Improving water use for dry season agriculture by marginal and tenant farmers in the Eastern Gangetic Plains

Key constraints and collective action challenges for groundwater governance in the Eastern Gangetic Plains

Working Paper

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1. Abstract

Globally, irrigated agriculture is the main user of groundwater resources. Specifically, in the Eastern Gangetic Plains (EGPs), groundwater is the most critical common pool resource because the livelihoods of at least three-fourths of rural population depends on groundwater as main source of irrigation. This chapter attempts to unravel the key constraints and opportunities for socially sustainable groundwater use, then looks at the way farmers shape the informal groundwater market and the outcome of collective action among the stakeholders. Findings show that governments in these countries (and states) have placed priority to harness the groundwater potential in the EGP, yet still have limited success mainly due to a range of constraints, which are often structural in nature. Land tenure characteristics, energy related constraints, and institutional barriers are identified as major constraints for groundwater development. One of the key features of groundwater governance is the presence of an informal groundwater market. In part because of small land holding and lack of farmers' investment capacity, small farmers depend on large farmers. In such situation, the proper functioning of groundwater market depends on coordination among them and their collective efforts. Results show that initiatives such as organizing smallholders into water users' groups have been helpful in improving the groundwater management through collective efforts of smallholders such as installation of tube wells and pumps in the group. Furthermore, once farmers organized into groups their bargaining power increases that help improve the functioning of groundwater market, and plays role in changing the existing incentive structure.

2. Introduction

Globally, irrigated agriculture is the main user of groundwater. An estimate has suggested that groundwater contributes about 38% of total irrigation in the world (Siebert et al., 2010). Groundwater irrigation is increasing both in absolute terms as well as in percentage of total irrigation (Wada et al., 2014). In most parts of South Asia, groundwater irrigation expanded rapidly after the start of Green Revolution in the 1970s (Scott and Sharma, 2009). Groundwater is the key irrigation source mainly for winter season crops, besides being used for supplemental irrigation of monsoon season crops. Groundwater is accessed through either shallow tubewells (STW), or deep tubewells (DTW). Particularly, in the Indus Ganges Basin (IGB), which feeds over one billion people and provides direct livelihoods for hundreds of millions of farmers with greater socio-economic heterogeneity (Sharma et al., 2010) groundwater represents the largest source of irrigation. The IGB includes some of the highest yielding aquifers of the world (Mukherji et al., 2015) and comprises 25% of global groundwater withdrawals (MacDonald et al., 2016). The western and eastern parts of IGB show a contrasting situation regarding the use of groundwater for irrigation. Groundwater is overexploited in the western IGB plains and is underutilized in the east (Scott and Sharma, 2009; MacDonald et al., 2016).

This chapter focuses on eastern lowlands of the IGB commonly refereed as the Eastern Gangetic Plains (EGPs), covering Nepal, Bihar and West Bengal of India. In the EGP, groundwater is the most critical common pool resource because the livelihoods of at least three-fourths of the rural population depend on groundwater as their main source of irrigation, particularly at a time of increasingly erratic monsoons. The EGP is facing the challenge of increasing food production to cater the food demand of ever growing population (Aggarwal et al, 2004). In most part of the EGP, the extent of groundwater irrigation is very low despite of potential.

Against this background, this chapter attempts to unravel key constraints and opportunities for socially sustainable groundwater use, then looks at the way farmers (both small and large) shape the informal groundwater market and the outcome of collective action among stakeholders. Both secondary and primary sources provided necessary information. National/state policy documents, published scientific literature, and reports from relevant agencies constitute the secondary sources. Primary information was gathered through a survey of farmers conducted in Saptari district of Nepal, Madhubani district of Bihar and Cooch Behar (and Alipur Duar) district of West Bengal.

3. Policies and Institutional Framework for Groundwater Management

Understanding the issues surrounding groundwater governance is a precondition for developing policy recommendations for both national and transboundary groundwater governance. Theesfeld (2010) emphasizes that in order to conceptualize the institutional aspects of groundwater governance the synthesis of resource system characteristics and the experience with policy instruments are critical. Three types of policy instruments could be relevant to groundwater governance: regulatory, economic, and voluntary/advisory. These instruments are ideal types and no policy option relies purely on one type of instrument alone (Stone, 2002).

Groundwater is crucial to the economy of the EGP region given its major contribution to the agriculture in the region. As a result, governments in the EGP region (Nepal, India - mainly Bihar and West Bengal) have formulated a range of policies at state/national level that addresses key issues of groundwater irrigation management by providing guiding framework. Table 1 summarizes key policies that address issues related to groundwater, the focus of such policies and the type of organizational structure.

Table 1. Groundwater policies and institutional framework at State/National level

Features	**Nepal**	**Bihar**	**West Bengal**
Key policies	Groundwater Act, Irrigation Policy, Water Resources Strategy, National Water Plan, Nepal Agricultural Perspective Plan	India National Water Policy, Bihar State Water Policy, Bihar Irrigation Act, Bihar Irrigation Water Management Rules	India National Water Policy, West Bengal State Water Policy, West Bengal Groundwater Act, Minor Irrigation Policy
Main focus	-Assessment and utilization of groundwater potential -Subsidies in STW installation and pump – mainly in group -Permission for STW installation	- Assessment of groundwater potential -Efficient management of groundwater and control depletion -Subsidies in STW installation	- Assessment of groundwater potential – quality and economic viability - Subsidies in STW/DTW installation – in group
Organizational structure	National, regional and district level	National, state and district level	National, state and district level

In the EGP region, policy and legal frameworks have progressed from a focus on water development until the 1970s, towards water management in recent decades in which water governance has become prominent (Sharma et al., 2010). India introduced a series of legislations in the late 1990s and early 2000s that deal with water sector. The federal structure of India has the provision that water resources related issues are dealt by the concerned state, even though the federal government provides guidance and model frameworks such as in the form of National Water Policy. At the federal level, there was gradual movement towards regulation of groundwater use since the formulation National Water Policy in 1987. Then the Groundwater Bill of 1992 e introduced permits for and registration of new and existing wells, as well as the regulation of commercial well digging along with creation of a National Ground Water Authority. Subsequent revisions in 1996 and 2005 introduced additional criteria while evaluating applications for new wells, and thereby issuing the permission to construct wells. The recent bill of 2005 placed more emphasis on enhancing the supply side through groundwater recharge systems. The federal Government of India has also favored the policy framework to

stimulate groundwater utilization in the EGP through public tube well development (Sikka, 2002). Specifically, government programs such as the Million Wells Scheme, which started in 1988/89, have sought to promote groundwater development targeting poor and marginal farmers.

Nepal has realized the importance of groundwater irrigation from the very beginning of its periodic plans (1950s). The Eighth Development Plan (1992-1996) put increased emphasis on irrigation development. Guided by the objectives of the Eighth Plan, the Government of Nepal promulgated a new Irrigation Policy in 1992 (with subsequent revisions thereafter) that included a provision of subsidy for STW installations. The government policy supported investments in irrigation infrastructure through capital subsidies, which for groundwater development ranged from 40% for an individual private STW to 85% for community DTW. Even though the ambitious target of the Agricultural Perspective Plan of 1995 to irrigate one-half of the total irrigable land with groundwater in the Terai region was not met because of insufficient budget allocation, the number of STWs increased rapidly (Kansakar, 2011). After 1999, the removal of direct capital subsidies on STW Nepal's government created a conducive environment for private financing of tubewells. Rural power supply expansion and availability of cheaper pumps, such as Chinese electric pump, made STW usage accessible and affordable to small farmers (Kansakar, 2011). Furthermore, since the 2000s, a number of shallow tubewell programs have been initiated by the government to provide 100% subsidy on tubewells in areas of the Tarai not served by canal irrigation. However, these are only provided to groups of farmers who form a water user association for a 2.67 ha command area (see Sugden, 2014). Nepal's subsequent development plans also put emphasis on harnessing the groundwater potential in rainfed areas of Terai region of Nepal. Recently, Government of Nepal has drafted Groundwater Act and is at the final stage of approval from the Parliament.

Findings show that the focus of policies has been on a range of regulatory, economic, and voluntary measures. Subsidies in STWs installation and pumps has been the key policy instrument to facilitate groundwater expansion in the EGP region. At the same time considering the significance of groundwater in EGP, one of the key policy focus was the assessment of groundwater potential.

4. Groundwater Access and Governance Challenges

Literature reveal a range of variation in accessing groundwater in different parts South Asia. For example, Scott and Sharma (2009) reported that the EGP specifically presents an energy-groundwater paradox, the region is rich in water sources but inadequate electricity supply has led to increased reliance on diesel power. Such reliance on single power source has been a major limiting factor in development of groundwater (Scott and Sharma, 2009). Other studies have documented land tenure characteristics, energy related constraints, and institutional barriers as major constraints for groundwater development in the Terai region of Nepal and other parts of EGPs (Bhandari and Pandey, 2006, Prathapar et al., 2014; Sugden, 2014; Sugden et al., 2014, Okwany et al., 2015).

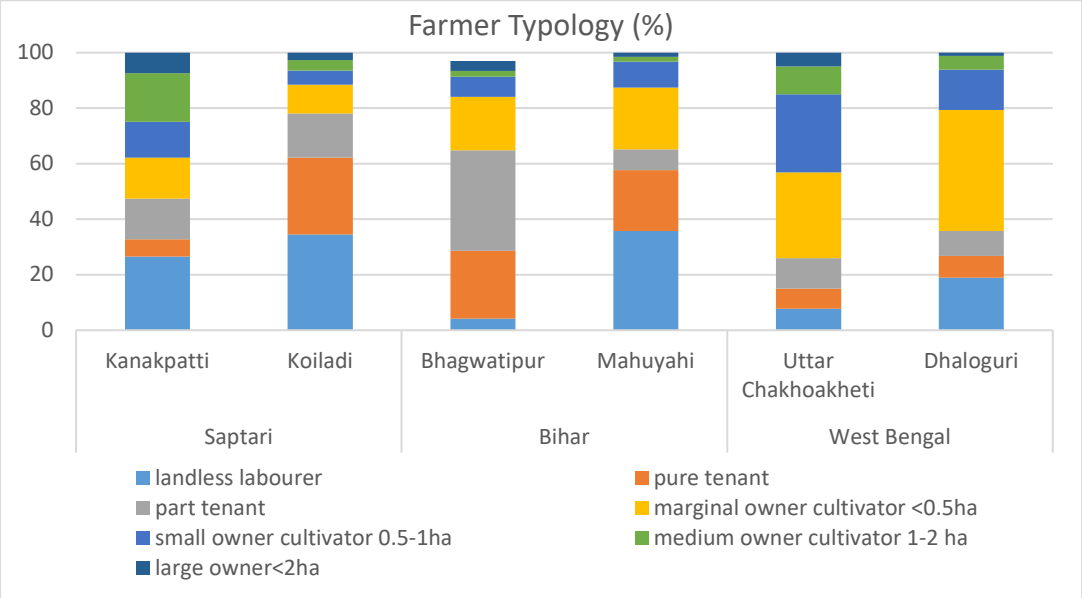
Groundwater irrigation is primarily characterized by small, decentralized private irrigation involving a large group of smallholder farmers (de Fraiture and Giordano, 2014) who face

several challenges. Groundwater requires capital investment to both dig the tubewell and purchase a pump, and it is dependent on the farmer having ownership of the land where they plan to install the tubewell. Skewed land tenure, farmers' limited access to market and inadequate power are key constraints that limit the expansion of groundwater irrigation in EGP (Bhandari and Pandey, 2006 and Sugden 2014). Others have also mentioned over-reliance on diesel for groundwater pumping and associated cost as the major constraints (Pant, 2004; Mukherji, 2006; Shah et al., 2006; Shah et al., 2009). It is apparent from those studies that one of the governance challenges for groundwater irrigation is related to energy, implying that energy management plays key role in groundwater governance.

Another crucial aspect associated with groundwater use is the differential access to groundwater by different categories of farmers. Such differential access particularly could have possible negative effects on the marginalization of small farmers (Amichi et al., 2012; Srinivasan and Kulkarni). Similarly, rental markets for tubewells and pump sets, which in many cases are the only way marginal farmers can access groundwater, are by no means governed by the free hand of the market (Bhandari and Pandey, 2006; Wilson 2002). In such context, inciting debates on equity as first and fundamental step can be made toward advancing more inclusive groundwater governance that crucially engages the marginalized farmers (Hoogesteger and Wester, 2015).

In order to understand the details of groundwater access and associated constraints at the local level we conducted a survey covering six villages from Nepal, Bihar and West Bengal. In Nepal, we covered the villages of Kanakpatti and Koiladi in the Saptari district. In Bihar, the villages of Bhagwatipur and Mahuayi in the Madhubani district, and in West Bengal the village of Dholaguri in the Cooch Behar district and the village of Uttar Chakhoakheti in the Alipur Duar district. The socio-economic survey showed that a large gap exists in terms of access to land (Figure 1). A large proportion of farmers are landless labourers, pure tenants and smallholder part tenants – with some variations across locations. In Dholaguri and Uttar Chakhoakheti in West Bengal, there are a greater proportion of small and marginal owner cultivators, and few tenants, due to the history of land reforms in the state. By contrast, other four villages in Nepal and Bihar still see the persistence of landlordism, and have a high proportion of landless tenants, or part tenants who work primarily as sharecroppers. There are also a large pool of landless labourers, who move in and out of tenancy depending on the need of the household.

Figure 1. Farmers' categories based on landholding characteristics in the study districts of EGP

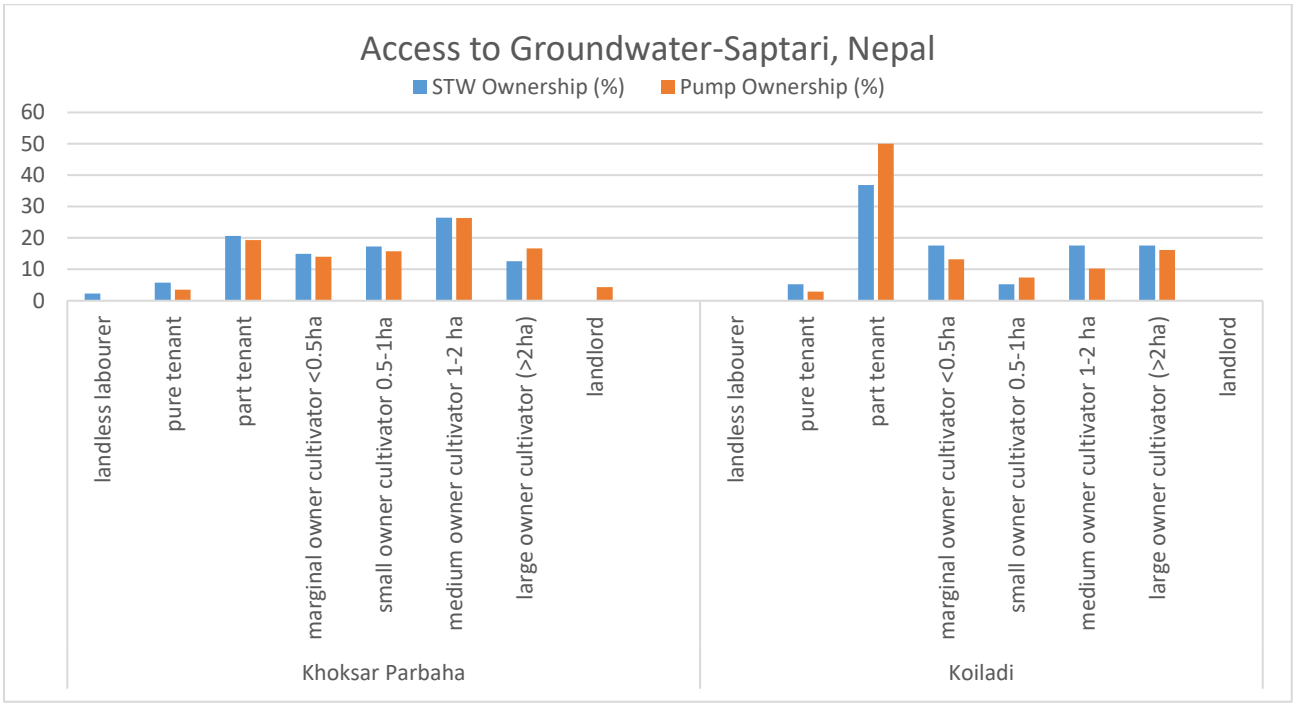


Focus group discussions (FGD) conducted in all the study villages reveal that groundwater was the main source of irrigation although some villages reported the existence of canal irrigation. FGD participants reported installation of a number of STWs in their villages, mostly installed and managed as private and owned mainly by medium to large farmers. The survey result also showed that STW and pump ownership are skewed towards large farmers (Figure 2 a-c). Pure tenants are rarely able to access their own tubewell. Only a tiny percentage of pure tenants own tubewells, and these are likely to include tubewells next to their homesteads. Landlords are often not supportive to bear the costs of fixed investments on rented out land. Furthermore, few tenants have formal documents, making any investment in a tubewell or other infrastructure risky. By contrast, ownership of tubewells amongst part tenants is relatively high, given that they have the security of some owned land. It is important to note though that more than ownership of tubewells, it is ownership of pump sets, which is essential for irrigation. Pump sets are a considerable expense, and from the result, it is clear that very few marginal or tenant farmers own pump sets in Bhagwatipur, Mahuayi and Koiladi, where ownership is negligible for tenants and mostly below 10% for part tenants or marginal owner cultivators. Only in Kanakpatti are there higher levels of ownership. In contrast, the majority of large owner cultivators and many medium owner cultivators own their own pumps. Some landlords own pumps, which are rented out, while others do not own them as they are not engaged in direct cultivation.

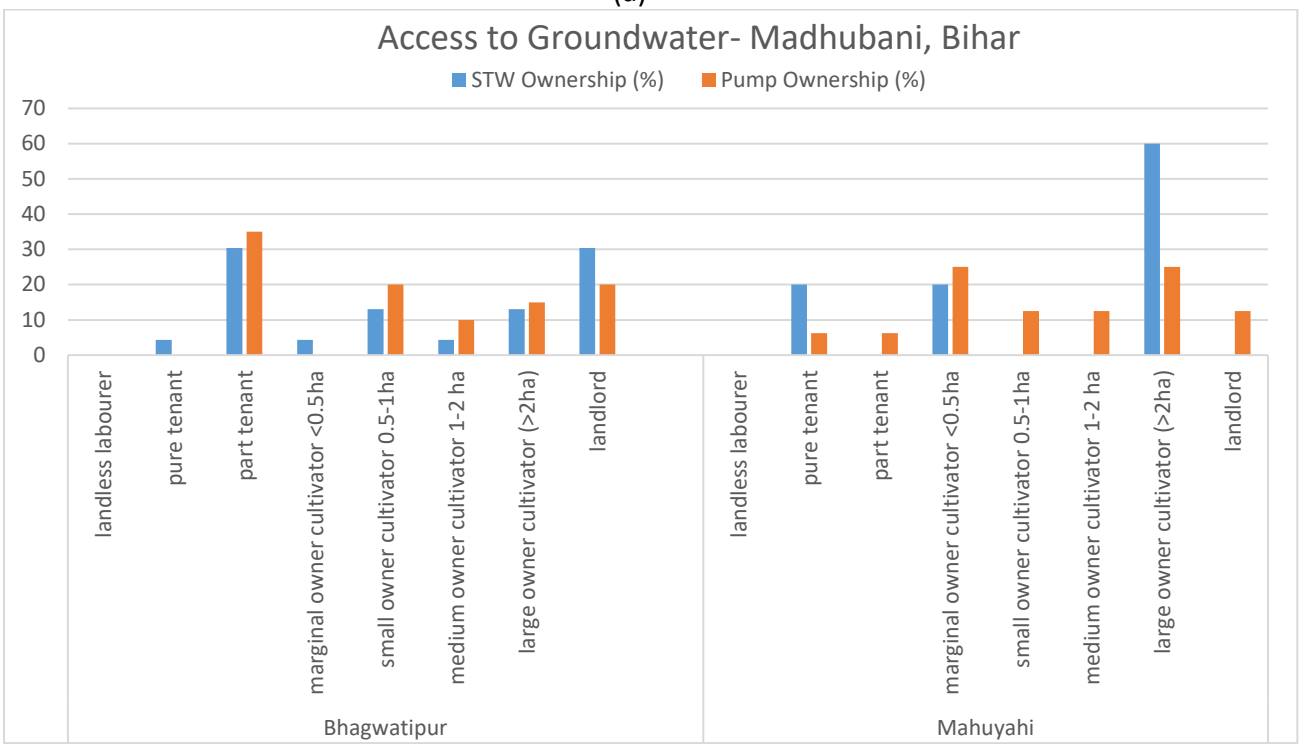
During the FGDs farmers reported land tenancy as one of the key constraints for groundwater irrigation. Since a majority of farmers are tenants this prevents them from planning any STW installation. Even if they would be interested to install the STW most of those tenant farmers had insufficient capacity to invest in STW. Additionally, a lack of land entitlement and land tenancy certificate prevents tenant farmers to access STW schemes from government agencies

such as Ground Water Resource Development Board and District Agriculture Office in Nepal (Kansakar, 2011). Often small and marginal farmers were found to be unaware of such schemes. In cases where farmers had the information, they expressed procedural difficulties to apply (IID, 2012). They reported land fragmentation also constrains STW installation. Further, the high operational cost of groundwater pumping, mainly the expensive diesel price and unreliable electricity, also constrain groundwater access.

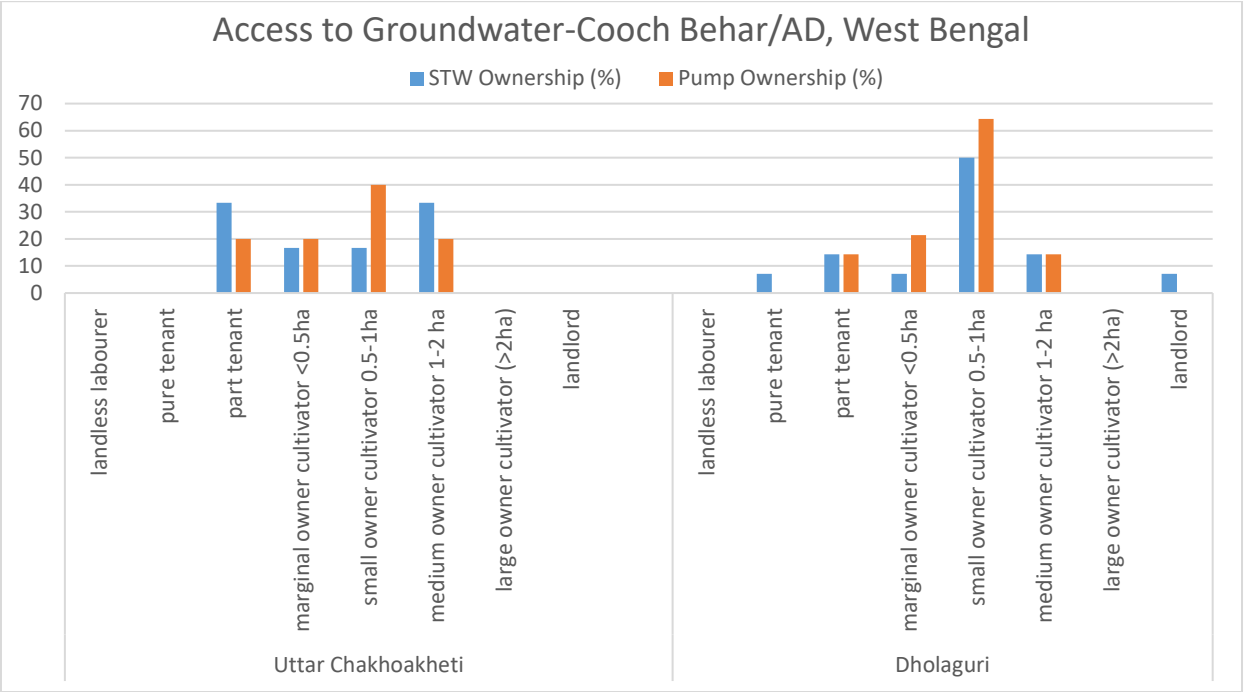
Figure 2. *Access to groundwater – STW and pump ownership situation in the study districts of EGP*



(a)



(b)



(c)

For marginal farmers, unavailability of timely cash for pump rental is another constraint. Difficulty to access credit hampered planting and irrigating when needed. In some cases, male migration to neighboring states and abroad has brought women to the forefront of pump operation and negotiation with water lords, the large farmers who sell the water. While there is a shift of women's role towards traditionally male oriented irrigation activities, accessing STW on time was highlighted as a challenge (Sugden et al., 2014). Moreover, repair and maintenance of pumps and having to irrigate their field at night are other constraints, particularly for the women farmers.

Water markets are a key aspect in groundwater irrigation. Water markets played a key role around the 1990s when diesel pump operators were able to offer competitive services due to relatively lower diesel prices that provided them profitability to operate in areas where electricity was not available. Several studies have shown that such local groundwater markets have emerged as the mainstay of poor and marginal farmers including sharecroppers in the EGP region as it helped enhance productivity through access to groundwater (Fujita and Hossain, 1995; Shah and Ballabh, 1997; Pant, 2005; Mukherji 2007). However, some others (such as Wilson, 2002) argued opposite that groundwater markets were monopolistic and led to greater inequality.

Survey and FGDs conducted in study villages reveal that marginal and tenant farmers mainly depend on groundwater markets to access groundwater irrigation. In such cases, they rent a pump set and tubewell from a better off farmer who has his/her own equipment. In general, water price was set based on an hourly use of pump or STW. The rate per hour varied across

villages as well as depending on the season. The pumping charge varied according to the capacity of the pump as well. Even though the GW market enhances access, since it operates on an informal basis, sometimes the pump rent could vary even though it has no relationship with farmers' category. In addition, farmers may not access water when needed. The STW/Pump owner mainly decides the price, so a kind of monopoly exist, controlled by limited number of large farmers and landlords (Sugden, 2014).

5. Collective Action for Groundwater Governance

The cases discussed in previous section highlight that land tenancy is one of the key constraints for groundwater irrigation. Marginal and tenant farmers have limited capacity to install STW but at the same time landlords are also not willing to spend on fixed investments on rented out land. Not only STW, marginal farmers cannot afford to purchase pump sets. As a result, those farmers have to rely on informal groundwater market, in which case they often have to pay higher rental fee. The unavailability of timely cash for pump rental further make the situation difficult.

The nature of the problem faced in groundwater access indicates that marginal and tenant farmers needed better ways to work collectively. Past studies also highlighted the importance of collective action in groundwater management (Meinzen-Dick et al., 2016), which communities manage through crafting a range of rules (Ostrom, 1990; 1992). Community-based groundwater management requires working through complex rural dynamics at various levels (Reddy et al., 2014, Shah, 2009).

In order to get organized for a common cause, pre-existing institutional history in facilitating collective action could be crucial (Aarnoudse et al. 2012; Bouarfa and Kuper, 2012; Rica et al., 2012). Examples show that local communities have responded to issues related to groundwater management by implementing local rules that have reduced conflict and provided more reliable and equitable access to water (Taher et al., 2012), where participation at different level is key (Kulkarni et al., 2015).

Study villages show some forms of institutional history of engagement in groundwater management, such as STW Management Committee, which facilitated groundwater use. Institutional development was inadequate to facilitate groundwater access. They faced insufficient social capital such as dedicated leadership and explicit rules/norms to guide the groundwater access. However, involvement in those local institutions provided them with some exposure to different aspects of collective action required for groundwater governance, such as water allocation mechanisms, operation and maintenance, and benefit sharing to ensure equity. But in some cases, hegemony of powerful farmers over the pump created conflict resulting in group dissolution.

There are however, more radical forms of collective action, which can bring farmers together to enhance their access to irrigation. This involves addressing some of the root causes that impede access to groundwater – namely inequitable distribution of land, lack of capital, and tenure insecurity. In the study villages, groups of tenants were brought together to take a collective lease of land, while groups of small owner cultivators were encouraged to consolidate their plots voluntarily, and cultivate and irrigate contiguous area. This form of collective action has

helped to address the constraints associated with land tenancy, as farmers in this context, jointly share tubewell and pump sets. By operating a contiguous field, irrigation becomes more feasible and efficient, and costs can be shared across the group.

For the latter model where all the land is cultivated collectively, conflict over irrigation water ceases to be an issue due to joint installation of tubewell and shared ownership of pump. However, for models where farmers retain their own plots, farmers formulated rules and regulations to share diesel/electric pumps together with STW. Farmers specified the necessary rules focusing at water allocation, operation and maintenance of the STW and pump. These rules created space for equal contribution and benefit sharing. Through such rules, they would create balance in pump use requirement, capital contribution capacity among the members thereby eliminating exploitation of one over the other. Because of this form of collective action farmers are no more dependent on informal groundwater market. Not only are the groups no longer needing to pay a high rate to rent a STW and pump, they can also sell water to neighboring farmers, generating a fund from which is utilized in maintenance of the system and other agricultural inputs.

Availability of electricity, diesel and solar-powered pumps has ensured no delays in field irrigation in the groups. For example, in the event of power cut, farmers irrigate from one source if not another. Furthermore, monthly saving since they organized into the group has created group fund, now used for small loans and purchase of diesel or payment of electric bills incurred. In order to buy diesel or pay for electricity, money is pooled by all group members. Instances when one farmer is not able to contribute money on time, group fund is mobilized. Consequently, chances of irrigation delays are eliminated.

Women from migrant households have perceived some benefits from these collective arrangements. In some groups, while women are busy with internal household chores, fellow group member operate the pump. Women supplement labor by carrying out other agricultural activities. Interestingly, women have started operating pumps themselves in some groups. For repair and maintenance of the system, they established a mechanism to carry out such task by specific members by pump operator. Rules as such are formalized in written form in some groups and verbally arranged in others.

Additionally, engagement in groups has given exposure opportunities and created linkages with regional agricultural and irrigation departments. For instance, farmers from Saptari district (Nepal) have formally registered as a group in District Agricultural Development Office. They have started seeking and sharing information on water and agricultural input related schemes. The collective efforts resulted in uninterrupted access to groundwater at affordable prices removing their dependence of groundwater market. Farmers charged the rental fee just to cover the operational cost and maintenance of the irrigation equipment. In case they need to rent from large farmers they do it collectively, which have been helpful in improving the bargaining power of smallholder farmers. In overall, this ultimately has helped to deal with the imperfect informal groundwater markets prevailing in the village.

6. Conclusion and implications

Groundwater availability is not a constraint in the Eastern Gangetic Plains, but its use for irrigation in an energy-efficient manner is critical. Findings show that governments in these countries have placed priority to harness the groundwater potential in the EGP, yet still have limited success mainly because of reasons associated with groundwater pumping and the operation of informal groundwater markets.

One of the key features of groundwater governance is presence of pump rental market, an informal groundwater market. Due to small landholding and lack of investment capacity, small farmers depend on large farmers. Informal rental market provides smallholders with access to groundwater, but price and timely availability has been a concern. Poor social capital and low levels of collective action among farmers, especially, with landlords, still poses challenges.

Results show that initiatives such as organizing smallholders into different forms of collectives have been helpful in improving groundwater management through collective efforts of smallholders such as installation of tube wells and pumps in group. Furthermore, once farmers organized into groups their bargaining power increases that help improve the functioning of groundwater market, and plays role in changing the existing incentive structure. In overall, the access of smallholders could be improved through more formal pump rental market, for which reliable and cheap energy supply is crucial. Policies that facilitate collective operation of marginal farmers could help create such situation.

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