Irrigation Service Markets in Bangladesh: Private Provision of Local Public Goods and Community Regulation?[1]

By Richard Palmer-Jones

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Abstract

The exploitation of groundwater for agricultural production in Bangladesh has been crucial to the agricultural growth that has enabled Bangladesh to emerge from being the 'basket case' to a sort of self sufficiency in staple food production in the last 20 years together with significant reductions on HCR poverty. This has come about not through the innovative aid dependent NGOs for which Bangladesh has become famous, but largely through private investment in tubewells selling irrigation services (water) to farmers of contiguous blocks of land, evidently overcoming collective action problems posed by the fragmented and unequal land holding structure, and confounding pessimistic prognoses of several political economies. Groundwater drawdown externalities are not crucial in most areas due to the abundance of the resource. Competition in these markets can perhaps be modelled as 'contestable' and 'embedded'; disputes are regulated (perhaps imperfectly) by creative use of indigenous dispute resolution institutions and various cultural, economic, social and political resources. Poverty is reduced but the implications for inequality are not clear - but which is of greater significance?'

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Introduction

The exploitation of groundwater for agricultural production in Bangladesh has been crucial to the agricultural growth that has enabled Bangladesh to emerge from being the 'basket case' to a sort of self sufficiency in staple food production in the last 20 years and significant reductions on HCR poverty. A somewhat similar phenomenon has been experienced in West Bengal and some other parts of Eastern India (Rogaly; Harriss-White, and Bose 1999), where similar benefits to the poor appear to have been experienced.

There are several interesting aspects of this process that are relevant to the themes of community management of common pool resources. Firstly, groundwater appears to be a classic common pool resource and examples of institutions governing groundwater exploitation feature prominently in major texts on the subject (e.g. Ostrom 1990). As such it is generally argued that the private sector will overexploit groundwater, the user-group or community can and should manage the resource and property rights of some type established. Secondly, because there are significant economies of scale in the exploitation of groundwater (due to technological economies in pumping and in canal and pipeline technologies) and the spatial nature of water and land, groundwater irrigation has natural monopoly characteristics that give it the characteristics of local public goods. The agricultural growth and poverty reduction based on rapid and extensive exploitation of groundwater in Bangladesh and elsewhere in Eastern India suggests that the collective action problems implied in this type of situation have been managed to considerable human benefit. Understanding how and perhaps why this has come about can throw light on the exploitation of an important common pool resource and the provision of these and possibly other local public goods.

For centuries groundwater in South Asia has been extracted from dug wells but in the 20th century tubewells have become the almost exclusive technology in the regions of interest. While initially development of groundwater was promoted through cooperatives of various types (Khan, Blair 1985), and then through NGO supported groups, which have received much attention in the academic and development literature (Wood and Palmer-Jones 1991), by far and away the largest proportion of irrigation devices (Water Extraction Mechanisms – WEM) and of the area irrigated from these sources has come to be through the private sector, and is manifest in what can be termed irrigation service markets although they are often loosely termed water markets. While water is transferred it is not the economic good produced and sold, rather it is the service of raising and delivering the water to farmers' fields. I may use the term 'water markets' here inter-changeably with 'irrigation service markets', but the distinction is important although not appreciated in some of the uses to which interpretation of these phenomena have been put, e.g. by the World Bank (World Bank, 1993, 1994, Rosegrant and Binswanger 1994). In most cases no property rights in ground water are enforced in South Asia and no charge is made for the water per se. The situation is one of open access. The State often imperfectly attempts control of groundwater through siting and other regulations which are imperfectly (corruptly) enforced.

These irrigation service markets are usually analysed using the economists model of oligopoly, or more loosely monopoly, or more colourfully by the politically inclined as 'water-lordism'. Within the context of south Asia examples important in the development of these analyses have been drawn from many different locations (many of them conducted by and reported in Shah 1993) which have rather different hyro-geological, agro-ecological, and socio-political and economic characteristics, which should suggest needs for significantly differentiated analyses, which have generally not been forthcoming (Palmer-Jones 1995). In some these locations monopoly and water-lord models may have greater relevance than those based on modern micro-economics and industrial organisation theory which I prefer, at least for heuristic purposes and for the typical Eastern India situation. This latter approach suggests that despite obvious potential imperfections (see below) which have led many to see little prospect for or benefit in such 'market' mechanisms, they can be and in these situations have been crucial and beneficial in the provision of local public goods on a massive scale. This has been of immense benefit in terms of the numbers of people lifted out of absolute poverty, although it is still common to assert that the poor do not benefit (Sadeque 2000). The institutions which have facilitated this warrant closer investigation. In many ways such phenomena are far more important institutions for human welfare than the 'community irrigation', 'community forestry', or even, perhaps more controversially, the groups savings and credit examples of collective action widely canvassed in the development literature.

This paper reports a case study of an area intensively covered by irrigation service markets whose aim was to understand them better. Most earlier studies were methodologically very limited and highly flawed, based on a priori reasoning, personal knowledge, informal visits, informal/rapid/'participatory' investigative methods, and or limited or partial theoretical frameworks; consequently one aim was to explore a potentially more appropriate empirical approach, arising out of our own earlier work (BAU 1985, BAU 1986; Palmer-Jones and Mandal 1987). What we found was private provision of local public goods within a socially regulated 'contestable' market – embedded in local society. It is unlikely that this market is very imperfect, under the circumstances of poverty and natural and market uncertainty, and bureaucratic imperfections. While this finding can only be claimed for our particular site and perhaps period of study, it is likely to apply much more widely, and suggests the need for much contextually and theoretically richer studies before policy conclusions are drawn about the nature of and appropriate institutions for collective action in poor agrarian economies.

Agricultural and Groundwater Development in Bangladesh

Since the extensive margin of cultivation in what is now Bangladesh was reached by the late 1950s if not before, the growth of agriculture has had to come from intensification[2]. The two main forms of intensification are irrigation and flood control (and drainage without or with irrigation - FCD and FCDI respectively). In both cases intervention in the environment facilitates the cultivation of High Yielding Varieties (HYV) with fertilisers, and other agro chemicals. Increases in cropping intensity could be achieved by extending cultivation in the dry rabi and boro seasons (November through to May or June), or through the substitution of higher productivity crops or varieties for lower productivity crops traditionally grown in the monsoon or rabi seasons. Rescheduling of crops is often required with in some cases a reduction in time between harvesting and desirable planting times of the next crop, putting pressure on tillage and power resources. These latter forms of intensification (FCD and FCDI) had been limited by the capital intensity and technical and other limitations of these schemes (Hughes et al, 1994), but from the mid 1960s the spread

[2] There was much concern about post-harvest losses in the late 1970s; it seems likely that the gains from these reducing these losses are limited (Greeley, 1982).

of small scale mechanically powered irrigation equipment had produced the rapid growth of agricultural production of boro rice and wheat. In the late 1960s Low Lift Pumps (LLP) had been rapidly deployed under rental arrangements by the East Pakistan Agricultural Development Corporation (EPADC), making use of readily available surface water sources to spread irrigated HYV *boro* rice (see Figure 1c for the spread of different types of minor irrigation equipment). Deep Tubewells (DTW) were also promoted under rental arrangements by EPADC (and subsequently by the Bangladesh Agricultural Development Corporation - BADC), but spread more slowly from the late 1960s to the present. From the mid 1970s, privately owned Shallow Tubewells spread rapidly irrigating HYV *boro* rice from groundwater, sponsored initially by the BADC, but then through credit schemes of the nationalised banks (Palmer-Jones 1992, gives the sales of STW by different programmes in the early 1980s).

While the growth of *boro* rice production has provided much of the structural change in agriculture over the last three decades, the overall level of agricultural production in Bangladesh is still dominated by the *aman* rice crop which also has a profound effect on year-to-year fluctuations in agricultural growth and consequently on its short term trend. This rice crop occupies most of the cultivable land in the kharif season, and still accounts for more than half of foodgrains production. Apart from the catastrophic fall in *aman* production during the war of independence, from which it took until about 1977 to recover to where production might have been, and the two successive years of flood in 1987 and 1988, the *aman* crop has grown fairly steadily over the past three decades. Figures 1a-d show these longer run trends and indicate quite clearly how production in 1989/90 was above the long run trend.

After the initial boom in LLP-based irrigation of the *boro* crop in the second half of the 1960s, production of *boro* rice stagnated through the 1970s. The initial rise in STW based irrigation was associated with a rapid rise in irrigated wheat production in the late 1970s, but this tailed off in the early 1980s to be replaced by rapid growth in boro rice irrigated mainly by STW (see Figures 1b&d[3] for growth trends of wheat and *boro*). A slowdown in the sales of STW occurred in the mid 1980s, and there may

[3] Figure 5 shows the longer run trends of *boro* rice production with trend kinks in 1970, 1979 and 1991; Figure 6 shows wheat production with trend kinks in 1966, 1969, and 1981; see Boyce, 1987:267-271, for explanations of kinked exponential models.

have been some faltering in the growth of boro irrigated areas (although locational shifts and increasing irrigated area per STW at this time[4] may have partly offset this slowdown in new installations).

Using different political economies for their understandings and prescriptions for these phenomena different authors have produced what I term elsewhere ‘neither good desctiptions nor descriptions good to give’ (Palmer-Jones 1999).

Despite apparent slowdowns in agricultural growth, putatively associated with slowdowns in net installations of WEMs in 1984-5 and again in 1994-5 agricultural growth (proxied by staple cereals production) has proceeded apace in Bangladesh apparently to the present (Figure 1a), associated with and largely explained by continuing net expansion of private irrigation capacity.

There are potentially convincing reasons why private irrigation might have been expected to fail in the Eastern India context. This context is that while groundwater is abundant relative to effective demand (although this was not known to be the case in the earlier phases of its exploitation, is still disputed by some, and is the case in some localities), land ownership, while highly unequal, with many landless households and much (share-payment) tenancy, experiences a high degree of fragmentation and is largely ‘minifundist’ and there are very few very large farms (Boyce 1987). Broadly this structure is typical of the Eastern Indo-Gangetic plains comprising of much of Eastern Uttar Pradesh, North and (the new south) Central Bihar, most of West Bengal and Bangladesh, and parts of Assam and Orissa. Probably more than 300 million absolutely poor people lived in this region in the early 1980s. This agrarian structure means that few farmers have sufficient contiguous land to warrant investment in a tubewell to irrigate their own lands from a single point, and they therefore either have to transport their pump and prime mover from location to location where they have fields and to have separate tubewells in each location, or enter into some sort of collective arrangement with their neighbours. This can take the form of joint or cooperative ownership, or some sort of ‘water sale’, or rental arrangement from

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[4] In the early years STW entrepreneurs (and those to whom they might sell irrigation services) may have been unduly cautious in their determination of the appropriate command area per STW of a given capacity, due to inexperience with the technology. Later they may have expanded the command areas, but pressure of competition and ageing of their equipment might then have led to contractions. Appropriate command areas will also depend on soils and other local conditions (Wood and Palmer-Jones, 1990, Chapters 4-7).

owners of tubewells to farmers of land in the neighbourhood of the tubewell. In some of the earlier state promoted tubewell development schemes state ownership and provision was employed, and since the 1970s there have been many innovative schemes including ownership and management of tubewells by NGO sponsored groups of ‘landless’ men or women (who then sell the water – or as I would put are paid for the service of delivering water - to farmers with land within reach of the location where the group installed their tubewell). Given that ownership of tubewells was likely to be by larger and richer farmers who would generally be in a local monopoly position in relation to owners of neighbouring plots, many of whom would also be poorer and less socially and politically powerful than the tubewell owner it was not surprising that social scientists and others anticipated that, given the multi-stage nature of water inputs to crop growth, potential water buyers would be afraid that the more powerful water seller would behave strategically towards them by withholding water at crucial stages of crop growth once the buyer had purchased initial irrigation s and was committed to further purchases

Groundwater Based Irrigation in Bangladesh

Thus the dominant maintained hypothesis in policy discourse in Bangladesh has been that the agrarian structure in Bengal is not conducive to the emergence of competitive irrigation water markets (Boyce, 1987; Adnan 1999). The economies of scale in mechanical irrigation and the small and highly fragmented farm plot structure meant that individual farmers would not have sufficient contiguous land to make investment in the minimum scale of mechanical irrigation an economic proposition. Some form of cooperative or market institutions would be needed but these were unlikely to form given the highly unequal and conflictual social relations. Rural elites would dominate and control cooperatives, or would be the water sellers who would have a strategic advantage in relation to water buyers. They might use this advantage to withhold water to the disadvantage of water buyers. To the extent that water markets emerged they were likely to be monopolistic.

Economists have tended to use a relatively naive model of monopoly to analyse irrigation water markets (Shah, 1993; see Jacoby; Murgai, and urRehman 2001et al., 2001, for a more sophisticated treatment), and they have paid relatively little attention to the organisational and institutional characteristics of these markets. Other social scientists have also used the idea of monopoly to characterise these markets although they have used both social class and social network analysis to elaborate their accounts (Wood, 199?). These approaches use basic text-book economic models of imperfect markets which have been extensively replaced in modern economics by varieties of transaction cost, imperfect information and new institutional economics.

Claims that irrigation service (groundwater) markets are imperfect are based on application of price-marginal cost differences that are inapplicable to the complex reality of selling and buying irrigation water and irrigated agricultural production. Risk, credit, information and incentives, asymmetric bargaining power, agro-ecological and hydro-geological, and other factors are important. These features of the agrarian economy together with the spatial nature of irrigation necessitates a rather unique approach to socio-economic investigations in particular the need to study contiguous blocks of land rather than undertake random sample surveys.

Methodological considerations

Some general characteristics of the (natural and social) environment in which irrigation service markets exist are necessary to understand the methodological issues involved in researching these markets. We can discuss these relevant characteristics in terms of agro-ecology and hydro-geology, irrigation technology, and social structure.

As is well known, water runs down hill, seeps into the soil, and spills into low lying areas (and evaporates). The topography of most of Bangladesh and that with which we are concerned is typically deltaic, composed of ridges and troughs formed by the shifting and meandering of large rivers in easily erodible alluvial soils (see FAO, 1988:102-4 for a detailed exposition and Brammer 1996, for an accessible account). Ridges are former river banks and levees and have lighter sandier soils[5]; land slopes gently towards low lying areas – bheels – which are (or used to be) more or less permanent water bodies formed in former meanders, etc.. Soil texture, which is a crucial determinant of irrigation input-output relations and of fertility, is progressively heavier from ridges to troughs and surface water is increasingly available either from

[5] This account applies to areas on younger alluvial materials; topography and the spatial arrangement of soil types and water resources are somewhat different in the older alluvial areas such as the Barind and Mudhupur tracts and, of course in the hilly areas (terrace and hill areas in Brammer, 1996). Younger alluviums constitute much more than 50% of the land area of Bangladesh and a much higher proportion of the cultivated area and of the population.

previous floods or in the form of runoff from rainfall or irrigation towards the troughs which lead them to be sometimes termed naturally irrigated. Plots on high land have different cropping patterns (seasonal sequences) to those on medium and low land because of different soils, flooding regimes and access to and returns to irrigation sources. Water loss from canals and in fields is high especially on the more elevated land with lighter textured soils, making rice unattractive, but rice is almost compulsory on low land because seepage losses make low land permanently waterlogged so that only rice is viable. Crop production is risky due to nature and (output and input) price variability, and bureaucratic and political malfeasance. Returns to irrigation are spatially variable (due to soil and hydro-geological characteristics) and risky (breakdowns of machinery, shortages of diesel or electricity, risks of floods and other ‘natural’ disasters, and the variability of agricultural returns). Farmers are poor; credit and insurance markets are constrained and inter-linkage of factor and product markets is common; social security and safety nets to the extent that they are available are provided more through local moral economy than the State (or NGOs).

As mentioned above the agrarian structure while predominantly characterised by small average size of farms is also highly unequal, and there is a high level of landlessness. There is much share-cropping, still; most credit is informal; there is some interlinkage with output markets. Property rights are not well enforced by the State. Although there has been much seasonal and longer term migration and members of elite families have good posts in or contacts with the State bureaucracy these societies are also strongly characterised by community institutions, although it has been fashionable for the last three decades to analyse them in terms of class.

Modern irrigation now mainly consists of DTW and STW which have almost entirely replaced the pioneer LLPs and are gradually displacing DTWs which are economically and socially inappropriate although engineers considered them technically efficient[6] and social scientists thought them socially desirable[7] (Palmer-Jones 1993). The remaining DTW although initially set up as either formal or

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[6] Lowest cost of water at the well head due to economies of scale.

[7] Since they were technically efficient and lent themselves to state or co-operative management in contrast to smaller scale technologies which could be privately owned.

informal cooperatives (see Palmer-Jones and Mandal 1987) have with one exception become de facto privately owned, but are hard to sustain in competition with STW, hence I will focus on STW.

There are now numerous variants of this technology and the institutional forms of ownership and management both within the study region, elsewhere in Bangladesh and in other countries of South Asia and elsewhere. In the study site STW consist of the well itself – generally a cast iron pipe of some 200 ft in length, joined to a perforated filter pipe at its end which lets in the groundwater. This pipe is connected to a centrifugal pump mounted at the surface (or in some places below the surface in pit), and a prime mover – generally a 5-12 hp diesel engine or and electric motor. Electric motors are preferred as they have lower running and maintenance costs (and less noisy and troublesome), but there are problems of unreliable electricity supplies with frequent power cuts and brown outs which can burn the motors, and the electricity supply agencies engage in predatory behaviour to extort bribes from electric tubewell owners (as well as to get them to pay arrears of electricity charges). Some installations have both types of power source because of the unreliability of electricity supplies. Pumps and motors are maintained on contract by village mechanics in return for seasonal in-kind fixed payments for the labour (owners must obtain and pay for spares other than those used in routine servicing). Generally a pump operator is engaged for the whole irrigation season (who may also be the owner, or, to anticipate discussion below, one of them), again generally for a fixed seasonal fee in cash or kind. Water is paid for in this area almost exclusively by one quarter share of the gross crop, harvested and delivered to the tubewell owner.

Irrigation takes place through hand dug canals which sometimes carry over from year to year but have to be extensively repaired each year since theya re damaged by annual flooding, and by field to field flow. The prime mover sometimes is used for other purposed out of the irrigation season (rice mills, boats). The pipe and filter are installed by manual methods and can generally be removed if the owner so wishes (because the well ceases to or never yielded well, or because it is not in an advantageous site from the point of view of water selling). Hence, costs of sinking the well and raising it if necessary are sunk; there is an active market in second hand pumps and motors. Sunk costs are generally less than 10% of initial capital costs.

Models of Irrigation Service Markets

Most commentators argue their case for monopoly either on the grounds of structure – there are few suppliers, and generally only one who is presumed to be a more powerful actor than the many buyers – or performance – the implicit water price is well above computed marginal cost – or conduct – narratives of exploitative behaviour and outcomes in irrigation service markets. But these are inappropriate methods of assessment at least when applied in naïve ways. Markets with few suppliers can be competitive if there is regulation or is there is competition for the market (with regulation). It is evident that many marginal cost-price calculations are seriously flawed and are anyway inherently problematic (see Palmer-Jones 1994for an extensive discussion of the groundwater irrigation case, and Bresanahan 1989, for the general case). Finally, it does not seem convincing to argue from (temporally and often also spatially) limited samples that suggest 'monopoly profits' and cases of hold-outs that these markets are generally highly imperfect. To begin with, in a risky environment sometimes large profits will be made but there will also be large losses, perhaps in other years or places[8]. One must also bear in mind the uncertainty for pioneering risk takers in the initial stages of adoption of this new technology. Ad hoc accounts of exploitation must be held up to examination of more and representative cases.

If competition takes place and it cannot be detected either by a priori deduction from simplistic accounts of the structure of the market, from its performance, or from conduct, then it will have to be studied by more sophisticated and contextually relevant methods. What can be claimed to be more sophisticated analyses – as with the contestable markets approach, or more realistic understandings of the (imperfect information, high risk, poorly defined and enforced property rights) structure of the markets involved – and more satisfactory empirical work can help to open up the debate in the face of obstinate adherence to these simplistic approaches even if these more complex approaches are themselves incomplete and flawed, as I am sure my collaborators and I would agree that ours were.

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[8] A good example of this is our finding that data from a number of years and many different locations the landless irrigation groups sponsored by the Bangladeshi NGO Proshika, whose experience Geof Wood and I reported in 1991 (Wood and Palmer-Jones, 1991), showed that over time relatively few of

Our research was a first attempt to take a more nuanced approach, though limited by resources and initial understanding; first we studied all the WEM and farm plots in a contiguous block which more or less constituted a spatial market – there were natural boundaries to water transactions defining our area. Second, we studied for four years. Thirdly, we combined empirical quantitative approaches – including mapping , geographical information systems, direct observation of quantitative data by local people literate only in the vernacular, and census and sample survey questionaires - with some informal and observational work.

Based on our earlier work (BAU, 1986) we expected that if competition takes place it would be expressed in subtle changes in locations of WEM and of sources of water for plots between years rather than within years (because of the contractual nature of irrigation services)[9]. Using the idea of contestable markets we expected that some new entrants would emerge and some incumbents would fall by the wayside. We also assumed that it would be important not only to quantify convincingly these changes but attempt to unravel in at least some cases the details of conduct through informal research means, since the important processes would not be captured in the usual types of formal survey research or indeed in informal rapid or participatory methods. These ideas provided the driving forces behind our choices of methods, combined with the limitations on senior researchers time and capabilities[10]

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these groups made ‘profits’ despite the high expectation that they would be able to exploit their monopoly power.

[9] In other locations and at other times we have observed individual plots buying water from different sources within agricultural seasons; this can occur if there are multiple sources of water available to a plot. Surface water in khals and bheels is often available especially early in the boro season, and some plots buy (or are self supplied) from these sources before later buying water from ‘their’ (natural monopoly) WEM. Even in our study area this is practised in the low lying areas around the 5 bheels, and some farmers atempt to negotiate share reductions not successfully according to some informants thought there may be reasons to be cautious about the veracity of these reports. Hidden discounts may be given conditional on secrecy. Also, in low lying areas high groundwater levels reduces the costs of using human power and some cultivators supplement WEM water by using treadly pumps or traditional swing baskket, dhone or even bucket irrigation, especially to advance planting dates in expectation of greater returns.

[10] It is important to be honest and frank about the limitations of research and to report failures as well as claim successes. This will prevent the god-fathering of increasingly inappropriate research methods. Among the factors constraining methodology were (1) limitations of the theoretical and methodological training and grasp of most socio-economic and scientific researchers; (2) lack of development anthropologists in Bangladesh; (3) constraints on senior researchers, who perhaps could understand the issues, in terms of time available to be in the field; (4) political instability in crucial periods of the research in Bangladesh which limited fieldwork even more; (5) other limitations of personal and insitutional nature.

Key Findings

We observed the location and irrigated areas of all the mechanically powered WEM for four years; the number of WEM and the area varies from year to year. Maps 1-3 provide locational and some contextual information. Maps 1 and 2 show the location and the cadastral units. Map 3 shows the main land use characteristics, and Map 4 summarises the water market in the first year of our study, showing the typical layout of command areas in the whole area. The increase in area irrigated by mechanical powered WEM from 1995 to 1996 (Map 5 shows these and other changes in irrigation sources) was largely due to the rise in rice prices from their relatively low levels from mid 1992 to the end of 1994 (see Figure 2); prices remain high during 1995 and up to the middle of 1996[11]. Also, there had been flood damage over a considerable area at the end of the 1995 kharif season, and farmers sought to recoup their losses first by planting an exceptionally large area of mustard, and then by increasing their interest in boro rice. 32 new STW installations were made, and only 2 were discontinued. 1 DTW discontinued, and its command area was taken over by several STW; the remainder of three new STW, and the remaining STW were installed where they could take up land that had not been irrigated by mechanical

Table 1: Numbers of WEM and Area irrigated by technology and year

Tech-nology	1995		1996		1997	
	no	% area	no	%area	no	%area
DTW	9	16.6	8	16.4	5	10.3
STW	129	83.1	160	79.8	172	86.3
LLP	0	0	2	.3	2	.1
Manual	many	4	many	3.5	many	3.3

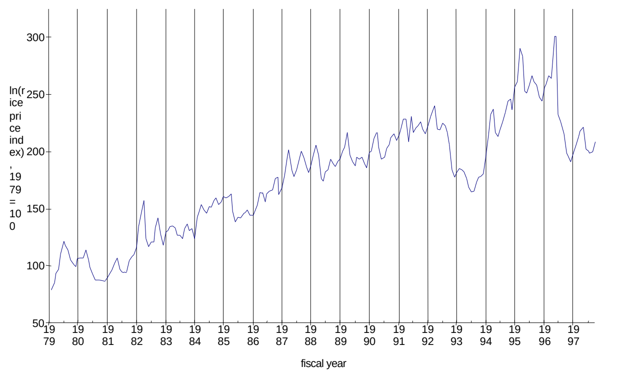
Table 2: Numbers of WEM by Start and End Dates

		Year of operation			
	Start year	1995	1996	1997	1998
DTW	1995 or before	8	8	5	5
STW	“	129	127	121	119
	1996		32	29	29
	1997			21	15
	1998				14
LLP		0	2	1	2
Total WEM		137	169	178	193

[11] A key feature in the interpretation of the evolution of groundwater irrigation in Bangladesh is the rice price; the prominent features in the figure are the sharp drops in price in mid 1985, and again in late 1992 to early 1994 and in mid 1996. These falls have very significant effects on the incentives of WEM owners and boro farmers, and their ability to finance these cash intensive activities. These relationships are as yet poorly understood.

means in 1995, or had been irrigated by manual methods, and in some cases by partially encroaching on the area irrigated by other STWs[12]. A number of STW relocated to adjust their command areas, or otherwise adapt to changed circumstances. A number of others experienced changes in the plots they irrigated. In all there was evidence of considerable ‘activity’ in the water market, showing that it was indeed quite dynamic, and therefore not obviously consistent with an oligopoly where village elites had carved up the command area amongst themselves.

Figure 2: Bangladesh Rice Price Index, 1979-96



For the following year (1996/7) there was again considerable dynamism in the water market. The price of paddy fell dramatically in mid 1996 (see Figure 2), resulting in very low prices of paddy at the harvest of aman and low price expectations for the boro season of 1997; people who had stored paddy in expectation of a price rise were very disappointed. Also, the out turn of the 1996 boro season had not been particularly impressive. Finally, there were many electricity outages, and widespread rumours about fertiliser shortages. 3 DTW went out of operation, in two cases at least partly because of the electricity problem, and in one of these because of long standing problems of organisation among the owners. In the third case the diesel powered DTW had become expensive to operate, and manage, and, as the returns had been low due to relatively low rice price, the owners decided to discontinue. 8 STW came into the area vacated by the DTW. In all, there were 21 new STW, and 9 discontinuations, 6 of which had been working in 1995, and 3 which had started up in 1996. These 3 were all in areas classified as marginal because of their soils, topography and the proximity of other WEM. One electric DTW reduced its command area considerably, and enabled 3 STW to come into the vacated area, and the owners of the DTW

[12] As in other places in this paper, the data should be treated with caution because the analysis is at a preliminary stage; I don’t think that any figures, or interpretations based upon them will be altered greatly when the final numbers are decided..

themselves installed an STW to cover for the anticipated reduction in capacity of the electric DTW.

Inspection of the command areas of the WEM shows that on the whole command areas are compact and rationally laid out (although engineers comment that more with ideal technical efficiency the number of STW could be reduced by 10-15%); one does not find WEM owners irrigating their fields at a considerable distance from the WEM with fields in between irrigated by other WEM, as suggested by Wood in his account of irrigation service markets in North Bihar. This is not because WEM owners do not have fragmented holdings which could be irrigated from their own WEM by constructing longer canals; rather, it appears that they prefer to irrigate the plots of others that are contiguous to their own WEM and let others supply water to their plots not readily accessible to their own WEM. I will return to this below.

There is one other aspect of the structure of the irrigation service market that needs to be described; this is the structure of ownership. As noted above, there were some 170 WEM in 1997; of these fewer than half were owned by a single person (or nuclear family). The remainder (52%) were owned by partnerships, among people whom we call sharers. Even among the STW more than 50% were owned by sharers. In all there were 366 sharers[13]. This phenomenon had not been expected, at least to the extent found, and we had to adjust our research to take account of these other owners, for reasons to be given shortly.

Management by Sharers

Many STW (and some of the DTW) are owned by sharers, as noted. The question arises as to why there are sharers and how the sharers manage their shares and control the manager who is in charge of day to day management. The following example shows how one quite dispersed group is constituted and manages its affairs.

There are six sharers (Table 3) who emerged from the collapse of a DTW group (of 16 persons) which bought a DTW from BADC that had originally been installed under the Milners contract in the mid 1970s. Intially a nominal rent was paid to

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[13] there were 2631 households which were potential sharers recorded in the study area. Probably rather more household should be considered since we did not count households whose houses were outside our boundaries in those villages bisected by these boundaries. Perhaps of more relevance is the number of bari (the residential unit) which have sharers; our estimate based on a crude enumeration of bari is that some 20% of bari have a sharer.

BADC but the group had to collect payments for operating costs. This was never easy and resulted in chaos, and made the DTW manager unpopular.

Table 3a Sharers in Jalal Professor's WEM Business

Sharer	Relation to Jalal	Number of shares
Jalal Professor	Self	4
Joaher Ali	Cousin	3.5
Abdul Jalil	'biyai' (to be translated)	1.5
Abul Hussain Bindal	Cousin	1
Abdul Halim	Neighbour	1
Abul Hossain Talukder	Friend	1

In the early eighties, many DTWs in neighbouring Pakutia and Digor areas were learnt to have operated on the basis of one-fourth cropshare as water charge. This new practice of crop sharing for irrigation water proved very profitable from managers' point of view and it was also financially convenient for the water users, most of whom had cash constraints and get water on credit by this payment system[14]. This system became popular and attracted new entrepreneurs to take up water selling as a business together with irrigation for self cultivation. The DTW was offered for sale in the 1980s but many of the original groups were not interested; eventually the present group emerged. The group consists of relatives, neighbours and friends who each contribute some resources (see below). They soon ran into management problems with the DTW and accumulated large arrears of electricity bills. They then installed a STW in the DTW bore and arranged a new connection, thereby avoiding having to pay arrears on the electricity bill. A second STW has had to be installed to cover most of the former DTW command area.

What is interesting about this group is the way finances are arranged and managed even though several of the principals are not permanently locally resident. The group is a combination of partners having varied sources of money and it appears that quite a bit of the capital costs and operation & maintenance costs (O&M) comes from

[14] Share payment for water also provides strong incentives to the water seller to supply water to ensure harvest. Whatever dilution of incentives the share system may entail can be offset by common knowledge and supervision by locally resident actors and their relatives.

outside the village eg. business (Abul Hossain Talukder), service (Jalal professor and Joaher), remittances (Halim Talukder). This year, the group also borrowed from a Hindu money lender in Kalihati Tk10,000 at 6% interest per month mainly to pay for the 12 hp Dongfeng diesel engine and Jalal Professor's acquaintance with this lender (trust) was used as the security for the deal. In order to mobilise funds for repaying debt with interest, Jalil in consultation with Jalal professor rented out the newly bought engine after the boro irrigation to someone in Kalihati who used the engine for his husking mill for 3 to 4 months for a payment of Tk2000. A provisional budget is fixed at some time before the start of the irrigation season and the money collected from the sharers is deposited with Jalal Professor who releases the funds to Jalil for day to day use. If the money runs out then Jalal contacts the other sharers and arranges for further contributions; this is managed flexibly and verbal arrangements are sufficient, since they are all closely connected by multiple relationships. Jalil keeps written account of expenses by items and informs Jalal professor regularly on Hamidpur market day and even going to latter's house in Kalihati. Whenever convenient, Jalal professor checks account and also discusses the expenditures with other sharers, especially Joaher Ali when he comes home. Jalil usually deposits a sum with a diesel dealer in Hamidpur Bazaar, and Jalil takes diesel until the money is exhausted and can even get diesel on credit.

In August, the six sharers met to settle the accounts for 1997. It appeared that a total of Tk56,000 was spent, including Tk16,000 for the purchase of a new engine and accessories. The two machines used about 5 drums of diesel (2 for new engine and 3 for the old engine); thus the sharers had to pay taka 4700 for each share.

As return from investment, they got 25 maunds of paddy at harvest for each share which at the rate of taka 200-220 per maund during harvest stood at taka about 5250 as gross return, meaning that there was very little net return this year after deduction of labour cost for carrying harvested paddy from the fields. But it should also be kept in mind that this year an additional amount of taka 1333 was spent per share as capital cost for buying a new engine and pump.

This year on-farm water distribution suffered to some extent due to electricity failures in the case of the first STW and serious breakdown of crank shaft and oil pump of the second STW. As a number of plots dried due to prolonged shortage of water in late February, a farmer named Abdul Fafur of Shalonka actually closed a field channel to enforce water supplies to his plot. Jalil and the other sharers responded to this protest immediately and were forced to buy a new diesel engine for the first STW and also to repair the second STW machine without delay. They bought crank shaft for Tk850 and the oil pump for Tk120 from Hamidpur bazar where almost all sorts of irrigation equipment spare parts are available and fixed it quickly with the help of a local mechanic, Sorab Ali from Hamidpur. Sorab Ali contracted this STW to provide repair services for 3 maunds of paddy for the season, irrespective of the frequency of breakdowns (spare parts costs are borne by the STW owner).

Sorab Ali contracted 20 STWs this season (5 STWs in Badeparshi, 5 in Beel bari, 5 in Kaliagram, 4 in Shailota and 1 in Kashtola). The STW management had to be careful about improving water distribution because they were facing intense competition from other STWs. Already, they lost some 30 pakhi to two STWs owned by Lutfor Rahman Khan (1061) and Abdul Kader of Shekhshimul and they might also loose some more land in the east to Fazlul Haque's electric STW which is located on his house plot. They also agree to offer irrigators of low lying plots closer to the Boicha bheel one-eighth cropshare in stead of one-fourth share as those plots use beel water by dhones in the beginning and also require less frequent irrigation due to clay soil. For example, an offer of one-eighth crop share for water was given to one Omar Ali of Shalonka who was sharecropping a plot (plot 470) from Manik Khan from Kaliagram. However, while water could reach this plot, it could not reach his other one which was at a higher elevation. This second plot could only be irrigated by Nurul Islam's STW in Kaliagram. So, constrained by local micro topographic variations Omar Ali had to settle with Nurul Islam at one-fourth crop share for both plots.

These examples show how the interweaving of informal information with elementary economic analysis (at this stage) reveals how economic forces work in conjunction with social structures and relations to make up an embedded market. It would be a false distinction to pose the economic and the social as alternatives. We have many more examples where we can explore these interrelationships in more detail.

Sharers

The existence of this organisational form raises many interesting questions, reminiscent of those which address the question of why firms exist at all, why they take the form they do, why some transactions occur within organisations while some occur between them. I only briefly mention some salient points here.

More than 50% of STW were owned by more than one person, so that in all while there were 177 WEM there were 366 people who were owners (Table 4). Share ownership was embedded in kin, neighbourhood and more extended social networks. Some enterprises included more than one WEM. The reasons given for having sharers included access to capital (36% of sharers), social support (63%), has land (27%), or belongs to the same family or is a friend (46%) (Table 5). Only 19% of sharers had no kin relationship with a co-sharer, and 47% were reported as brothers (Table 6), though this will perhaps not be strictly the ‘same farther same mother’ definition. Several reasons apply to the same pair of sharers and many combined a social proximity with an economic reason such as having land or capital. Ownership and management of a WEM is a demanding and risky enterprise.

While some degree of vertical integration between water provision and cultivation is achieved, it is still the case that far more land is irrigated by non-owners of the WEM in question, although, as others have found, many owners cultivate land irrigated by WEM in which they do not have a share. Thus a water seller in one location is a buyer in another, often from someone to whom he himself sells water. Sharers generally owned land under their own WEM (although there were some who owned and cultivated no land), but far more land under their own WEM was cultivated by others (Figure 2). Sharers even rented out some of their own land to others to irrigate under their own WEM. Sharers owned and cultivated more land with irrigation from WEM under the ownership of others, and they rented in relatively little land to cultivate under their own WEM. Hence, in aggregate it is clear that ownership of a WEM has not been resulted in accumulation or consolidation of land either through purchase or land rental.

Sharers mainly gave cultivation as their main occupation, although a number had service or business occupations. Managers (who were the sharer or sole owner who undertook the day to day management) had somewhat larger land holdings than other sharers but neither had more land than the average (managers on average cultivated .68 ha, while sharers cultivated .34 ha; the average is estimated to be around .67 ha and the median cultivated land size to be 0.50 ha). As noted above, a number of reasons were given for having sharers, which can be interpreted in economic terms – raising capital, vertical integration, economising on transaction costs – or sociological – transacting within networks.

Ownership of WEM (particularly STW) is not particularly profitable and quite variable both between WEM and between years; most of the profits from irrigated agriculture accumulate to land owners rather than WEM owners[15]. In the three years of this research the main immediate economic attraction of owning a STW lies in irrigating land that one cultivates under it[16]. The profitability of DTW also varied greatly, with considerable profits accruing to owners if there was no breakdown. These profits are more by way of rents since they accrue only because the capital costs of DTW had been heavily subsidised, and DTW are going out of business when they face major repairs, or other difficulties[17]. In the past it may have been more profitable to own a STW[18], although then the business may have been perceived to be more risky, as there had been less experience with the mechanical and irrigation technologies, repairs were more difficult, and so on. The main reasons for differences in profitability between 1996 and 1997 was the lower price of paddy which adversely affected the gross revenues to WEM businesses since payment in this area for irrigation services is by share of the irrigated crop. Paddy prices fluctuate considerably both within and between years (see Figure 1); there have been two recent periods when paddy prices have been well below trend, from mid 1992 to the end of 1994, which may have adversely affected incentives to irrigate in 1995, and again from mid 1995 to the end of 1997, again adversely affecting incentives to

[15] These arguments are supported by detailed budgets for 150 WEM in 1996, and 50 WEM in1997.

[16] The detailed cost and return information for all WEM in 1996 and a sample of 50 WEM support this argument.

[17] This may not everywhere be the case. One of the DT(E)W which did not operate in 1997 due to electricity shortages (it actually operated but on a very reduced command area – three STW took over the bulk of its command area in 1996), is reported to have taken back most of its command area in 1998.

[18] We have budget data from the 1980s from this area to compare with our results; however, these budgets have to be recalculated to conform with the methods used in the present study, and this has not yet been done.

irrigate in 1997 (when in fact some areas which had been irrigated in 1996 were not in 1997).

Dispute Management and Social Regulation

In this example we see the processes of economic, social and no doubt political competition in operation during the take over of an area formerly irrigated by a DTW; the actual and potential entrants mainly lived in the middle para (Madhya Para) of Kurmushi Village although other actors live nearby. The main actors come from three main Gushti[19], and the main conflict is between people who are members of two different Gushti. However, the most salient conflict is between two people who would normally be in the same Gushti, and are in fact paternal cousins (fathers' brothers' sons). are but the main conflict in .

The background to this case is relevant; dry season mechanical irrigation had started in the 1969 with Low Lift Pumps (LLP) provided under the BADC rental scheme from the Louanganj River. Abdul Malek, who used to be an energetic but not very wealthy farmer, had taken the initiative to approach the Union Chairman to obtain the LLP, and he was then appointed as the manager of the two LLPs. Malek was often assisted by Gafur, from Haji gushti; about 67 acres of land sloping northwest from the river bank towards Koicha Bheel were irrigated. Malek, and most of the other actors in this story, live in Madhy Para, Kurmushi Mauza. There are three samaj in Kurmushi corresponding to the three para (Uttor para, or Sailota, Mahya para and

[19] The formal administrative and political structures of Bangladesh coexist with local social institutions of Samaj and Gushti. Gushti are groups of agnatically related kin living in several groups of houses (bari) in one or more para, usually in one Gram, but sometimes in different Gram, or Mauza. One descent group can have members in different Gushti, which can be thought as corresponding to factions, between which there is often considerable rivalry. A Samaj is a local body of decision making among local Gushti undertaken in intermittent meetings – Salish – to hear cases and make judgements. Gushti are represented by their matbors (leaders or elders). Membership of Gushti can be fluid, and it is not possible to enumerate the whole population by their Gushti. However, Gushti and Samaj are important emic institutions through which local social and political processes function. It is notable that the canonic international works on Bangladesh society and development over the last three decades (van Schendel 1981, Wood 1994, White 1992, Lewis 1991, Jansen 1986, Hartmann and Boyce 1979;Hartmann and Boyce 1983, Rahman 1986, and so on) pay very little attention to these indigenous institutions, and give them even less analytical weight, dominated as they have been by the neo-marxist framework of class. Jansen's influential 'Rural Bangladesh: Competition for Scarce Resources', 1986, is atypical in that the analysis by class is admitted to be 'naturally not used by the villagers themselves' (72), but are presented as , to borrow from an eminent source, ; the executive committee of the ruling class'. Clarence Maloney 1986was a notable exception. The lacuna is all the more evident in more popular and polemical literature such as that associated with NGOs (e.g. BRAC's 'The Net'. Arguably this myopic and biased approach has done great harm to the understanding of rural Bangladesh, and, to the extent that understanding promotes well-being, to the well-being of its peoples.

Kudus para). In our account there are three gushti (while gushti, or factions, are broadly groups of agnatic kin and their clients, the affiliation through agnatic kin is not strict and personal rivalries can lead to people affiliating with gushti other than that of their agnatic kin, particularly if they have affinal ties with the other gushti).

Water was paid for by a fixed cash charge according to the area irrigated. In the early 1980s some STW were installed by people from Ukilda Mauza, charging one quarter crop share. At the same time the government was withdrawing its support for rental LLP. Farmers were no longer able to get official loans at low rates of interest to cultivate HYV boro, and pay cash for water in advance. Malek tried to change the payment system for the LLP to one quarter crop share, but the cultivators refused as this would entail a significant rise in the water charge.

Malek, who is from Munshi gushti, then considered dropping the LLP, and took the initiative again to get a DTW, which the Government was now selling to farmers' groups. Haji Mokbul, a local school teacher whose sons all have outside employment, is Malek's maternal uncle (mother's brother), and his gushti owned much land in the area and were interested to share in the purchase of the DTW. Malek's brother Mortuz Ali is married to Haji Mokbul's sister; Malek used some of the benefits he obtained as manager of the LLP and DTW to pay for Mortuz' education.

In the end four groups of shares were allocated in the DTW;

1. Haji Mokbul took one quarter share, and 3/16ths each were allocated to
2. Uttor bari (whose members were from the same gushti and Haji Mokbul - Haji gushti),
3. Paschim bari (whose members were from Sheik Gushti),
4. Three members of Munshi Gushti, and to
5. Moksed Ali, who came into the village from Kaizalipur with support from Haji Gushti, by marrying a daughter Haji Kefayetullah who is a paternal cousin to Haji Mokbul (Kefayetullah's father was brother to the father of Mokbul's father).

The three shares which went to Munshi Gushti were allocated one each to Malek Manager, who also became the manager through the influence of Haji Mokbul, Mortuz Ali who is brother to Malek, and to their paternal uncle Mokkades Ali, who is the father to Bazlur Rahman. The Uttor bari (of Haji Gushti) shares went to two brothers Mokter and Anser Ali. The remaining three anna went to three brothers from Sheik Gushti (Osman, Mozibur, and Karim).