they attribute to GKF's growing experience in command area development.

Equity

One of the basic objectives of the GKF Irrigation Program is to provide a return from its DTW profits to those rural poor who are GB shareholders. This has not, however been possible so far because the DTW schemes have not been able to make any profit for GKF yet. In regard to the distribution of farm sizes within the effective DTW command areas, the 1991 IIMI study observed a middle-size farm domination--with farm sizes in Bangladesh being categorized as: small ≤ 1 ha; medium > 1 ha but ≤ 3 ha; large > 3 ha. No discrimination was observed, however, in terms of the distribution of water among various size categories of farms and among different field locations. As to input provision, small and tenant farmers especially have benefited by GKF's provision (for an increased crop share) of fertilizer, seeds and pesticides as this aspect of the program helps solve a cash constraint many farmers face at the beginning of the season.

Income/Expenditure

The GKF Irrigation Program in the Rangpur-Dinajpur areas has been in operation since 1988-89,--i.e., more than five years. The program, however has yet to make any profit. Its losses, in fact, have increased over the years (Table 2). According to GKF information sources (GKF Annual Report, 1993; GKF unpublished table, undated) the net loss of the program as a whole has increased from Taka 1.4 million (US\$35,000 at today's exchange rate) in 1988-89 to Taka 116.4 million (US\$2.9 million) in 1992-93. At the micro level, as well, almost all individual DTWs are incurring losses. The average loss per DTW in 1992-93 was about Taka 100,000 (US\$2,500), excluding GKF costs in program offices away from the tubewells or its costs from holding more than 300 non-operating tubewells. However, GKF is reported to be covering its variable operational costs (fuel, maintenance, etc.) for the DTWs (Mallorie, 1994).

PROBLEMS FACED BY GKF

The progress of turnover of public DTWs to GKF and the performance of the turned-over wells has been affected by factors that can be grouped into two general categories: (a) factors external to GKF management; and (b) factors associated with the implementation of GKF's Irrigation Program, i.e., internal to the project. External circumstances would seem to have been primarily responsible for the low turnover record. GKF management had little control over these external factors. Some external factors would also appear to explain a portion of the operational performance presented in the previous section.

External Factors

Attitudes against Transfer of DTWs to GKF. Many agency officials, local opinion leaders, farmer leaders and farmers had vested interests in public ownership and management of DTWs. Their negative attitude towards irrigation management transfer seems to have significantly influenced the success of the turnover policy. The IIMI field survey in 1991 on turnover of BWDB DTWs to GKF found that a large proportion of the sample farmers had been against the turnover policy. Local public opinion leaders (from farmer cooperatives, elected local bodies, school teachers, etc.,) were also largely against turnover of the BWDB DTWs. The BWDB lower level officials had made no secret of their disapproval of the policy while mid and high level officials, being government servants, did not openly oppose the policy but predicted that it would not ultimately succeed. All the groups against the general turnover policy were also specifically against the selling of DTWs to GKF. Each of the groups felt its interests were at stake.

Fees. Irrigation service fees have been part of this dissatisfaction. Under BWDB's management of DTWs no irrigation fee had been exacted for more than a decade after project initiation. After that period of no fee, a user fee was charged but it was very nominal and was never paid by farmers. Then in 1983-84 a new fee was fixed at only US\$9.30 per hectare for a dry season crop and US\$3.10 for a wet season crop. The collection rate of this low fee was found to be only 24 percent in the 1984-85 period and 34 percent in 1989-90 (Hakim and Parker, 1991b). After 1991 the fee has been increased twice which has resulted in the present rate of US\$75 per hectare (but still with a low rate of collection). Under the GKF System the contracted per hectare fee (collected as a share of the crop) was the equivalent of about Tk.4,220 (US\$105.50). This was similar to what was paid by users under other non-BWDB tubewell owned/managed by private individuals and groups. Because of the increase in the fee they faced under GKF management, farmers receiving water from the former BWDB wells did not like the turnover policy and opposed GKF's takeover of their wells. Even the presently enhanced fee of BWDB (if enforced) would be much lower than the GKF fee. So opposition on these grounds to the GKF takeover still remains.

Reactions to Loss of Control. Fees, however, have not been the only issue. Farmer cooperative leaders also faced through DTW transfer to GKF a loss of control of the tubewells (and the benefits and status accompanying that control). Some leaders of local elected bodies found that tubewell transfer to GKF could be a popular political issue and have been able to use it to gain political support and influence. Lower level BWDB officials had the fear of losing their jobs and extra monetary benefits if BWDB wells are disposed off to GKF. For mid and high level BWDB officials the issue was more one of not wanting to see their agency diminished, in addition to wishing to avoid losing position or promotions.

Active Resistance. The negative attitude of all the above interest groups was expressed in both overt and covert ways--ways which adversely affected the attainment of command area and the collection of contracted fees (especially in the early years) at the wells taken over by GB. The strength of these attitudes, in part, dissuaded GKF from taking over further numbers of wells. Such attitudes also has led to non-operation by GKF of a number of wells which it had purchased.

At the operating sample wells surveyed in the 1991 IIMI study (Hakim and Parker, 1991a), some of the larger and more influential farmers chose not to cultivate land themselves and also dissuaded their tenants and share-croppers from using irrigation water provided GKF. This behavior reduced the size of irrigated command area, increased GKF's cost per hectare of providing irrigation and reduced its income. In some cases, hostility and lack of cooperation from farmers also led to the delayed start of irrigation during the season--which both discouraged interested farmers from taking part in irrigation and affected crop yields. Some influential local opinion leaders also persuaded many of the participating farmers not to pay all or part of their contracted shares to GKF. In addition, it was reported that while paying a reduced share, some farmers chose to mix low quality paddy and sand into what they did give GKF.

The IIMI study also examined three non-operated tubewells. One of them could not be operated because of resistance from one of the field level staff of BWDB and a few of his big farmer associates. That staff person was a tubewell operator and one of the larger farmers in the village in which the tubewell was located. It was reported that he threatened his tenants with eviction if they chose to irrigate their land in defiance of him. The second well remained idle because the local farmer cooperative manager mobilized people against GKF and persuaded them not to irrigate their land under it. The third well, remained idle because of delays in the process of getting an electrical connection and because the number of farmers willing to cultivate was not enough for operation. Under this well there was no open resistance--although a school teacher from the local village reported to one of the principal investigators that GKF's fee rate was exploitative. He compared GKF irrigation enterprise with the business of the British East India Company in colonial India.

Despite the above, it should be noted that farmers did not seem to be against the Grameen Bank as such. They had some knowledge of the bank and of its objectives. What the farmers did not want was that GKF should operate the irrigation enterprise in their (formerly BWDB) area. Many of them did say that they would like GKF to help the poor to undertake income raising activities in the region, give training and credit to poor women and undertake other rural development activities.

From recent discussions with GKF officials it is understood that the opposition of various interest groups to GKF's takeover and management of BWDB wells has not decreased over the years. A major additional form of non-cooperation has been added to the ones noted in 1991. The large and influential farmers are now sinking STWs in the command areas of GKF DTWs.

With Bangladesh Agricultural Development Corporation (BADC) DTWs the GKF takeover experience has again included: a) resistance by those locally in control of the wells, and b) a degree of uncooperativeness by local BADC officials. Such officials often failed to hand over DTW technical files to GKF, sometimes turned over incomplete DTWs, and did not fulfil the warranty obligations agreed to by BADC. On the other hand, problems related to differential

irrigation fees have not arisen as the turned-over BADC DTWs are located in an area (greater Rangpur District) where no agency (including BADC) has had an irrigation program charging fees lower than those of GKF. Local politicians also did not create problems in the area.

Electrical Supply Problems. Out of 231 BWDB wells taken over by GKF, only 8 are diesel-operated and the rest run on electricity provided by the Rural Electrification Board (REB) which is the sole electricity supplier in the area. REB currently charges irrigation users Tk. 2.25 (US\$0.056) per kilowatt hour, a figure 38 percent below its average unit cost. In the initial years GB found itself facing three major electricity-related problems:

- 1) REB electricity meters are fitted on a pole outside the well house and are within easy reach of vandals (reportedly including hostile farmers). In a number of cases meters were stolen and in other instances they were broken. When a meter is stolen or broken, REB goes through a process of fixing responsibility. During that process the well remains out of operation causing damage to crops. If responsibility is fixed on GKF (as has happened), GKF must pay a penalty. In one of its sample wells IIMI found that the meter had burned-out twice, leading to a halt in operation for one month and causing damage to the crops. In another case (outside the sample), problems related to fixing responsibility for the meter damage led to the non-operation of the well for the whole season. REB reportedly has declined to place the meters within the security of the well-houses due to the inconvenience caused to meter reading.
- 2) Reported electricity consumption at some wells has seemed unjustifiably high. The process of bill adjustment has also been prolonged.
- 3) By REB policy electricity connections are only made if all DTWs along a particular grid line are to be operated. This has caused some GKF wells to remain idle. In one case there were 20 wells under a single line and GKF could not convince the farmers of some of these wells to irrigate land under their management. To get the connection GKF would have had to accept responsibility for the electricity bills of those wells which would be run by farmers independently of GKF. This the GKF could not do and all of the wells remained idle. In regard to these and other problems there was some level of dispute between GKF and REB as to responsibility.

On the whole, the electricity supply situation in GKF's Rangpur-Dinajpur Irrigation Program area does not seem to have improved over the years and program performance has suffered as a result. Due to its own internal problems, REB was unable to provide electric connections to a number of intended GKF DTWs. REB's supply of current has also been often insufficient or unavailable at crucial times. In 1990-91 electrified DTWs in some areas are reported to have received electricity only for two to three hours in a day and sometimes they received no current for three to four days in a row. This experience seems to have discouraged GKF from operating some of its electrified wells in the following years. While in 1990-91 it operated 142 electrified wells, in 1991-92 and 1992-93 their numbers were respectively only 42 and 57.

Support from Local Administration. In some cases the Grameen management has reported that local civil administrators would not support GKF in its attempts to enforce farmer share contracts or to control vandalism against the electrical meters. The authorities evidently had some doubts about the legal basis for their involvement in these disputes.

Soil Condition. Most of the greater Rangpur-Dinajpur soil is mainly sandy, sandy loamy or loamy--all of which have very low water holding capacities and require more irrigation water than do other kinds of soil. The soil is also lacking in organic matter and requires more fertilizer. Irrigation and crop production in this soil thus is more expensive.

Farmers' Experience. Farmers in the area, especially those irrigating under new DTWs, are far less experienced than farmers elsewhere in HYV crop cultivation under irrigated conditions. As a result, yield per hectare on their lands is relatively low. When farmers get low yields, GKF's fees derived from proportional crop shares also are low and the tubewell income falls. In addition, many farmers in the new wells have not yet learned the technique and culture of sharing water among themselves--which leads to conflicts that cause the temporary closure of some tubewells and damage to the crops.

Relative Price. In Bangladesh prices of many inputs have been increasing at a higher rate than crop prices--making farming under irrigated conditions a progressively less attractive enterprise for all farmers in the country including farmers in GKF Irrigation Program (Figure 1). Lower output prices reduce GKF income, too. GKF generally charges its fee in terms of a fixed share of output. As output prices fall GB's revenue from sale of output decreases. For GKF

as well as for farmers, the year 1992-93 was the worst year in the recent past in respect of output prices. Output prices in that year, especially that of paddy, fell by an amount equivalent to about forty percent of the average price during the recent past.

Acceptability of Social Practices. Many big farmers (over 3 ha) in the GKF Irrigation Program area have been in the practice of leasing land to poorer farmers on a share-crop basis. While they are used to taking in a crop share as payment they consider paying out a share to be a social practice associated with low prestige. Some larger farmers reported this as being a problem they have regarding their own participation in GKF's system of share-based fee collection.

Internal Factors

The Rapid Pace of Project Development. The GKF management has adopted a very rapid pace in implementing the takeover program of BWDB and BADC wells. In the rush to take over wells the tubewell selection process may have been somewhat neglected, leading to the choice of problematical wells. Also, due to the felt need for speed, the magnitude of local opposition seems to have been underestimated.

Experience of GKF Officials. GKF personnel in the irrigation program had little prior experience or training in irrigation management. Their officers also did not have much prior knowledge about crop production and related subjects. Most officers and field staff have only a social science background. Perhaps because of GB's haste in implementing the program, the management could not give sufficient training to the field officials and staff on irrigation management and crop related subjects. The management seems to have heavily relied on the high level of motivation of its officers and staff, to the neglect of needed technical qualifications. This may have affected GKF's performance.

Farmer Participation. The GKF management model does not have any formal mechanism for farmer participation, although field level staff and officials reported informal participation of farmers. Farmers, it seems, have often felt alienated from the process of irrigation management--possibly decreasing their willingness to cooperate.

Command Area Development Program (CADP). In the initial years, GKF management did not adopt many of the usual CADP methods to increase water use efficiency by improving the poorly constructed and aligned channels, using a rotation system of water distribution among farmers, etc.

Input Supply. In the early years of its operation, the GKF Irrigation Program's input supply component evidently faced some problems. A majority of the farmers who got inputs as part of their package reported that they did not get those inputs in sufficient quantity and at the right time. GKF supplied fertilizers at the BADC recommended doses. But farmers said they wanted a higher rate of application on the grounds that soil in their regions requires more fertilizer than the recommended doses. Some farmers complained that seed quality was also poor. Instead of using them in their fields, some farmers are reported to have sold inputs supplied by GKF to others for cash. Supplying inputs directly to the farmers also turned out to be costly to GKF due to transport and storage problems.

Staff Cost. Intensive supervision has been seen to be necessary for achieving the objectives of the GKF Tubewell Program. Program staffing replaces farmer participation--but the level of staff input may help ensure that distributional equity goals can be reached as less advantaged farmers can be protected from discriminatory practices. Each well is assigned one Farm Manager and one general worker. Their combined salaries are an important component in the high O&M costs and the resultant losses experienced by the GKF Program.

Share Collection Efficiency. In the beginning years GKF's fee collection efficiency was low in comparison with other private tubewell management systems in Bangladesh. This cannot be totally explained by farmers who refused to pay their shares. The ability of the staff to supervise the harvest crop division might explain part of the problem. There also seems to have been a great deal of flexibility in regards to the fixing of shares. In one tubewell there were simultaneously several different crop sharing arrangements among the farmer contracts. Such variety was hard to manage at harvest time and lead, in some cases, to farmers who had originally agreed to a relatively high share as a fee deciding that they would pay no more than the amount charged under some of the less expensive contracts.

SUSTAINABILITY OF THE GKF IRRIGATION PROGRAM

In the context of increasingly large losses incurred over the past five years by the GKF Irrigation Program and the opposition which it has been facing, the sustainability of the program may be questioned. While actual closure of the program might be a possibility in the future, the present program managers and staff are highly optimistic about the sustainability of the program. They base their optimism on the rich tradition and varied experience of the Grameen Bank in achieving success against serious odds and also on the number of coping measures they have initiated in recent years. The coping measures so far adopted include some of the following activities.

Screening and Selection of DTWs

GKF not only stopped buying DTWs since 1989-90 but has also chosen not to operate all of the wells that it owns. It has been going through a careful process of screening and selection of wells before putting them into operation. The objective has been to avoid losses from the operation of otherwise unviable schemes.

Command Area Development Program (CADP)

GKF has started implementing a CADP including: construction of improved water conveyance systems; introduction of better irrigation and water management practices; conversion of diesel to electric drive (justified by cost as well as expected improvements in electricity delivery under REB, the Rural Electrification Board) and provision of backup facilities for emergency water supply. In sixteen demonstration DTWs, these activities are reported to have improved performance significantly--increasing irrigated area by 44 percent and decreasing pumping hours and fuel requirements by 43 and 38 percent, respectively, over the pre-CADP year (Tables 3 and 4). Crop yield, however, has not yet increased appreciably, reportedly mainly because of bad weather

Crop Diversification

In most of GKF's greater Rangpur-Dinajpur Irrigation Program area, farmers used to grow irrigated rice--for which the soil of the area was not suitable. GKF, in its initial years, followed this farmer practice and suffered losses as a result. Recently it has started a vigorous crop diversification program under which it has been encouraging and helping farmers to grow low-water-consuming, high-value nonrice crops such as wheat, maize, pulses, soybeans, and sugarcane. For demonstration purposes GKF is growing these crops in its own farms. It is also growing export quality aromatic rice. Under its crop diversification program, GKF is introducing improved technology. All of these activities seem to be beginning to pay off. Area under irrigation is increasing and so is revenue from water selling.

Non-Crop Activities

GKF is not limiting its production activities to the crop sector only. It is involving itself in non-crop agricultural activities like fish farming and livestock production. In addition, seed production, nursery and homestead gardening development and the marketing of agricultural products are all being pursued. To benefit from improvements in technology and knowledge generated by the country's national agricultural research system (NARS), GKF has established formal linkage with all of the NARS member institutions. It also collaborates with other NGOs to share their experiences.

THE FUTURE: A SECOND GENERATION TRANSFER

GKF has a long-run plan to transfer management of DTW irrigation to local landless groups. There is an expectation that the involved landless people will reap a return on their management efforts--and as tenant farmers within the schemes some of them will also have access to a reliable source of irrigation water. As a start to implementing that plan, the Foundation has already organized 96 groups, currently associated with 41 DTW sites, to be trained to manage tubewell schemes. As of October 1993, GKF had actually transferred management of 13 DTWs to the landless groups. Under this program, GKF rents out DTWs to landless groups against a rental charge (which in 1993 was US\$250). It supports the groups with interest-bearing operating loans, free technical services to maintain wells and an assured supply of fuel/oil and spare parts at full cost. GKF staff also help the groups negotiate with buyers of water.

As it is implementing this plan GKF would appear to be going back towards the Grameen Bank's earliest model of irrigation management. Will it have any better success this time around now that the Foundation has its own experience in managing deep tubewells? The landless-managed wells are reported to be netting a profit above their variable costs for fuel and maintenance--but evidently, because GKF is subsidizing them. The present rental fee cannot cover much

of the annualized value of DTWs nor the cost of the services of GKF staff. If landless groups could manage DTWs without so large a subsidy, the GKF Irrigation Program's income position might move towards a more sustainable condition. Whether or not the landless can do this will depend on: a) the proper working of the wells; b) the level of the return from water to pay for the costs of operating the tubewells--which would involve, among other things, increasing command areas; c) improved access by the landless to technical knowledge and to spare parts and fuel/oil/electricity; and d) an adequate level of cooperation between the landless tubewell managers and the user farmers.⁴ For its part, GKF must continue to seek ways to help the tubewell schemes be more profitable. It must also persevere with its efforts to cut the cost of providing its own services to the schemes--in part, perhaps, by spreading the fixed costs of providing such services to those of its growing non-irrigation programs which need similar management inputs from the Foundation.

⁴These conditions are similar to ones needed in transfer programs in other countries. See Johnson III and Reiss, 1993.

Table 1. Performance of the Grameen Krishi Foundation's Greater Rangpur and Dinajpur DTW Irrigation Program.

Indicators	Years				
	1988-89	1989-90	1990-91	1991-92	1992-93
1. DTWs owned (number)	24	805	805	805	805
2. DTWs operated for growing boro paddy only (number)	24	585	618	495	496
3. DTWs operated in a full year for growing all irrigated crops including boro paddy (number)	na	na	na	592	548
4. Average area irrigated per DTW for the boro paddy crop (hectares)	17.6	18.0	16.9	13.9	13.0
5. Average area irrigated per DTW in a year for all irrigated crops including boro paddy (hectares)	na	na	na	20.4	35.7
6. Yield per hectare of boro paddy (kilograms)	3,392	2,652	2,910	4,227	3,870

Sources: Grameen Krishi Foundation deep tubewell project annual report through 1993; Rahman, 1993; and GKF Internal Information Table (undated).

Note: na = Not available.

Table 2. Income and expenditure of Grameen Krishi Foundation 1988-89 to 1992-93.

Year	Income (mil. Tk)	Expenditure (mil. Tk)	Profit/Loss (mil. Tk)
1988-89	0.17	1.56	- 1.39
1989-90	55.06	76.76	- 21.70
1990-91	84.36	167.62	- 83.26
1991-92	83.32	170.85	- 87.53
1992-93	116.70	233.10	- 116.40

Sources: Grameen Krishi Foundation Deep Tubewell Project Annual Report through 1993. GKF Internal Information Table (undated).

Table 3: Increase in cropped area due to technical assistance and earth channel improvements in demonstration wells.

Region	TW Scheme	Cropped area in dry season (ha)	
		1991-92 (before)	1992-93 (after)
Birgonj	Chaklakkhipur	18.6	24.3
	Keralgaon	22.7	25.1
	Shangkarpur	19.0	26.3
Dinajpur	West Rajibanpur	14.2	24.3
	East Rajibanpur	17.8	24.3
Birampur	Lohachara	20.2	34.4
	Aptair	18.6	24.3
	Chhatochangram	19.0	32.0
Kurigram	Joydebhyat-2	18.2	24.3
	Johdebhyat-3	23.5	28.3
	Bancharam	15.0	26.3
	Prashadkalua	19.8	28.3
Rangpur	Dhanipara	12.1	24.3
	Buribazar	25.1	28.3
Gaibandha	Analertari	15.8	26.3
	Baraipara	15.4	24.3
Total 16 schemes		295.0	425.4
Cropped area per scheme		18.4	26.6

Sources: Grameen Krishi Foundation: Grameen Deep Tubewell Irrigation Project. First Annual Report, 1992-93 (undated).

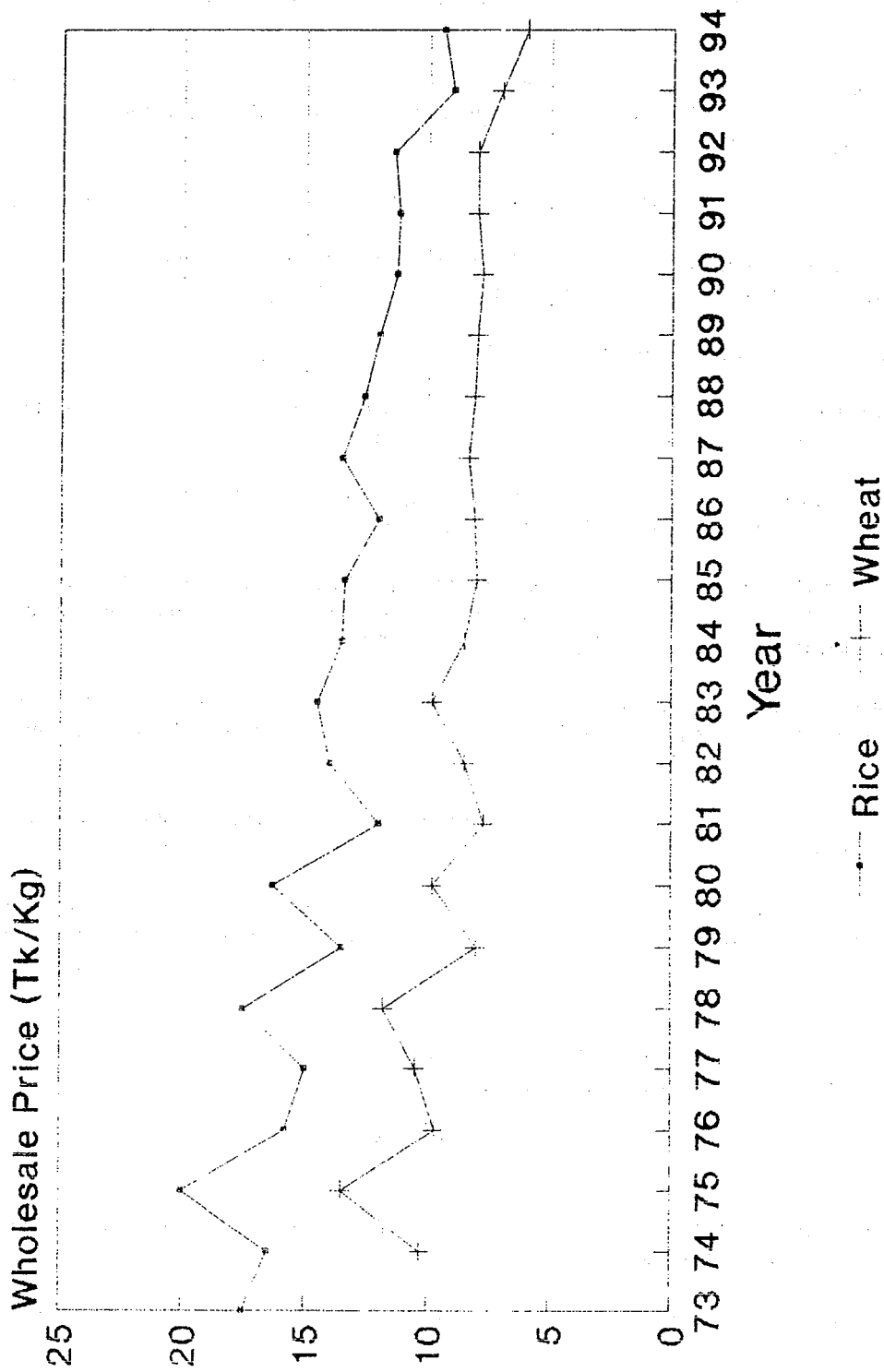
Note: TW = Tubewell.

Table 4. Pumping hours and cost for boro irrigation in demonstration wells 1991/92 (before demonstration program), and 1992/93 (with program).

Pump scheme	1991 - 92		1992 -93	
	Pumping (hrs/ha)	Diesel (l/ha)	Pumping (hrs/ha)	Diesel (l/ha)
Chaklakkhipur	62.1	186.4	40.1	101.2
Keralgaon	55.3	165.4	35.9	105.4
Sangkarpur	64.8	194.4	43.0	128.8
W. Ramjibanpur	82.7	282.9	15.0	77.9
E. Ramjibanpur	64.9	231.6	31.5	125.0
Lohachara	57.4	161.3	30.6	86.8
Aptair	50.2	109.8	26.8	58.8
Chhatochangram	88.8	151.2	30.2	71.5
Joydebhyat-2	73.4	226.9	32.7	145.6
Joydebhyat-3	67.1	175.7	43.4	156.2
Bancharam	53.5	112.4	36.0	91.5
Prashadkalua	55.8	154.1	42.0	131.7
Dhanipara	109.1	342.5	51.4	146.8
Burirbazar	67.6	200.8	53.1	151.1
Analertari	100.0	248.0	71.3	177.4
Baraipara	84.6	210.7	53.0	173.6
Average	71.1	197.1	39.8	120.6

Source: Grameen Krishi Foundation: Grameen Deep Tubewell Irrigation Project. First Annual Report for 1992-93, (undated).

Figure 1. Real food grain price trends.



Source: Haggblade, 1994

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