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## **Role of Private Investment in Groundwater Irrigation and Emerging Changes in Seasonal Land Leasing Contract during Boro Rice Cultivation in West Bengal Since 1990s: An Application of Game Theory**

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### ABSTRACT

Since the early-1990s, with the advent of globalisation in Indian economy, there has been growing demand for agricultural inputs associated with the growing burden of subsidies combined with fiscal constraint. Paradoxically with spread of the new technology there is an increasing dependence on modern inputs in agriculture, while there has been declining public investment in agriculture. The share of public sector in the gross capital formation (GCF) in agriculture which was about 43 per cent in the early 1980s drastically declined to about 15 per cent by 2010-11. The growing capital intensity in agriculture and the relatively declining role of the state in input supply raises serious challenges to agricultural development and especially the welfare of the small and marginal farmers. Despite extreme population pressures and limited land resources, the notable progress of West Bengal in achieving food security can largely be attributed to the enforcement of tenancy reforms and the rapid expansion of groundwater irrigation. This policy promoted rapid expansion of irrigated “boro” rice farming in the dry season. As boro cultivation required controlled irrigation it flourished where canal irrigation in the post-monsoon season was adequate. In many areas that were outside the command areas of the governmental irrigation facilities, private farmers invested in groundwater extraction devices. The growth of private water market in the post monsoon season led to reverse tenancy, i.e., leasing out of land from relatively smaller to relatively large farmers. The study forms a game theoretical model based on the data collected from surveys conducted in some village households of Murshidabad district. The findings suggest that both the small and the large farmers gain from this seasonal leasing contract, without the fear of losing the existing Barga rights.

**Key Words:** Reverse tenancy, Irrigation water, Boro rice, Groundwater market, Operation Barga, Thika contract.

**JEL:** C7, O33, Q15, Q16

### I

#### INTRODUCTION

Rice is the most dominating food crop covering more than 70 per cent of the cropped area of West Bengal. The main causes of growth of rice production in the state are the adoption of higher yielding varieties of monsoonal aman paddy and the cultivation of winter boro paddy, in rotation with aman. Both of these forms of intensification were enabled by the rapid spread of groundwater irrigation, mainly in the form of privately owned shallow tubewells (STWs). Boro rice is cultivated in waterlogged, low-lying or medium lands with irrigation during November to May.

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Groundwater is a prime natural resource in the earth. It has emerged as the main source of irrigation for smallholder farmers in West Bengal and much of it has been through private investments. In the late 1980s and early 1990s, agricultural growth rates were 6 per cent per annum, which was attributed to expansion in the area under boro rice cultivation and an increase in yield of all paddy crops due to assured irrigation from tubewells (Sengupta and Gazdar, 1997). The development of minor irrigation, particularly private investment based expansion of shallow tubewells, has contributed to this impressive performance, and was an outcome of the government's market liberalisation policy for irrigation equipment in the late 1980s. This policy promoted rapid expansion of irrigated "boro" rice farming in the dry season. Time series data published by the Government of West Bengal reveals that in terms of area under cultivation, the acreage under boro paddy is second only to the area under monsoon paddy in the state. Further cultivation of summer (boro) paddy in the post monsoon season expanded rapidly after the introduction of high-yielding variety (HYV) seeds and the spread of irrigation facilities.

Until the beginning of the 1990s, it appeared that in rice cultivation the small and the marginal farmers had found security of tenure. But today, the access to water appears to be slipping away from many of the farmers in some parts of West Bengal, especially in parts of the districts of Burdwan, Murshidabad, Hoogly, Midnapore and Bankura. Since the early 1980s there has been a rapid increase in boro cultivation in various districts of West Bengal. Boro paddy cultivation is generally based on the use of HYV seeds. As this requires controlled irrigation it flourishes where canal irrigation in the post-monsoon season is adequate. In many cases canal irrigation is supplemented by underground water drawn by diesel or electrically-powered tubewells. In areas where canal irrigation is inadequate or unavailable, cultivation is carried out primarily through the use of groundwater. In many areas that are outside the command areas of the governmental irrigation facilities, the private farmers invested in groundwater extraction devices. Private investment in groundwater extraction mechanisms and the emergence of markets for the supply of groundwater have a significant role in the spread of boro cultivation. Previously (for most of the 1980s) the high risk factor involved in boro cultivation had led the larger landowners to lease out land on a fixed contract 'thika' lease (fixed rent seasonal tenancy). Thus, initially, the small and marginal farmers, even landless farmers in West Bengal were directly engaged in the cultivation of boro paddy.

In the early 1990s, mini-submersible tubewells (MSTWs) began to take over from the earlier diesel power shallow tubewells (STWs) in some rural areas. The electrically powered MSTWs can easily raise water from more than 20 meters below the ground and thereby reach more secure water resources. The previous tenancy situation has now reversed itself in many areas. The larger cultivators have individually or jointly invested in an MSTW and proceeded to offer to all the farmers (usually the smaller farmers) in the 15 acre command area of the MSTW, the option of a thika contract for leasing in their land under fixed rent or fixed produce for that

season. The owners of water source usually either refuse to sell the water to others or they form a cartel among themselves and raise the price of water to such a high level that relatively smaller farmers find it profitable to lease out their land to the owners of MSTW, STW, DTW (deep tubewells) etc. In this way, the growth of private water market in the post-monsoon season has led to reverse tenancy, i.e., leasing out of land from relatively smaller to relatively large farmers in rural West Bengal.

## II

### OBJECTIVES

The objective of this paper is to delineate the emerging changes in the contractual relationship in agricultural land markets in West Bengal. The paper, therefore, intends to review the nature and impact of this contractual agreement in the context of economic growth and equity. Our survey was aimed at collecting comprehensive data from some village households of Murshidabad district. The objective is to examine the reasons, nature and effect of reverse tenancy. In the paper a game theoretical model has been formed to show that both the small and the large farmers gain from this seasonal leasing contract, without the fear of losing the existing Barga rights.

## III

### METHODOLOGY AND STUDY AREA

The proposed study observed the phenomenon of reverse tenancy in the sample villages since last two and half decades (1990 – 2015), i.e., a period of about 15 years. Our study aims at collecting comprehensive data on some village households of Murshidabad. Two moujas have been selected in our sample from this district, namely Mahalandi (J.L No.:20) and Gokarna (J.L No.:19). These moujas are a near perfect example of the role of private investment in groundwater extraction devices. In the first phase of expansion of boro cultivation, diesel powered shallow tube well pump sets were installed by the farmers, and from around 1991 there was a rapid and almost universal shift to submersible pumpsets as water levels fell.

## IV

### REASONS OF REVERSE TENANCY

The basic reason behind the changes is 'technology', private ownership of technology bring land into the control of those who control technology. In fact, there are strong socio-economic reasons for large farmers having greater access to leased land, these are:

- (1) The growth of private water market is the main reason of reverse leasing. The large farmers have their own pumpsets, shallow tubewells, shallow pumps, mini-

submersible tubewells (MSTW) etc., whereas the small farmers have to buy water from the large farmers. In the early 1990s, MTSWs began to take over from the earlier diesel power STWs in some rural areas. MTSWs were introduced when the water-level fell in the aquifers and STWs could not ensure water supply. The MSTWs can easily raise water from more than 20 meters below the ground and thereby reach more secure water resources. This also increased the command area. In the early 1990s, an MSTW cost approximately Rs. 65,000 to install (this can increase to more than Rs. 90,000 if the electrical motor is more than 5 horsepower and driven by a separate diesel generator) and further a payment of Rs. 1,500 per annum for the electricity consumed. In the late 1990s, the cost had risen almost to Rs.1,30,000 (data collected from some large farmers at the time of interview). Thus the private ownership of MSTWs is concentrated in the hand of some large cultivators. This situation gives the owner of the MSTW a perpetual monopoly over water distribution in the command area. The owners form a cartel among themselves and raise the price of water to such a high level that the relatively smaller farmers are compelled to lease out their land to the owners of MSTWs.

- (2) The small farmers' limited access to institutional credit is a constraint to investment in new agricultural technology. Small farmers are often unable to satisfy the commercial criterion of credit worthiness (value of assets, land etc.). In relation to the credit requirement of the farmers, the institutional loans are quite insufficient. In addition, the medium and large farmers take more than proportionate share of the institutional credit. This indicates that institutional credit is allocated neither according to need nor to profitability of investment opportunities, but in proportion to value assets (particularly land) owned by different groups. Thus small farmers, largely being pushed outside the institutional credit of the organised money market, are forced to borrow mostly from non-institutional sources. Loans from non-institutional sources are so massive that inspite of significant increase in the institutional credit the latter can cover only 47 per cent of all loans (NSSO 70th Round, 2013).
- (3) Small farmers are forced to borrow from money lenders, landlords, water suppliers which ultimately compel them to surrender their land to big peasants. The agricultural credit system in the country is not realistic. Agriculture is an unorganised profession. Its success and failure depends to a large extent, on climatic factors. Further it is not always possible to distinguish between productive and unproductive loans. Farmers often require loans for consumption purpose as well. The financial agencies do not grant loans for unproductive consumption purposes. Rich farmers and landlords, not only often provide production loans to their tenants, but also provide consumption loans to ensure the supply of labour at a stipulated period (particularly during the peak season) at the prevailing market rate. Accordingly the small farmers are forced to fall back upon moneylenders, water suppliers, traders, mahajans etc. who are basically the

big farmers or landlords. The economic conditions of the small and marginal farmers may automatically lead them to surrender their land to financially capable landlords or big peasants in exchange of some fixed share of crops or equivalent money.

- (4) The large farmers' desire and ability to maximise income through expansion of the size of operational holdings is an important reason of reverse leasing. According to the Report of the National Commission on Rural Labour (NCRL) (1991)<sup>1</sup>, the new technology, being market oriented and capital intensive, has mainly favoured the big peasants. The small farmers not possessing the required resource base or requisite knowledge or risk-bearing capacity have lagged behind in the adoption and application of technology.
- (5) The marginal farmers' desire to maximise income through leasing out of land specially in the 'boro season' and wage earnings by hiring out labour within and outside agriculture is a prime reason of reverse tenancy. The small farmers now can lease out their land to the MSTW owners for boro season in exchange of fixed rent under 'thika' contract. At the same time, they can earn some money by selling labour. In this strategy, they now get dual income: (a) Income from fixed rent of land and (b) Income from selling labour.
- (6) The return from cultivation per unit of land is higher in large holdings than for the small holdings perhaps due to differential input costs and credit costs. The large farmers purchase raw materials at a lower cost, as compared to small farmers, as they purchase in bulk quantities. The large farmers can afford to store their grains and sell it in the market after four or five months (i.e., August/September) and thereby get a good price for their produce. The small farmers can sell their produce immediately after harvesting season (i.e., March/April) as they cannot bear the cost of storing the grains for a long period; they also need to finance their daily needs, pay back loans they have taken from mahajans and invest for the next aman crop.

v

GAINS FROM TRADE APPROACH OF REVERSE TENANCY

Both the small and large farmers (or in other words, the lessor and the lessee) gain from this leasing contract. As this leasing from small to large farmers is entirely verbal and informal, legal proceedings can easily be avoided in such cases. In such an agreement both the parties are happy - the landlord (or the owner of water source) gets the full control over the whole land during that season, the bargadar (or small farmer) gets the required share without any responsibility of cultivation and without losing the barga-right. The bargadars gladly accept this proposal of reverse tenancy because in this case he has no risk-bearing factors of cultivation, he has no responsibility on the land, no physical effort for growing crop; and in as much as this is a verbal agreement there is no possibility of cancellation of the barga-rights of the

small farmers. Even at the off-time the farmer now can look for a new fixed-wage job which increases the total income of the farmer. This gain from trade approach is the basic logic of reverse tenancy. Here the parties, the landlord and the small farmer gain from this mutual agreement (trade). Reverse tenancy leads to better allocative efficiency, induce higher farm investment and results in higher output and income. It is particularly argued that the small farmers, who are generally capital starved, will be able to participate in large scale farming and benefit through such contractual arrangement. It is also observed that in the case of absentee landlords, they are also better off by leasing out their lands to the large farmers during the boro season as the barga records are not enforceable then.

VI

APPLICATION OF GAME THEORY

In the reverse tenancy story there are two groups of players: Large farmers and Small farmers.

The large farmers have two strategies: (1) They can ‘Lease in’ the small farmers’ land within the 12 acre command area of MSTW. (2) They can ‘Sell water’ to the small farmers within the command area of MSTW. In this case, MSTW owner allows the small farmers to cultivate their own lands by purchasing water from him, provided the small farmers also agree to cultivate land, otherwise the land will remain uncultivated within the command area of MSTW.

The small farmers also have two strategies: (1) They can ‘Lease out’ their land to the MSTW owners for that particular season in exchange of fixed rent under ‘thika’ contract. At the same time, they can earn some money by selling labour. In this strategy they can get dual income: (a) Income from fixed rent of land. (b) Income from selling labour and (2) They can also take the decision of ‘Self-cultivation’ of land by purchasing water from large farmers, provided they are ready to sell it

	Small farmers	Lease out	Self-cultivation
Large farmers			
Lease in		a,b	c,d
Sell water		e,f	g,h

Reverse tenancy occurs only when ‘Lease in – Lease out’ strategy combination becomes the Nash Equilibrium Point.

*Assumptions*

From a sample survey in Murshidabad district, we have observed the followings:

- About four persons are generally required to cultivate one bigha of land.

- Large farmers purchase raw materials at lower costs, as compared to small farmers, as they purchase in bulk quantities. As a result, the average raw material costs are relatively lower for the large farmers (Rs. 2500/- per bigha for large farmers and Rs. 3200/- per bigha for the small farmers as estimated from our sample survey of Murshidabad district).
- Small farmers can earn extra pay by working on other farmers' land. The wage rate in Murshidabad district is Rs. 80/- per day.
- The price of water in Murshidabad district varies from place to place. In our sample, it is found that small farmers purchase water from large farmers during boro season at the rate of Rs. 2200/- per bigha.
- The large farmers can afford to store their grains and sell it in the market after four or five months (i.e., August/September) and thereby get a good price for their produce (at a cost of Rs. 1400/- per quintal).
- The small farmers can sell their produce immediately after harvesting season (i.e., March/April) as they cannot bear the cost of storing the grains for a long period; they also need to finance their daily needs, pay back loans they have taken from *mahajans* and invest for the next aman crop. In the month, March/April, they get the price of boro crop at Rs. 900/-, per quintal.
- Monthly operation and maintenance cost of MSTW is Rs. 200/- per bigha (mainly diesel or electricity cost).
- In general, eight quintals of rice can be produced per bigha of land.

#### *Formulation of a Two Person Game*

	Small farmers	Lease out	Self-cultivation
Large farmers			
Lease in		3700, 6000 N.E. Point.	- 200, 3600
Sell water		- 200, 3600	2200, 200

*1st Cell = Lease In / Lease Out*

Large farmer's calculation:

Costs of production:

Large farmer-

Labour cost (4 persons)  $80 \times 3 \times 20 = 4800$

Raw material cost 2500

Water cost 200

Total cost 7500

NB: 1 family labour + 3 hired labour worked for 20 days on average  
Lower costs due to large scale input purchase operation costs only

Price (Sept/Oct)            8 quintals×1400=11200  
 Return                        11200 – 7500= 3700

Small farmer’s Return calculation = Selling of labour (assuming 3 family labour)  
 + Fixed rent from leasing out of land = (3×80×15) + (2400) = 3600 + 2400 = 6000

Here our assumption is that small farmers may somehow manage daily wage employment to others land on 15 days on an average in a month, i.e., probability of wage employment = 15/30 = ½.

*2nd Cell = Lease In / Self-Cultivation*

Here the small farmers have decided not to lease-out their land; instead they want to cultivate their own land. But the large farmers are not ready to offer water to them may be in the expectation of leasing in their land in future.

Large farmers’ costs = Rs.200, per bigha (annual average operation cost of MSTW).

Land remains uncultivated within the command area of MSTW and hence return = – 200

Small farmers are not able to cultivate their land due to non-availability of water but they can earn by selling labour = (3×80×15) = Rs.3600 (assuming 3 family labour).

*3rd Cell = Sell Water/Lease Out*

Here both the large and the small farmers do not want to cultivate by own. Large farmers want to sell water (may be to avoid risks of cultivation) and small farmers also opt not to cultivate and they earn only by selling labour.

Large farmers’ return = – 200 (average operation costs of MSTW).

Small farmers’ return = 3600 (by selling labour).

*4th Cell = Sell Water/Self-Cultivation*

Large farmers’ return by selling water = Rs. 2200, per bigha.

Small farmers’ costs calculation

Labour cost (4 persons)	80×1×20 = 1600	NB: 3 family labour + 1 hired labour Higher costs due to imperfect credit market
Raw material cost	3200	
Water cost (operation)	2200	
	<hr/> 7000	



Price (March/April)	8 quintals×900=7200
Return	7200 – 7000= 200

If the large farmer takes 'Lease in' strategy, small farmer's best response is to choose 'Lease out'. Similarly, against large farmer's 'Sell water' strategy, the small farmer's best response is to choose 'Lease out'. So 'Lease out' is the dominant strategy of the small farmer. It always brings higher return to the small farmer.

If the small farmer takes 'Lease out' strategy, the large farmer gets higher return from the strategy 'Lease in'. Similarly against small farmer's 'Self cultivation' strategy, the large farmer's best response is 'Sell water'.

Nash Equilibrium occurs at the point 'Lease in – Lease out' from which both the small and the large farmers are benefitted.

## VII

### CONCLUSION AND POLICY RECOMMENDATIONS

Reverse tenancy in the post-monsoon season takes advantage of two major loopholes in the Land Reform Act. According to West Bengal land Reform Act, a barga may be recorded if the tenancy is for an entire agricultural year (i.e., from the first day of Baisakh to the last day Chaitra in Bengali calendar) as opposed to a cropping season on condition of delivering a share of produce as opposed to fixed rent or fixed produce.

In Murshidabad districts, it has been observed that fixed rent (in terms of produce) is the predominant term of leasing out of land. This may be attributed to the fact the lessor would always like to safeguard himself from the exercise of barga rights of the lessee. 'Share of produce' is generally avoided in such contracts to rule out barga recordings. In this respect, we may notice that reverse tenancy is possible due to the loopholes in the law which says that barga can be recorded if a tenant has cultivated a piece of land for one agricultural year (as opposed to a cropping season) on condition of delivering a share of produce (as opposed to fixed produce).

The Land Reform Act currently prohibits any fixed-rent tenancy, even if seasonal. Field research indicates that this prohibition has prevented virtually all long term fixed-rent leases. Field research also indicates, however, that seasonal, fixed-rent tenancy arrangements during the boro season are fairly common in irrigated areas.

The typical seasonal tenancy situation we encountered during field research involved owners who did not have direct access to a water source and who could not afford the high input costs (including purchasing water from neighbouring) necessary to grow a boro season crop. During boro season, such landowners rented out some or all of their land to lessees who would pay all input costs and pay the owner a fixed-rent in cash or kind, typically equivalent to between one-sixth and one-fourth the value of the crop depending on the locality (but on a fixed-rent, not share basis). Such

lessees were sometimes neighbouring landowners who had access to irrigation water through bore wells. The tenancy arrangements were typically verbal (not written or formalised).

Overall, however, our field research revealed that: (1) landowners often do not lease out their land because they are afraid that the tenants will record as bargadars; (2) even with seasonal leasing arrangements, landowners run the risk that seasonal tenants will try to record as bargadars; and, thus (3) such arrangements are not entered into without a substantial degree of mutual understanding and trust between the parties.

Several interviewees opined that restrictions on prospective tenancies on agricultural land work against the interests of all agricultural households (including the poorest) and should be removed. In our study, we found that both the small and the large farmers (or in other words, the lessor and the lessee) gained from this leasing contract. These interviewees stated that the legal prohibitions on tenancy caused some landowners to leave land fallow or farm it inefficiently, and also prevent land-poor, labour-rich or technology-rich households from leasing in land.

In order to encourage land to be used efficiently and to make additional land available to landless or marginal farmers, we recommend that the government should ease the broad prohibition on fixed-rent tenancy to allow farmers the right to lease-in land. If such tenancy arrangements are legally recognised, the legislation should also include several provisions:

First, the law should require that any such rental or lease agreement be in writing and should provide a mandatory, standardised form for such agreements that gives the tenant rights of exclusive possession but does not set maximum rent payments or a minimum length of terms.

Second, the law must make clear that such tenants will not be given any long-term or hereditary rights to the land beyond that contained in the written agreement.

Hence, it may be conjectured that reverse tenancy leads to an increase in the area under boro cultivation above what would have occurred had this not been possible. For the possibility of reverse tenancy increases the incentives of large farmers to invest in MSTWs which guarantee an adequate water supply for large tracts of land.

#### NOTE

1. Report of the National Commission for Rural Labour (NCRL), To Study the Problems of Rural Labour and make Recommendations thereon, was submitted to the Government on 31.07.1991. The Government had taken action on the recommendations of the NCRL, which, included enactment of the Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996.

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