
Groundwater Market and Agricultural Tenancy: A New Form of Collective Inter-Linkage in West Bengal

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ABSTRACT

Land ownership in West Bengal has passed through different phases. Initially there were land owners with large tracts of land. Later in the 1960s and 1970s, Government of West Bengal decided to redistribute land from the original land owners to the small and marginal farmers. The operation of this land redistribution was called 'Operation Barga'. In our survey of groundwater markets, we found that land relations are affected by water relations especially in case of groundwater sellers. In this background, the paper attempts to analyse the various water and related land based transactions experienced at the field level in the three agricultural districts of West Bengal. From field level survey of ground water markets and transactions between water sellers and water buyers, it is observed that owners of Groundwater Extraction Mechanisms (WEM), in order to economise their scale of water usage and maximise profit, form a collective monopoly amongst themselves, not only to divide the land to sell water but also to consolidate on the surrounding lands for economies of scale. Although this may lead to higher productivity of agriculture it may also lead to increase in landless farmers. Thus we find a situation in West Bengal which may thwart the very essence of land reforms.

Keywords: Groundwater, Agriculture, Market, Economies of Scale of Water Usage, West Bengal

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I

INTRODUCTION

Recent research has used the language of contract theory to motivate descriptive empirical analysis of groundwater markets. Examples include bilateral bargaining (Kajisa and Sakurai, 2003), relational contracting (Kajisa and Sakurai, 2005; Acharyya, 2019), moral hazard and risk sharing (Aggarwal, 2007), and enforcement by social institutions in the shadow of a formal legal system (Rahman *et al.*, 2011). Although the principal-agent theory has been most often used to understand water markets, it does not always work at ground level (Acharyya *et al.*, 2018). It seems that the casting of water buyer as the agent and water seller as the principal started with early studies focused on issues of power and taken its vocabulary from the works on land tenure contracts (Wood and Palmer Jones, 1990; Palmer Jones, 2001). These studies identified the water seller, sometimes referred to as the "water lord" as the principal and the waterless farmer as the agent. Subsequent approaches have maintained this identification. In cases where principal and agent are homogeneous or

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where bargaining power is explicitly accounted for, the reversal of roles should not matter.

In this paper, we are not applying any principal-agent problem. Rather, we try to analyse the various transactions experienced at the field level and use a theory that explains most of the features of the water market, especially under land fragmentation. We find from field level survey that owners of Groundwater Extraction Mechanisms (WEM) in order to economise their scale of water usage and maximise profit form a collective not only to divide the land to sell water but also to consolidate on the surrounding lands for economies of scale. Although this may lead to higher productivity of agriculture it may also lead to increase in landless farmers.

II

SURVEY BASED EXERCISES AND ANALYSIS OF CONTRACTS IN WATER MARKETS

We took those districts for our sample survey for studying groundwater markets where Boro cultivation using groundwater is high and where this is done using Electric Submersibles (ESBs). Ranking and matching the districts of the State of West Bengal in terms of the area irrigated by groundwater and number of ESBs, we chose the three districts of Burdwan, Murshidabad and West Midnapore.

The field survey was conducted from end of 2018 when cultivation of Boro paddy starts till August 2019 ending with *kharif* paddy cultivation. Rather than distinguishing between water buyer and water seller, we distinguish between an ESB owner and a non-owner. An ESB owner may be both a seller and a buyer of groundwater, but a water seller could only be the owner of an ESB. Since the average size of land holding is very small, an ESB owner would likely be a water seller in West Bengal. A non-owner is a pure water buyer. So by taking owner and non-owner of ESB, we can look at the market that operates between sellers and buyers.

The survey was conducted at two levels: the village level and the household level. First we asked key village informants about the irrigation status of all the agricultural households in the survey villages. We selected ten ESBs from each village to give equal weightage to the two villages in each block. We surveyed the owners of these ESBs in the village. Thus, we surveyed twenty ESB owners from each block and forty from each district so that in total one hundred and twenty ESB owners were surveyed.

So far as the choice of non-owner/pure buyer of groundwater was concerned, we observed that each ESB owner sells to at least two or more non-owners. Under the circumstances, we chose two non-owner/pure buyer households for each seller.

Plot-specific and farm household specific data were collected from both ESB owners and non-owners. Plot specific data included details on source of irrigation, availability of irrigation water, terms of the water transaction, information on labour and other inputs. Plot specific data is needed to estimate the demand for irrigation

water. Farm household data included socio-economic characteristics of the members to help identify farmer-specific effects on production.

III

LAND LEASE AND WATER MARKETS

One additional dimension that has come out from our field survey across all the districts is the fact that other than buying and selling of water, leasing-in of other farmer's land (especially during summer or Boro season) is a common feature among WEM owners. This is not to say that the non-owners of WEM's do not lease in land. But reasons for leasing in seem to be different for the two. Table 1 shows the details of lease-in of land by water sellers and water buyers for Boro and *kharif* seasons.

TABLE 1. LEASING-IN OF LAND IN DIFFERENT SEASONS BY WATER SELLERS AND WATER BUYERS

Season (1)	No. of water sellers leasing in (out of 120) (2)	Percentage of water sellers leasing in (per cent) (3)	No. of water buyers leasing in (out of 240) (4)	Percentage of water buyers leasing in (per cent) (5)
Lease taken in Boro	67	56	106	44
Lease taken in <i>kharif</i>	23	20	32	13

Source: Field survey conducted by the author in 2018-2019.

From Table 1 we observe that 56 per cent of WEM owners lease-in land of others in Boro season when groundwater is the main source of irrigation while only 20 per cent do so in *kharif* season. In case of pure water buyers, 44 per cent lease-in land during summer season and 13 per cent do so in *kharif* season. Since in *kharif* or monsoon season, lease-in of land is much less (mainly due to availability of rain water that works as an incentive for many farmers who cannot cultivate their land due to high water price in summer, to do so in monsoon) we concentrate on the Boro season. Most of the lease-in contracts are seasonal in nature and in most cases it is only for one season. In only a very few cases is there an annual contract as shown in Table 2.

TABLE 2. TYPE OF LEASE-IN CONTRACTS IN BORO SEASON

Type of contract (1)	Water sellers (2)	Water buyers (3)
Seasonal	65 (97 per cent)	97 (92 per cent)
Annual	2 (3 per cent)	9 (8 per cent)
Total	67	106

Source: Field survey conducted by author in 2018-2019.

Note: Figures in parentheses denote the percentage of total sample size for water sellers and water buyers.

We came to know from the farmers during our field survey, that after Operation Barga, many land owners started fearing that they might lose their land if they lease it out for more than one season to the same farmer.

However, when a land owner leases out his land to a water-seller whose WEM is near his land, the contract is repeated every Boro season as no other WEM owner would give water to his land. Hence the lease contract between a WEM owner and landlord whose land falls within the WEM owner's machine is repetitive in nature. The land owner cannot lease out his land to some other WEM owner, as in most cases WEM owners form cartels among themselves by dividing the area that they would irrigate amongst themselves. Moreover, if the land owner leases out his land to some other farmer, the WEM owner may not give any water in future to the land owner. So it becomes more of a compulsion for the land owner who wishes to lease-out his land, to lease it out to the same WEM owner whose machine lies within the vicinity or closest to his land for every Boro season.

Tables 3 and 4 give us the details of lease-in transactions of land of water sellers and pure water buyers. One important difference here is that the average area of land leased-in by water sellers during Boro season across all districts is almost three times greater than the average area leased-in by pure water buyers. In fact, the average area leased-in by pure water buyers is less than an acre while it is more than 3 acres for WEM owners. The maximum area leased in by both WEM owners and pure water buyers is in the district of Burdwan.

TABLE 3. DETAILS OF LEASE-IN TRANSACTION DURING BORO SEASON AMONG WEM OWNERS

Districts (1)	Avg. area leased in (in acres) (2)	Proportion of output given per acre for lease in (in quintals) (3)	Price per acre given for lease (4)	No of people who pay in output (5)	No of people paying in cash (6)
Burdwan	5.8	6.66	0	29 (100 per cent)	0
Murshidabad	2.27	6.6	6500	6 (75 per cent)	2 (25 per cent)
West Midnapore	2.06	5.92	10000	21 (70 per cent)	9 (30 per cent)
Total	3.71	6.38	9364	56 (84 per cent)	11 (16 per cent)

Source: Field survey conducted by author in 2018-2019.

Note: Figures in parentheses show the percentage of total sample size of water sellers (WEM owners) for a particular district.

TABLE 4. DETAILS OF LEASE-IN TRANSACTION DURING BORO SEASON AMONG PURE WATER BUYERS

Districts (1)	Avg. area leased in (in acres) (2)	Proportion of output given per acre for lease (in quintals) (3)	Price per acre given for lease (4)	No of people who pay in output (5)	No of people paying in cash (6)	No of people paying in both (7)
Burdwan	1.07	6.7	8185	34(81 per cent)	5(12 per cent)	2(5 per cent)
Murshidabad	0.74	5.9	6628	15(68 per cent)	7 (32 per cent)	0
West Midnapore	0.79	6.3	8556	22(52 per cent)	20(48 per cent)	0
Total	0.9	6.44	8083	71(67 per cent)	32(30 per cent)	2(2 per cent)

Source: Field survey conducted by author in 2018-2019.

Note: Figures in parentheses show the percentage of total sample size of water buyers for a particular district.

From Tables 3 and 4, we observe that the proportion of output that is given to the land owner per acre of leased-in area on an average in Boro season is almost the same

for water buyer and water seller (6.44 quintals per acre). However, when it comes to payment in cash, water sellers have to pay marginally more per acre. This is perhaps due to the higher income of water sellers that allows them to pay more for lease-in and acts as an incentive for the landowner to lease-out his land to the water seller on a regular basis. Majority of the farmers in both the groups of WEM owners and non-owners prefer to pay the price for leasing-in of land in terms of proportional output rather than cash. However on an average, larger number of water buyers was observed to be paying in cash than water sellers for leasing-in of land. We believe that for the landlord, uncertainty works more against pure water buyers than water sellers when it comes to leasing-out land, due to higher income of water sellers. From field experience we observed that many landowners who lease-out their land to landless farmers want the payment for rent in cash to remove the uncertainty of crop failure of which the landless marginal farmers are most vulnerable.

If one reason for leasing-in of land is higher profit for both WEM owners and pure water buyers, there is a significant difference when it comes to ownership of groundwater. While pure water buyers have to purchase groundwater for their leased-in land, WEM owners use their own surplus water (having a shadow price) to irrigate the land leased-in.

In our survey, we asked the question to both water buyers and sellers as to why they lease-in greater area of land during Boro season? While water buyers answered that leasing-in of land during Boro generates higher profit, sellers told us that they get more profit not only from cultivation of the lease-in land but also because there is surplus water that can be used in the lease-in land. For water buyers who lease-in, they have to purchase water. The various reasons that water buyers have given for lease-in of land in Boro season are outlined in Table 5. While a majority have given the reason as greater profit for lease-in, the other reasons include inability of the actual land owner to cultivate his own land, be it due to physical incapacity, financial constraint, labour constraint or absenteeism from land.¹

TABLE 5. REASONS FOR LEASING-IN OF LAND BY PURE WATER BUYERS

Reasons for leasing in land (1)	Burdwan (42) (2)	Murshidabad (22) (3)	West Midnapore (42) (4)	Total (106) (5)
For more income,	25 (60 per cent)	20 (91 per cent)	42 (100 per cent)	87 (82 per cent)
Lessor is physically unfit to cultivate,	2	1	0	3
Lessor does not stay in the village,	3	0	0	3
Lessor does not have the required labour	2	0	0	2
Lessor has no family member to help in cultivation	2	0	0	2
Lessor feels lease will generate more profit than self-cultivation,	8	1	0	9

Source: Field survey conducted by author in 2018-2019.

Note: Figures in parenthesis show the percentage of total sample size of water buyers for particular district

When it comes to the reasons provided by water sellers for lease-in of other's land in Boro season, most reasoned it on surplus water available from their own

WEMs that gave higher profit from lease-in. We shall discuss about this in greater detail later as a WEM owner can also earn by selling water. The other reason for the water seller to take lease is financial incapacity of the original land owner to cultivate as shown in Table 6.

TABLE 6. REASONS FOR LEASING-IN OF LAND BY WEM OWNERS

Reasons (1)	Burdwan (29) (2)	Murshidabad (8) (3)	West Midnapore (30) (4)	Total (67) (5)
Due to available surplus water and greater profit	27(90 per cent)	6 (75 per cent)	30(100 per cent)	63(93 per cent)
Lessor is financially weak and not in a position to cultivate	2(7 per cent)	2(25 per cent)	0	2(3 per cent)

Source: Field survey conducted by author in 2018-2019.

Note: Figures in parentheses show the percentage of total sample size of water sellers (WEM owners) for particular district.

In case of water sellers or WEM owners, most of them lease-in that area of land which falls within the catchment area of their machine. This is shown in Table 7, where out of the 67 WEM owners who take lease in Boro season, 66 owners cultivate the leased-in land using their own WEM. This means that they do not purchase water to irrigate the leased-in land. The only cost that they incur is the cost of extraction of groundwater for irrigating the leased-in land.

TABLE 7. SOURCES OF IRRIGATION USED BY WEM OWNERS TO IRRIGATE LEASED-IN LAND

Sources of irrigation used to irrigate leased-in land in Boro season (1)	No. of WEM owners (2)	Percentage of WEM owners (3)
Own source of irrigation for leased-in land	66	99
Own source as well as purchased water for leased-in land	1	1
Total	67	100

Source: Field survey conducted by author in 2018-2019.

One major reason for the WEM owners to irrigate the leased-in land with their own machine is land fragmentation that does not allow them to irrigate their whole own land with their machine. Hence, to reap positive economies of scale, the excess capacity or surplus water of the machine is used to irrigate other's land that falls within the catchment area of the machine. This can be done either by leasing-in other's land or by selling water. From our survey, we found that one acre of land leased-in during Boro season generates on average a greater profit (on an average Rs.500 more per acre) than selling of water to an acre of land. Hence, for the WEM owner, it is much more profitable to take lease unless and until there is a crop failure due to some natural calamity. Not only that, there are other advantages also. The village institutions are different from formal institutions. It is more inter-personal and localised with a certain village level peer pressure (Bardhan, 1984). Under such circumstances, it is sometimes difficult to retrieve payments for water sold. Time is also a factor since many WEM owners reported delay in payments from water

buyers. Under such circumstances, leasing-in of other's land was found to be more convenient as well as profitable by WEM owners rather than selling water.

We ran a correlation between number of years of lease-in of land by WEM owners and number of years of running of ESBs on an average and found a strong correlation coefficient to the tune of 0.99 between the two as shown in Table 8 implying a strong positive correlation between the advent of ESBs and leasing-in of land in Boro season.

TABLE 8. CORRELATION BETWEEN NO. OF YEARS OF LEASE-IN OF LAND AND NUMBER OF YEARS OF RUNNING OF ESBs FOR ESB OWNERS

(1)	No. of years of lease in (2)	Avg no of years of ESB running (3)
No. of years of lease in	1	
Avg. No. of years of ESB	0.998337488	1

Source: Field survey conducted by the author in 2018-2019.

We also looked at the distribution of groundwater that is extracted by WEM owners who lease-in land, in terms of the proportion of area irrigated of the owner's land, of leased-in land and by selling water as shown in Table 9. We also looked at the groundwater distribution for those WEM owners who did not lease-in land but only sold water in Table 10.

TABLE 9. DISTRIBUTION OF IRRIGATED WATER FROM OWN MACHINE IN TERMS OF PROPORTIONAL AREA FOR THOSE ESB OWNERS WHO LEASE-IN LAND INBORO SEASON

Districts (1)	Percent of Self area irrigated (2)	Per cent of other's area irrigated through lease in (3)	Per cent of area of water sold (4)
Burdwan	24.87	36.64	38.49
Murshidabad	15.77	16.04	68.19
West Midnapore	13.07	19.81	67.12
Average	17.90	24.16	57.93

Source: Field survey conducted by author in 2018-2019.

TABLE 10. DISTRIBUTION OF IRRIGATED WATER FROM OWN MACHINE IN TERMS OF PROPORTIONAL AREA FOR THOSE ESB OWNERS WHO DOES NOT LEASE-IN LAND IN BORO SEASON

Districts (1)	Per cent of self area irrigated (2)	Per cent of area of water sold (3)
Burdwan	50.95	49.03
Murshidabad	23.19	76.80
West Midnapore	20.60	79.39
Average	31.58	68.40

Source: Field survey conducted by author in 2018-2019.

From Table 9 we observe that across all the districts, proportion of area of leased-in land irrigated is greater than the proportion of area irrigated of own land. This is purely due to land fragmentation which does not allow the seller to irrigate his own whole land with his own machine. We have already seen that most of the leased-in

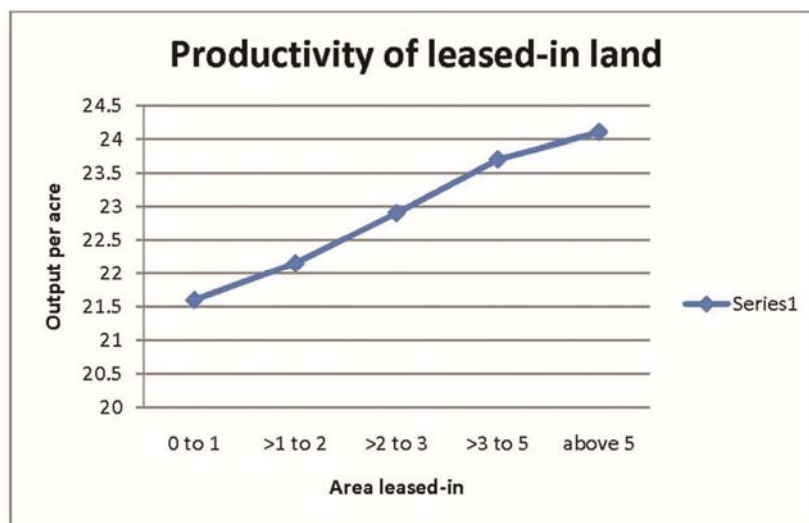
land of WEM owners fall within the catchment area of their machines, suggesting that ESB owners make greater profit from leased-in land (which we have already shown) and also consolidates land holding to reap positive economies of scale. This is shown in Table 11. Consolidation of land holding within the catchment area of the machine leads to a higher productivity and output.

TABLE 11. NET AREA LEASED-IN BY ESB OWNERS IN BORO SEASON

Area leased in (acre) (1)	Output per acre (2)	No of farmers (3)
0 to 1	21.6	13
>1 to 2	22.15	15
>2 to 3	22.9	10
>3 to 5	23.7	14
above 5	24.1	15
Total		67

Source: Field survey conducted by author in 2018-2019.

Figure 1 below shows that with rise in the area leased-in by the WEM owner, the per acre output or productivity rises. Thus consolidation of land holding within the catchment area of the machine leads to greater productivity.



Source: Field survey conducted by author in 2018-2019.

Figure 1. Relation Between Leased-in Area and Productivity in Boro Season.

One point to be noted here is that lease-in of land, although more welcome, depends not only on the WEM owner but also on the landowner whose land falls within the catchment area of the ESB owner's machine. We found several instances of providing incentives as well as coercion from the ESB owner to the landowner whose land falls within the vicinity of the catchment area of the WEM owner's machine, so that the land owner leases out his land to the ESB owner. Incentives

include free provision of water or water at a high discount in the *kharif* season if water is required. One form of coercion we observed was that if the landowner is not willing to cultivate and wants to lease out his land, he must do so to the ESB owner in the vicinity. If he leases out his land to someone else, his land will not be provided with water. From Table 8 above, it is also clear that lease-in of land is a continuous phenomenon of the ESB owners. However, most of the landowners lease out only for one season (mainly Boro) to the ESB owners as they either cultivate during *kharif* season or they fear that land might be usurped by the ESB owner if land is leased-out annually.

IV

CONCLUSION

Field survey reveals an inter-linkage between land market and water market in that WEM owners lease-in land that falls within the catchment area of their machine to increase profit through positive economies of scale and optimal capacity utilisation of machine. Analysing the groundwater market structure we found the existence of a fragmented oligopoly type market where there is a captive segment and a contested segment in the groundwater market.

NOTE

1) A person who leases-out his land is called "lessor" and a person who leases-in other's property is known as lessee.

REFERENCES

- Acharyya, Achiransu (2019), "Groundwater Pricing and Groundwater Markets" in *Groundwater Development and Management: Issues and Challenges in South Asia*, (Eds.) (2019), Pradip K. Sikdar, pp.471-488. N.p: Co-published by Springer International Publishing, Cham, Switzerland, with Capital Publishing Company, New Delhi, India.
- Acharyya, Achiransu; Madhusudan Ghosh and Rabindra N. Bhattacharya (2018), "Groundwater Market in West Bengal, India: Does it Display Monopoly Power?" *Studies in Microeconomics*, Vol.6, No.1-2, pp.1-25.DOI: 10.1177/2321022218785243
- Aggarwal, Rimjhim M. (2007), "Role of Risk Sharing and Transaction Costs in Contract Choice: Theory and Evidence from Groundwater Contracts", *Journal of Economic Behavior and Organization*, Vol.63,pp.475-496.
- Bardhan, P. (1984), *Land, Labor and Rural Poverty*, New York Guildford, Surrey: Columbia University Press and Oxford University Press.
- Kajisa, Kei and T. Sakurai (2003), "Determinants of Groundwater Price Under Bilateral Bargaining with Multiple Modes of Contracts: A Case from Madhya Pradesh, India", *Japanese Journal of Rural Economics*, Vol.5, pp.1-11.
- Kajisa, Kei and T. Sakurai (2005), "Efficiency and Equity in Groundwater Markets: The Case of Madhya Pradesh, India", *Environment and Development Economics*, Vol.10, pp.801-819.
- Palmer Jones, R. (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?* held at Lund University, Sweden, September 10-11.

- Rahman, M.W.; M.R. Ahmed and R.H. Sarwer (2011), "An Investigation of Groundwater Irrigation and Command Area Management Issues in Bangladesh", *Journal of Knowledge Globalization*, Vol.4, No.1, pp.93-114.
- Wood, Geoffrey D. and R.W. Palmer-Jones (1990), *The Water Sellers, a Cooperative Venture by the Rural Poor*, Kumarian Press, West Hartford.