Implications of Alternative Institutional Arrangements in Groundwater Sharing

Evidence from West Bengal

Informal groundwater based pump irrigation services markets are an all-pervasive agrarian institution in south Asia but have been criticised for bringing about less than equitable outcomes and causing groundwater over-exploitation. In view of these drawbacks of private water markets, many scholars have advocated "alternative institutional arrangements" in water sharing. The alternatives refer to those water sharing arrangements that violate either of the three basic conditions of private water market transactions, viz, *private, individual ownership of irrigation assets and rights of the owners of means of irrigation to decide the terms and conditions of water sale. In this paper two alternative institutional arrangements in water sharing from West Bengal have been compared from the perspective of the impact they have on the water buyers – in most cases small and marginal farmers.*

Aditi Mukherji

Informal groundwater market or pump rental market[1] is an all-pervasive agrarian institution in south Asia. It is an arrangement through which the owner of a pump sells water to others for a consideration, generally a pecuniary one. Water markets are of two types, one formal, where water rights (customary or otherwise) are clearly defined, e g, in Chile [Bauer 1997] and another informal where water rights are not separately defined. Groundwater markets in south Asia are a classic example of informal water market since groundwater rights are inalienable from land rights.

There are several advantages of groundwater market. First, it leads to increased use of pumping capacity, thereby enhancing efficiency of tubewells [Meinzen-Dick 1996]. Second, it provides access to irrigation among those farmers who cannot afford their own wells and pumping equipments [Shah 1993]. Third, water markets encourage farmers, even small and marginal farmers to invest in tubewells through the prospect of profitable water sales [Palmer-Jones 2001]. Fourth, as a direct result of increased access to groundwater, cropping intensity goes up, as does demand for labour. Thus, net irrigation surplus[2] under groundwater markets is higher than in a scenario without groundwater markets [Fujita and Hussain 1995]. Finally, a positive externality of groundwater markets in water surplus regions such as West Bengal is the lowering of water table through vertical drainage, which in turn ameliorates flooding and water logging conditions [Roy 1989].

From these very advantages, however, spring some of the limitations of groundwater markets. For one, investment in groundwater pumping equipment is often lumpy, especially in regions with deep aquifers. As a result, ownership of groundwater assets tend to get concentrated in the hands of richer peasants. This is further aided and abetted by the absence of clearly specified property rights in groundwater [Saleth 1994]. As a result, a disproportionate percentage of the net irrigation surplus may accrue to the pump owners and this often reinforces their position as "water lords" in the rural society [Janakarajan 1994]. Similarly, in regions of low rainfall and deep alluvial or hard rock aquifers, such markets might provide incentive for over-pumping which may result in over-exploitation of the resource. This has happened in many parts of north Gujarat [Dubash 2002, Prakash 2005] and Tamil Nadu [Janakarajan and Moench 2006].

In view of these disadvantages of private pump rental market as an institution, many scholars are of the opinion that alternative institutional arrangements such as cooperative ownership of irrigation assets and local government intervention in the functioning of private water market have superior equity outcomes than "pure" private water market transactions [Boyce 1987, Rawal 2002]. In this context, the paper will try to answer two questions, first "do alternative institutional arrangements in groundwater transactions have better equity outcomes than private water market operations?". Second, if yes, "are these arrangements easily replicable?". In this paper superior equity outcome is measured in terms of benefits accruing to non-pump owners (who are mostly small and marginal farmers) through such alternative institutional arrangements. "Alternative institutional arrangements" are defined as an arrangement in which three inherent conditions of private water market, viz, that of private, individual ownership of water extraction mechanisms (WEMs) and freedom of WEM owners to decide the terms and conditions of water sale are violated. Rawal (2002) has called similar interventions, "non-market" intervention, but the term is problematic, because even under alternative institutional arrangements, sale and purchase of water takes place.

This paper is divided into four sections. In the second section, two examples of alternative institutional arrangement in water sharing in the Indian state of West Bengal are discussed. In the third section equity implications of these interventions along with the scope of replication of these alternative institutional

arrangements are discussed. The fourth and the final section of the paper spell out the conclusion and policy implications of this study.

Two Case Studies

The alternative institutional arrangements in water sharing predate private water market transactions. In Uttar Pradesh, government owned and operated public tubewells were introduced as early as in 1930s [Cunningham 1992]. Many like Dhawan (1982) and Boyce (1987) argued that public tubewells were the only viable management option in the Indo-Gangetic plains owing to scattered and small sizes of land holding. International donor agencies too held similar views [Palmer-Jones 1994] leading to massive investment in public tubewells in India. However, the poor performance of most public tubewells belied these expectations [Kolavalli and Shah 1989, Brewer et al 1999]. Private ownership of groundwater assets too came to be associated with exploitative behaviour of water sellers [Janakarajan 1994, Webster 1999]. Therefore the middle path of cooperative ownership of irrigation assets was suggested as a win-win situation, one that took care of the "public failure" as well as "market failure" [Wade 1987].

In this paper, two case studies of alternative institutional arrangements in water sharing has been discussed. The common feature that binds the two cases is that none fall in the category of conventional private groundwater markets that are now ubiquitous in south Asia. Further, these merit special attention as cases of self-induced cooperative ventures. The alternative institutional arrangements discussed in this paper have moulded the architecture of the private water markets in the study villages. These interventions have been compared in terms of the impact they have on the water buyers. Water buyers most often happen to be small and marginal farmers, who in the absence of state provisioning of irrigation and informal groundwater markets, would have remained outside the ambit of irrigated agriculture. The two cases of alternative institutional arrangements in water sharing that are discussed in this section are: (a) kinship group-owned electric submersible tubewell (ESB) in Dunipara village in Birbhum district, (b) private water market with price regulation by panchayat samiti[3] (PS) in Mohanpur village of Hugli district. Table 1 shows the demographic and hydro-geological characteristics of the villages.

Case of Kinship Group-Owned Electric Submersible Tubewell

Dunipara in Bolpur-Santiniketan block of Birbhum district is a small and quaintly remote village set amidst picturesque surrounding of red soil, undulating topography and tall green palm trees. The nearest town, some 12 kilometres away, is the famous university town of Santiniketan. There are around 45 households spatially segregated into four caste-based localities. In this village, sadgopes are the dominant caste owning or

operating almost 250 bighas[4] (~ 100 acres) of land out of cultivable area of around 380 bighas (~ 152 acres). There are 10 sadgope families in the village. The other 35 households in the village are predominantly small and marginal farmers, sharecroppers, and farm and non-farm labourers. Some of them also hold registered barga rights, i e, sharecropping rights, but in recent years, many bargadaars (sharecroppers) have relinquished their rights in exchange for land – a trend also noted elsewhere in West Bengal [Nielsen and Hanstad 2004].

While several among my sample villages have ESBs, what makes Dunipara unique is the fact that this ESB is owned jointly by a group of 10 villagers – all except one related by ties of family and kinship.[5] All these 10 households are the sadgope households mentioned earlier and they own and operate 65 per cent of the net cultivated area in the village. This group of 10 people formed themselves into a group owning nine shares, eight people owned one share each, while the ninth share was owned jointly by two. Shares were distributed on the basis of ability to cultivate at least six 2.4 acres of land within the command area of the ESB. The entire cost of the ESB was borne equally by the nine shareholders. The operational costs are also shared equally.

Rules of water sharing were clearly specified in 2002 itself when this joint ESB was constructed. The group of 10 shareholders were divided into three sub-groups and each sub-group was assigned 12 hours of irrigation in every 36 hours. There was no restriction on the amount of land that could be cultivated and the group members who received four hours of irrigation each were free to do as they deemed fit with their allocation. At the beginning of the season (January-February) when water requirement for summer paddy is relatively low, each of the shareholders were required to take out 20 minutes from their allocated time and fill up a pond in the village such that this water could be lifted with diesel pumps in times of prolonged power cuts or pump malfunctioning. The salient feature of this arrangement was the reduction in transaction cost. This was achieved in several ways – by division into smaller groups, by ensuring that each group was autonomous and took care of its own problems without reference to the other groups, by providing the same kind of autonomy to individual members within the group and by laying down simple rules for emergencies. The need for monitoring of the rules was also minimal. The rules were seen to be fair and transparent in every respect and hence, this ESB has been operating for the last four years without any major problem.

What were the implications of this joint ESB on the functioning of water market in this village? Not much, as the following discussion shows. Water market in Dunipara started with occasional pump renting activities in 1978-79. This market was limited to the winter season. Pumps were hired out on an hourly basis, the charges being Rs 10-12/hour in the early 1980s, Rs 20-25/hour in the early 1990s and Rs 50/hour in 2005. Of the 20-24 acres of winter season cultivation in the village, some four acres were served by this type of market. Thus pump rental market were never central to the village economy. Sale of water in the summer season was conspicuous by its absence.

In 1998, Baboi Soren, a tribal farmer owning around three acres of land constructed an ESB in the village and started selling water in the summer season. In the very first year, he sold water to 15.2 acres and serviced 20 water buyers. Most of these water buyers (85 per cent) owned and operated less than two acres of

Table 1: Location, Demographic and Hydro-geological Details in Dunipara and Mohanpur Villages

Sr No	Demographic Indicators	Dunipara	Mohanpur
1	Location (district and block)	Birbhum, Bolpur-Santiniketan	Hugli, Pandua
2	Village area (hectare)	69.72	460.74
3	Adult population (number)	216	3386
4	Number of households	45	701
5	Percentage of scheduled castes and scheduled tribes population	83.0	61.8
6	Percentage of literates	50.4	56.9
7	Dominant land-owning caste	Sadgope	Brahmin, Kayastha
8	Average depth of water table below groundwater level in April (metres) – 1995 to 2001	9.56	3.05
9	Trend of water table in pre-monsoon season (April 1995 to April 2001)	Constant (rising trend of 8 cm per year)#	Constant (a falling trend of 5 cm per year)#

Note: # According to CGWB [WIDD 2004] guidelines a rising or falling trend of -10 cm/year to +10 cm/year is categorised as constant groundwater trend, while a falling trend of more than +10 cm/year is classified as falling trend and that of -10 cm/year is classified as rising trend. Here the trend line was computed based on water table data from 1995 to 2001.

Source: Sr No 2-6: GOWB 2001, Panchayat Chalchitra, Sr 7: Author's fieldwork, May 2005 at Dunipara, September 2005 at Mohanpur, Sr 8-9: CGWB Yearbooks (several years).

Table 2: Water Sale Details of ESBs in the Summer Season of 2005, Dunipara Village

Sl No	Indicators	ESB 1 (Individual)	ESB 2 (Joint)
1	Total area irrigated (acres)	21.2	29.4
2	Of which area of the ESB owner (acres)	3.0	24.4
3	Of which area leased-in by the ESB owner (acres)	0.2	4.2
4	Number of water buyers	20	1
5	Number of water buyers who own less than 2.0 acre of land	17	0
6	Area of water buyers (acres)	18	0.8
7	Percentage of area to which water is sold to total irrigated area	84.9	2.7
8	Total hours of operation in summer season	1710	2200
9	Of which hours used for self-irrigation	230	2150
10	Hours used for irrigating buyer's field	1480	50
11	Percentage of hours of water sold to buyers to total hours of pumping	86.5	2.3
12	Number of water buyers	25	2
13	Water charge for summer paddy (Rs/acre)	1500	2000

Source: Interviews, May 2005.

Table 3: Cropping Pattern and Crop Productivity of Three Classes of Farmers, Dunipara 2004-05

Sl No	Indicators	Pump Owners	Water Buyers in Summer Season	No Access to Irrigation in Summer Season
1	Number of respondents	11	8	6
2	Gross cropped area (acres)	110	15.8	16.2
3	Percentage area under monsoon paddy	54.0	74.6	79.1
4	Percentage area under winter crops	17.0	8.8	20.9
5	Percentage area under summer paddy	29.0	16.6	0
6	Productivity (kilograms/acre) of aman paddy	1900	1500	1600
7	Productivity (kilograms/acre) of boro paddy	2900	2500	Not grown

Source: Questionnaire survey, October 2004 and interview, May 2005.

land. The water charge was Rs 1,500/acre for 'boro' paddy (summer paddy), a rate prevalent in neighbouring villages. This is for the first time that small and marginal farmers got the opportunity of cultivating water intensive and profitable summer paddy. Then, in 2002, the joint ESB mentioned earlier was installed. However, this joint ESB did not contribute to the groundwater market in the village during the first three years. It was only in summer season of 2005 that one of the shareholders sold water to a fellow villager in 0.2 acres of land at the rate of Rs 2,000/bigha – a price higher than the prevailing rate. Instead of direct water selling, the joint ESB owners have preferred leasing of land from others. Table 2 shows the water selling and land leasing details of the two ESBs in the village.

The fact that the water market in Dunipara is limited both in its depth as well as breadth resulted in distinctly different cropping patterns and crop productivities for the owners and non-owners of irrigation assets. One of the impacts of a reasonably well-functioning water market is to smooth out the cropping pattern and productivity differences between the buyers and the sellers [Mukherji 2004, Shah and Ballabh 1997]. Table 3 shows the cropping pattern and crop productivity of three classes of farmers in the village, viz, pump owners, water buyers and other respondents who do not buy water in the summer season. It shows that the pump owners dedicate larger part of their gross cropped area to profitable summer paddy and also get higher yields than the water buyers. The small size of the sample restricts us from deploying standard statistical tests for measuring significance of difference in mean productivities. However, what this table clearly shows is that a sizeable part of the village population (i e, 26 households out of 45 households given that there are 11 pump owners and eight water buyers) do not get access to irrigation during the summer season. Of the eight water buyers who did get access to irrigation in summer season, seven did so from the individually-owned ESB. It is to be noted that all these seven water buyers own and operate less than two acres of land. The only water buyer who got access to irrigation in summer season from the joint ESB owned 7.4 acres of land and was related to the joint ESB owners through ties of kinship. When put together, all these evidence means that joint ownership of an ESB by a group of medium and large farmers who already owned and operated 65 per cent of the net cultivated area in the village had practically no impact on the small and marginal farmers in the village.

Panchayat-Determined Water Price

Mohanpur in Pandua block of Hugli district is a large village (~460.74 ha) situated on a metalled road that connects it to two district towns in the vicinity. It is also well connected by railway to the state capital of Kolkata. The village has all the important amenities such as school, hospital, library, market, potable water, electricity, banks and post offices, etc. The brahmins and the kayasthas are the two dominant castes in this village. Land distribution in Mohanpur is skewed, with around 400 or so landless families and 34 families with landholding of more than eight acres. However, majority of the households (200 or so) own land between one to four acres. Many of the landless families have barga or sharecropping rights. Water table in this village is within three metres below ground level even in the pre-monsoon season. Yet, the educated and the well-connected landowners of Mohanpur took the opportunity of subsidised rural electrification and directly converted their diesel centrifugal pump operated shallow tubewells (DSTs) to electric submersible pump operated shallow tubewells (ESB) because of higher irrigation capacity of ESBs.

Table 5: Comparison of Cropping Pattern and Cropping Intensity among Water Sellers and Buyers in Mohanpur Village, 2003-04

Category	Operated Land (Acres)	Average Area Cultivated in Acres			Gross Cropped Area (Acres)	Cropping Intensity (Per Cent)*
		Kharif 2003	Rabi 2003-04	Summer 2004		
Water sellers	8.5	6.1 (48.3)	1.6 (12.7)	5.0 (39.0)	12.6	149
Water buyers	4.6	4.9 (52.8)	1.6 (17.3)	2.8 (29.9)	9.3	202

Note: Number of respondents is seven water sellers and seven water buyers. Figures in parenthesis show percentage to total GCA. * Cropping intensity is derived by dividing GCA by operated land.
Source: Questionnaire survey, October 2004.

Table 6: Comparison of Productivity of Different Crops among Water Buyers and Sellers
(Kilograms/acre)

Category/Crop	Aman Paddy	Boro Paddy	Potato
Water sellers	1575	1875	6925
Water buyers	1325	1650	7550

Note: Number of respondents is seven water sellers and seven water buyers.
Source: Questionnaire survey, October 2004.

Table 7: Comparison of Input Application between Water Sellers and Buyers in Mohanpur Village

Crop	Category	Fertiliser (Kg/acre)	Irrigation (Hours/ acre)	Labour (Person Days/acre)	Seed (Kg/acre)	Ploughing (Hours/acre)
Aman paddy	Water seller	91.5	80.5	40.5	21.3	5.3
	Water buyer	78.5	31.0	61.3	18.0	5.0
Boro paddy	Water seller	173.5	147.0	41.0	26.8	3.5
	Water buyer	173.3	138.8	67.3	22.8	3.8

Note: Number of respondents is seven water sellers and seven water buyers.
Source: Questionnaire survey, October 2004.

Table 4: Water Rates for Various Crops Before and After the Panchayat Intervention, Mohanpur Village

Period	Water Rate (in Rs/acre)			Electricity Bill (Rs/year)*
	Aman Paddy	Boro Paddy	Potato	
Water rates before panchayat intervention				
1984-1987	112.5 kilograms paddy (~ Rs 158- Rs 180)	325 kilograms of paddy (~Rs 455-Rs 520)	Rs 412.5	Rs 1,100
Water rates after panchayat intervention				
1988-1996	Rs 412.5 plus 5 kg paddy	Rs 825 plus 10 kg paddy	Rs 495	Rs 3,060
1997-1999	Rs 495 plus 7 kg paddy	Rs 1,015 plus 15 kg paddy	Rs 660	Rs 4,028
2000-now	Rs 552.5 plus 7 kg paddy	Rs 1,237.5 plus 15 kg paddy	Rs 660	Rs 6,810

Note: * Electricity tariff has been obtained from WBSEB head office, Salt Lake, Kolkata in December 2004.
Source: Fieldwork in September 2005.

Groundwater market started in this village with the installation of the first private ESB in 1984. From 1984 until 1987, payment for water was made in kind (paddy), the rates were 300 kilograms of paddy/acre for boro paddy and 150 kilograms of paddy/acre for 'aman' (monsoon) paddy. In addition, payment of 25 kg and 12.5 kg of paddy (in summer and monsoon season respectively) per acre had to be made for initial field preparation. For potato and other winter crops, water price was fixed at Rs 412.5 per acre. By 1987, there were seven ESBs in the village and each on an average sold water to 20-24 acres of land during the summer season. During that time, paddy prices were high at Rs 3.5 to 4.0 per kilogram, so rupee equivalent of water price for boro paddy worked out to be as high as Rs 1,050 to Rs 1,200 per acre. The monopoly rent realised by the water sellers was very high and the buyers were disgruntled. In retaliation, the buyers often tried to cheat the water sellers by giving them poor quality paddy as payment for water. Disputes among water sellers and buyers were common. In view of these disputes, in 1988, the panchayat samiti decided to intervene and determined the water prices for different crops. The water price for boro paddy was fixed at Rs 825/acre and that of monsoon paddy at Rs 412.5/acre, while the earlier practice of paying 25 kg and 12.5 kg of paddy per acre (for summer and monsoon paddy respectively) for field preparation continued. Table 4 shows the water rates in this village before and after PS intervention.

Thus, as a result of price regulation, water price in the village came down by a third in case of summer paddy, yet the ESB owners agreed to this arrangement. This begs two interrelated question, first, why did the ESB owners agree to these new rates and second, how did the PS ensure compliance by the ESB owners? This brings us to the arena of rural politics. Villages in West Bengal are intensely political [Bhattacharyya 1999, Ruud 2003]. Elected panchayats and even more importantly, party members of the ruling Communist Party of India (Marxists), command respect and obedience in the villages. To a large extent, the ESB owners agreed to the new water rates as inevitable and those who were reluctant to agree were threatened with the prospect of labour boycott. More importantly, the ESB owners realised that even under the new rates, they would be able to make decent profits. At that time, electricity bill was Rs 1,100 per year and an ESB owner had to just sell water to 1.32 acres to recover the electricity bill, while in practice they sold water to 20 to 24 acres of land, thereby earning a neat profit.

What was the impact of groundwater market, in terms of cropping intensity, cropping pattern and crop productivity of both the water sellers as well as the buyers? Tables 5 and 6 compare the water sellers and buyers in this village on the above parameters.

From Tables 5 and 6, it can be seen that cropping intensity of the water buyers is much higher than that of water sellers. However, cropping pattern is different with the water sellers devoting a greater part of their land to water intensive boro paddy cultivation than the water buyers (39 per cent and 30 per cent of GCA respectively), while the water buyers devote larger share of area to low water intensive but equally profitable potato crop. Water sellers achieve higher crop productivity than the water buyers for both aman and boro paddy, but not for potato. Since the sample size is too small to test the hypothesis that water transaction status (being seller or buyer) affects crop productivity, the input use intensity of water sellers and buyers were compared (Table 7). This table shows that there is no significant difference in input use between the water seller and the buyer, except for the labour component, where water buyers are likely to employ more labour than the water seller.

Of the 40 villages in the larger sample,[6] 11 villages (including Mohanpur) have ESB dominated groundwater market. Does the fact that in Mohanpur the panchayat decides water prices have any impact on the overall profitability from water selling activities of the sellers? A priori, it may be hypothesised that monopoly rent earned by the water sellers in Mohanpur will be lower than in other ESB villages. In order to capture this, various parameters related to water selling activities of the water sellers in Mohanpur and other ESB dominated villages have been compared.

Quite contrary to the a priori assumption that price determination by the panchayat may have a negative effect on the ability of water sellers to charge monopoly rent (shown by W/C and W/AC ratios), Table 9 shows that water sellers in Mohanpur charge anything between 1.9 and 3.5 times of average cost of water extraction as water price. The corresponding figure for ESB water sellers in other villages is lower at 1.4 and 2.6 times respectively. This is made possible by lower per unit water extraction costs in Mohanpur compared to those in other villages. Average water extraction costs in Mohanpur are lower because water sellers in Mohanpur have higher command area than water sellers in other villages (41.2 acres vs 36.3 acres) and also sell water to more area (35.0 acres vs 26.8 acres). Given, the flat electricity tariff which is constant across villages, higher irrigated area translates to lower costs per unit area.

Table 8: Average Numbers of Buyers, Average Area Served and Average Number of Hours of Water Sold Per Water Seller, 2003-04

Village Name	Sample Size		Average Number of Buyers Served Per ESB	Average Area to which Water was Sold (Acres) Per ESB	Average Number of Hours of Water Sold Per ESB	Per Cent Hours of Water Sold to Total Hours Pumped
	No of Water Sellers	No of ESB				
Mohanpur	7	11	67.4	35.0	2070	81.5
Other ESB villages	51	54	57.7	26.8	1774	73.4

Source: Questionnaire surveys in various villages from August to December 2004.

Table 9: Measure of Monopoly Power of Water Sellers Depicted by Price to Cost Ratio, 2003-04

Village Name	Average Area Irrigated by Each ESB Owners in Acres (Own Plus Others)	Operational Cost of Water Extraction in Rs/Acre	Long-term Average Cost of Water Extraction in Rs/Acre with Interest and Depreciation	Average Price at which Water is Sold (Rs/Acre)*	Price to Operational Cost Ratio	Price to Long-term Average Cost Ratio
		C	AC	W	W/C	W/AC
Mohanpur	41.2	343.5	603.0	1122.5	3.5	1.9
Other 10 ESB villages	36.3	435.8	825.0	1155.0	2.6	1.4

Note: Sample size is the same as shown in Table 8. * Water price per acre is the average water price charged in all the three seasons.
Source: Questionnaire surveys in various villages from August to December 2004.

An interesting point in this regard is that right after this intervention in 1988 monopoly rent earned by the water sellers in Mohanpur was considerably lower than monopoly rents in other villages. Over time, with the increase in number of WEMs and progressively high flat rate electricity tariff water markets became dense and competitive in most villages. As a result water price to cost ratio declined in all the villages. It may be speculated that perhaps in the absence of PS regulation, water prices might have fallen even sharply in Mohanpur. However, unlike other villages where water sellers have to frequently undercut their prices in face of increasing competition and water buyers often have to bargain, the presence of an external agency in Mohanpur has done away with these institutional uncertainties: water price is fixed and both water buyers and sellers are aware of the market prices.

What has been the impact of price setting by PS on the water buyers? Since boro paddy is the most water intensive crop in all the villages concerned, here crop economics of summer paddy for water buyers in Mohanpur and in other ESB villages has been compared (Table 10). This table shows that despite higher gross returns from paddy cultivation in other ESB villages, net returns are more or less the same between the water buyers in Mohanpur and other villages. This is because of lower irrigation costs in Mohanpur village as compared to other ESB villages. This shows that the PS intervention is a win-win case for both the water buyers and the sellers.

Equity Implications of Alternative Institutional Arrangements

Both the alternative institutional arrangements discussed in the previous section have taken place in case of ESB technology. This is related to the nature of ESB technology – due to high capital investments and high potential command area of a tubewell, many prospective WEM owners are pushed out of the market and those who enter the market tend to have higher monopoly power. The alternative institutional arrangements are ways of overcoming the problems posed by high initial investment and preventing the possibility of appropriation of high monopoly rent by the water seller.

Joint ownership of tubewells in Dunipara has worked well for its shareholders – a case of successful collective action featuring reciprocity and repetitive interaction. Since the joint ESB was owned by a group of large and medium farmers who already owned and operated 65 per cent of the village land, this ESB was barely sufficient to meet their own irrigation needs. Quite naturally, the shareholders of the ESB refrained from participating in water markets as sellers and prospective water buyers got no access to irrigation. This example shows that joint tubewell ownership – when that ownership lies with largest landholders in the village – will not benefit the small and marginal farmers. Joint ownership of ESB might have had an entirely different impact in Dunipara, had the ESB been owned and operated by a group of small and marginal farmers. Rawal (2002) provides one such example of a tribal group-managed-ESB in Bankura district. Thus, the characteristics of the irrigation asset owner are more important than the mode of ownership itself. The case of panchayat samiti determined water price in Mohanpur is a win-win solution for both water sellers and water buyers and a very promising case for further replication. In this case, though the PS has decided the water price, the water sellers still manage to earn reasonable profits through aggressive water sale and providing better service to the water buyers. The water buyers achieve similar cropping intensity and crop productivity as water sellers and also pay lower water charges than other ESB villages.

So far, in the context of this paper, equity has been defined in terms of whether or not the water buyers (who happen to be mostly small and marginal farmers) benefit in terms of access to irrigation. Therefore, this definition of equity embraces only inter-generational issues and not so much the issues of long-term sustainability of groundwater irrigation, i e, inter-generational equity. In recent times, a wide array of literature in India has looked into the issue of sustainability of groundwater in face of increasing scarcity and depletion [Janakarajan and Moench 2006, Shah et al 2006 and several others]. They have rightly pointed out that while flat rate electricity tariff encourages the development of pro-active water markets, it also leads to over-exploitation of groundwater. Such indeed has been the case in Gujarat, Tamil Nadu and many other parts in semi-arid regions with hard rock aquifers. Has the rapid expansion of groundwater markets under a flat electricity tariff regime in the study villages led to over-exploitation of groundwater resources thereby putting long-term resource sustainability at stake?

No, this does not seem to have happened in either of the study villages and for that matter in most places of West Bengal. Of the total utilisable groundwater endowment of 27.4 billion cubic metres, only 11.3 billion cubic metres is abstracted annually in the state [WIDD 2004]. None of the blocks in West Bengal fall under the "over-exploited" category as defined by Groundwater Estimation Committee (GEC) 1984 and 1997 methodologies [CGWB 1998]. West Bengal is also perhaps the only state in India where the number of critical and semi-critical blocks (also called dark and grey block under GEC 1984 methodology) came down from 100 to 86 once groundwater estimations were revised using GEC 1997 methodology. At the same time, the number of white (or safe blocks) went up from 191 to 205.[7] In the two study villages discussed in this paper, groundwater level is only at 3.0 metres in Mohanpur village while it is around 9.0 metres in Dunipara village. In neither of the two villages was any marked decline in groundwater table seen (the long-term groundwater

Table 10: Cost of Cultivation of Summer Paddy among Water Buyers in Mohanpur and Other ESB Villages, 2003-04

Crop	Sample Size	Average Production Q/Acre	Gross Returns Rs/Acre	Cost of Cultivation Rs/Acre					Net Return Rs/Acre
				Irrigation	Fertiliser	Labour*	Others#	Total	
WB in Mohanpur	5	1650	8250	1250	1310	2212	793	5565	2685
WB in other 10 ESB villages	50	1750	8750	1840	1428	2098	808	6174	2576

Notes: * Here only cost of hired labour is included while the imputed cost of household labour is excluded.
Other costs include that of seeds, tractor, bullock and pesticides.
Source: Questionnaire surveys in various villages from August to December 2004.

trend is within +10 cm/year to -10 cm/year, see Table 1), even though groundwater has been intensively used in these villages for the last 15 to 20 years. Anantha and Sena (2007) based on well monitoring data of 28 years (from 1979 to 2006) in Bhakuri-II gram panchayat of Murshidabad district found that even after continuous groundwater extraction in the last three decades, pre-monsoon water table is still within six metres below ground level and the rate of decline is only nine cm per year in the pre-monsoon season. Given the current precipitation, recharge and assuming higher rate of growth in water extraction mechanisms and population (for drinking water purposes), they further extrapolated the groundwater levels in their study area and found that water tables would remain within 6-8 feet in pre-monsoon season for another 32 years, thereby implying that centrifugal pumps fitted with a shallow tubewell will suffice for boro paddy cultivation for at least another three decades. The same conditions hold in much of West Bengal. This is because West Bengal receives very high average annual rainfall (1,500 mm to 2,500 mm), is underlain by mostly unconfined alluvial aquifers with high recharge potential and lies on one of the most prolific river aquifer systems in the world, viz, the Ganga-Meghna-Brahmaputra (GMB) basin. All these three factors ensure that groundwater is amply recharged during the post-monsoon season. Therefore, concerns of over-exploitation of groundwater while true in parts of arid and semi-arid India with hard rock aquifers are far from so in the humid and sub humid GMB basin with unconfined alluvial aquifers.

Having shown that alternative institutional arrangements may be a viable alternative to private groundwater markets and that there are no immediate concerns about groundwater over-exploitation in the state, the next question then is, are these interventions replicable in other villages? While the kinship group-owned ESB did not have positive equity impact on the village agriculture and the small and marginal farmers, it need not necessarily have been so had the ESB been owned by a group of small and marginal farmers. Rawal (2002) has documented one such successful case in West Bengal and based on that case recommended state support in setting up cooperative ventures in tubewell ownership and management. However, implementation of such recommendation is fraught with limitations. While there are several examples of successful cooperative actions that evolved spontaneously without external intervention,[8] they have always been problematic to replicate. Number of experiments were carried out to encourage community ownership of irrigation assets, notable among them being the case of endowing tubewell capital to the landless in Bangladesh [Wood and Palmer-Jones 1991] and that of community tubewells in Vaishali district of Bihar [Pant 1984]. Neither of the two experiments was successful in the long run [see Islam and Gautam 2007 for a recent documentation of failure of community tubewells in Vaishali district]. A vast body of literature, for instance, tries to understand the various factors that facilitate or impede cooperative behaviour in the context of irrigation management [Ostrom 1990; Uphoff 1986] and yet, answers are at best elusive. That individual ownership is preferred over group ownership is borne out by the fact that only 2.8 per cent of all wells and tubewells in West Bengal were owned by groups of farmers, while some 92.1 per cent of them were owned individually [GoI 2001]. On the whole, recommending cooperative ownership of irrigation assets without understanding the "design principle" of such cooperative action is neither realistic nor practical.

By far the most promising intervention from the perspective of replicability is the case of PS determination of water prices as found in Mohanpur village. Rawal (2002) too documented a similar case in Bankura district and concluded that it was a positive intervention much as this paper concludes. What may make replication easier in this case is that it was a win-win solution for both the water sellers and water buyers. One therefore would have expected more such interventions, especially in the state of West Bengal where villages are intensely political and panchayats wield real power unlike the panchayats in most other states of India. Yet, such interventions are rather rare.

For instance, while Pandua PS could successfully regulate water price in that block, in the neighbouring Balagrah block this was not done – though both the PS are a part of the same district with the same political party (CPI(M)) in power at all the three tiers of the panchayat. Then, left party domination in all three tiers of the panchayat system does not by itself guarantee successful intervention by the panchayats. Successful intervention by this Pandua PS may be explained in terms of characteristics of the panchayat members. At Pandua, sabhapati (chairman) of PS in 1988 (when this intervention took place) was a school teacher with very little direct agricultural interests while the present 'pradhan' (elected head of panchayat) is a tribal farmer with very little land. None of the elected members of the PS in this particular block are ESB owners. At the same time, the Pandua block PS was pragmatic enough not to antagonise the ESB owners.[9] While PS had decided water price for the entire Pandua block, there were some inter-village differences. For example, water price for boro paddy (per acre) varied from Rs 1,155.0 in Ilchoba village to Rs 1,237.5 in Mohanpur village to Rs 1,320.0 in Jamgram village. The PS member in charge of irrigation committee explained these differences in terms of difference in water retention capacity of the soil. But several ESB owners as well as other respondents were sceptical of this explanation. According to Lakshminarayan Ghosh, an ESB owner in Mohanpur village: "Village leaders who are more influential at the PS, at the behest of their village submersible tubewell owners' association successfully negotiate a higher water price for their own village" (Excerpts from an interview conducted on August 22, 2005).

This case study indicates that the success of panchayat intervention will depend upon the relative bargaining power of the ESB owners vis-à-vis water buyers and the characteristics of the panchayat member themselves. Perhaps the conditions which facilitates panchayat regulation of water prices are absent in most villages; otherwise one would have found more such examples. Thus both the interventions documented in this paper emerged as a result of village specific factors, factors that were unique to those locations at that point in time.

Conclusion

This paper shows that in many cases alternative institutional arrangements have superior equity outcomes than pure private water market transactions. This is especially so in the initial stages of groundwater irrigation development when pump capital is scarce and monopoly power of the water sellers considerably high. External interventions such as that of the PS in the initial stages of development of groundwater markets can have very positive impact on the functioning of such

markets as was seen in the case of Mohanpur village. However, not all alternative institutional arrangements have better equity implication as exemplified by the case of joint ownership of ESB in Dunipara village. In view of positive equity outcomes of some these alternative institutional arrangements, it is tempting to conclude that policy interventions must be designed to replicate these alternative institutional arrangements such that they replace private water market transactions. But such a policy recommendation is naïve given that this analysis shows that success of each intervention is path dependent and contingent upon unique village history, geography and politics. This is not to say that these interventions cannot be replicated at all. But recognising the path dependent nature of institutions and the fact that if conditions are right then alternative institutional arrangements in water sharing will emerge on its own (as it has in the case study villages) will save a lot of often unsuccessful institutional and capacity building efforts in trying to forge community management of natural resources. EPW

Email: am523@cam.ac.uk

Notes

1 Groundwater market may be more aptly referred to as pump rental market or irrigation services market. However, in this paper, the term groundwater market is used for the sake of brevity.

2 Net irrigation surplus is defined as the gross value added by irrigation less the nominal cost of irrigation.

3 Panchayat samiti (PS) is the second tier of the three-tiered panchayati raj (i e, village self-governance) system. The first tier is the gram panchayat (GP) and the third tier is the zilla parishad (ZP).

4 Bigha is the local unit of land measurement used more or less in all parts of India, though the conversion factor of bigha to acre or hectare varies from one place to another. In West Bengal the conversion factors are: 2.5 bighas = 1 acres and 7.5 bighas = 1 hectare.

5 Joint ownership of wells and tubewells is a common phenomenon in many parts of water scarce India where investment costs are high, e g, the tubewell companies in north Gujarat and group dugwells in peninsular India. On the other hand, cases of joint ownership of irrigation assets are relatively rare, though not unheard of in water abundant regions like that of Bengal plains.

6 The two case studies on alternative institutional arrangements in water sharing presented in this paper were undertaken as a part of a larger study on informal groundwater markets in West Bengal. The study involved two phases. In the first phase, structured questionnaires were administered to seven WEM owners and seven water buyers in each of 40 sample villages (including these two case study villages). In the second phase, based on various criteria, water markets were studied in greater detail in six villages. This paper presents case studies of two villages in West Bengal where alternative institutional arrangements have been forged for water sharing.

7 All these figures pertain to the year 2000-01.

8 For instance, a very interesting case of shared tubewells in a village in Punjab has been recently documented by Shaheen, Selvi and Machiwal (2007). This arrangement evolved in response to groundwater resource conditions that required high capital investment, presence of a strong agricultural community and their ethos of cooperation. The same intervention could not however be replicated in the two neighbouring villages they studied.

9 This pragmatism of the CPI(M) government has been called the 'politics of middleness' by Bhattacharyya (1999).

References

Aggarwal, R M (2000): 'Possibilities and Limitations to Cooperation in Small Groups: The Case of Group-Owned Wells in Southern India', *World Development*, 28(8): 1491-87.

Anantha, K H and D R Sena (2007): 'Groundwater Resource Conditions, Its Socio-Economic Impacts and Policy Institutional Options: A Case Study of Murshidabad District, West Bengal, India', Report submitted to International Water Management Institute (IWMI), Colombo.

Bauer, C J (1997): 'Bringing Water Markets Down to Earth: The Political Economy of Water Rights in Chile, 1976-95', *World Development*, 25(5): 639-56.

Bhattacharyya, D (1999): 'Politics of Middleness: The Changing Character of the Communist Party (Marxists) in Rural Bengal (1977-1990)' in B Rogaly, B Harriss-White and S Bose (eds), *Sonar Bangla? Agricultural Growth and Agrarian Change in West Bengal and Bangladesh*, Sage Publications, New Delhi.

Boyce, J K (1987): *Agrarian Impasse in Bengal: Agricultural Growth in Bangladesh and West Bengal, 1949-1980*, Oxford University Press, New York.

Brewer, J, S Kolavalli, A H Kalro, G Naik, S Ramnarayan, K V Raju and R Sakthivadivel (1999): *Irrigation Management Transfer in India, Policies, Processes and Performance*, Oxford and IBH Publishing Co, New Delhi, Calcutta.

CGWB (several years): *Groundwater Year Book*, Central Groundwater Board, eastern zone, Calcutta.

– (1998): *Detailed Guidelines for Implementing the Groundwater Estimation Methodology-1997*, Central Groundwater Board, Ministry of Water Resources, New Delhi, Government of India.

Cunningham, J F (1992): 'Public and Private Groundwater Development in India: The Case of Uttar Pradesh' in Le Moigne G, S Barghouti and L Garbus (eds), *Developing and Improving Drainage Systems: Selected Papers from World Bank Seminar*, The World Bank, Washington DC.

Dhawan, B D (1982): *The Development of Tubewell Irrigation in India*, Agricole Publishing Academy, New Delhi.

Dubash, N K (2002): *Tubewell Capitalism: Groundwater Development and Agrarian Change in Gujarat*, Oxford University Press, New Delhi.

Fujita, K and F Hussain (1995): 'Role of the Groundwater Market in Agricultural Development and Income Distribution: A Case Study in a Northwest Bangladesh Village', *The Developing Economies*, 33(4): 442-63.

GoI (2001): *Report of the 3rd Minor Irrigation Census*, Ministry of Water Resources Development, New Delhi, Government of India.

GoWB (2001): *Panchayat Chalchitra*, Census data of 2001 compiled in a CD format by the Ministry of Panchayats and Rural Development, Government of West Bengal, Kolkata.

Islam, A and R Gautam (2007): 'Groundwater Resource Conditions, Its Socio-Economic Impacts and Policy Institutional Options: A Case Study of Vaishali District, Bihar, India', Report submitted to International Water Management Institute (IWMI) Colombo.

Janakarajan, S (1994): 'Trading in Groundwater: A Source of Power and Accumulation' in M Moench (ed), *Selling Water: Conceptual and Policy Debates over Groundwater Markets in India*, VIKSAT and others, Ahmedabad, India.

Janakarajan, S and M Moench (2006): 'Are Wells a Potential Threat to Farmers' Well-being? Case of Deteriorating Groundwater Irrigation in Tamil Nadu', *Economic and Political Weekly*, 41(37):3977-87

Kolavalli S L and N Shah (1989): 'Management of Public Tubewells in Uttar Pradesh', unpublished report, Centre for Management in Agriculture, Ahmedabad, Indian Institute of Management.

Meinzen-Dick, R (1996): 'Groundwater Markets in Pakistan: Participation and Productivity', Research Report No 105, International Food Policy Research Institute, Washington DC.

Mukherji, A (2004): 'Groundwater Market in Ganga-Meghna-Brahmaputra Basin: A Review of Theory and Evidence', *Economic and Political Weekly*, 30(31): 3514-20

– (2006), 'Political; Economy of Groundwater Markets in West Bengal, India: Evolution, Extent and Impacts', PhD thesis, University of Cambridge, UK.

Nielsen, R and T Hanstad (2004): 'From Sharecroppers to Landowners: Paving the Way for West Bengal's Bargadars', Rural Development Institute Report No 121, available at SSRN: http://ssrn.com/abstract=829306

Ostrom, E (1990): *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge University Press, Cambridge.

Palmer-Jones, R W (1994): 'Groundwater Markets in South Asia: A Discussion of Theory and Evidence' in Marcus Moench (ed), *Selling Water: Conceptual and Policy Debates over Groundwater Markets in India*, VIKSAT and others, Ahmedabad, India.

– (2001): 'Irrigation Service Markets in Bangladesh: Private Provision of Local Public Goods and Community Regulation', paper presented at Symposium on Managing Common Resources: What Is the Solution? Lund University, Sweden, September 10-11.

Pant, N (1984): 'Community Tubewell: An Organisational Alternative to Small Farmers' Irirgation', *Economic and Political Weekly*, 19 (Review of Agriculture), June.

Prakash, A (2005): *The Dark Zone: Groundwater Irrigation and Water Scarcity in Gujarat*, Orient Longman, New Delhi.

Rawal, V (2002) 'Non-Market Interventions in Water-sharing: Case Studies from West Bengal, India', *Journal of Agrarian Change*, 2(4): 545-69.

Roy, K C (1989): 'Optimisation of Unconfined Shallow Aquifer Water Storage for Irrigation', PhD dissertation, Utah State University

Ruud, A E (2003): *Poetics of Village Politics: The Making of West Bengal's Rural Communism*, Oxford University Press, New Delhi.

Saleth, R M (1994): 'Groundwater Markets in India: A Legal and Institutional Perspective' in M Moench (ed), *Selling Water: Conceptual and Policy Debates over Groundwater Markets in India*, VIKSAT and others, Ahmedabad.

– (1996): *Water Institutions in India: Economics, Law and Policy*, Institute of Economic Growth, Commonwealth Publishers, Delhi.

Shah, T (1993): *Water Markets an Irrigation Development: Political Economy and Practical Policy*, Oxford University Press, Bombay.

Shah, T and S Bhattacharya (1993): 'Farmers' Organisation for Lift Irrigation: Irrigation Companies and Tubewell Cooperatives of Gujarat' Overseas Development Institute, London.

Shah, T and V Ballabh (1997): 'Water Markets in North Bihar: Six Village Studies in Muzaffarpur District', *Economic and Political Weekly*, 32(52): A183-A190.

Shah, T, O P Singh and A Mukherji (2006): 'Groundwater Irrigation and South Asian Agriculture: Empirical Analysis from a Large-Scale Survey of India, Pakistan, Nepal and Bangladesh', *Hydrogeology Journal*, 14(3):286-309.

Shaheen, F A and R L Shiyani (2005): 'Equity Redistribution: Groundwater Borewells in North Gujarat', *Economic and Political Weekly*, 40(2):307-12.

Shaheen, F A, V Selvi and D Machiwal (2007): 'Groundwater Resource Conditions, Its Socio-economic Impacts and Policy Institutional Options: A Case Study of Hoshiarpur District, Punjab, India', report submitted to International Water Management Institute (IWMI), Colombo.

Uphoff, N (1986): *Improving International Irrigation Management with Farmer Participation: Getting the Process Right*, Westview Press, Boulder CO.

Wade, R (1987): 'The Management of Common Property Resources: Collective Action as Alternative to Privatisation or State Regulation', *Cambridge Journal of Economics*, 11:95-106.

Webster, N (1999): 'Institutions, Actors and Strategies in West Bengal's Rural Development: A Study on Irrigation' in B Rogaly, B Harriss-White and S Bose (eds), *Sonar Bangla? Agricultural Growth and Agrarian Change in West Bengal and Bangladesh*, Sage Publications, New Delhi.

WIDD (2004): *Groundwater Resources of West Bengal: An Estimation by GEC-1997 Methodology*, Water Investigation and Development Department (WIDD), Kolkata, Government of West Bengal.

Wood, G D and R W Palmer-Jones (1991): *The Water Sellers, A Cooperative Venture by the Rural Poor*, Kumarian Press, West Hartford.