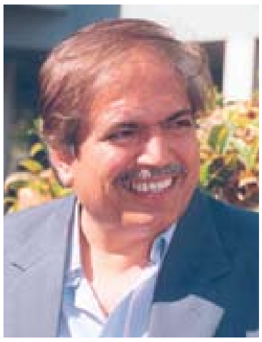

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Electricity reforms and their impact on ground water use in states of Gujarat, West Bengal and Uttarakhand, India

Managing the externalities of groundwater use by minimising the negative impacts of over-exploitation, while preserving the benefits from such use, has emerged as the key natural resources management challenge in South Asia. Direct regulation of groundwater is not a feasible option in the region given the large number of pumps (over 20 million or so) and the huge transactions costs involved. In this context, an indirect mechanism, such as the regulation of the electricity supply and changes in electricity pricing and subsidies, can provide an effective tool for governing groundwater use. The link between groundwater and electricity is rather straight forward – electricity is used for pumping groundwater from aquifers. This paper documents three such cases of electricity reforms that have had a profound impact on groundwater use in the Indian states of Gujarat and West Bengal.

Keywords: groundwater, electricity, reforms, subsidies, Gujarat, West Bengal

Introduction

Indian policy discourse on the most suitable form of agricultural electricity tariff has come full circle. Until the early 1970s, all state electricity boards (SEBs) charged their tubewell owners based on metered consumption, but, due to a whole range of administrative issues, this was later changed to a flat tariff in the early 1980s. However, the flat tariffs remained low over the years and the SEBs started making large losses. Low flat tariffs also led to the over-exploitation of groundwater in arid and semi-arid states of India. Therefore, recently, there has been a renewed interest in reforming the electricity sector. This has been triggered by the poor financial status of most SEBs. The main element of electricity sector reform has been the unbundling of services – that is, the separation of the electricity generation, transmission and distribution functions and the universal metering of all consumers. Almost 50% of India's pumps depend on electricity for pumping groundwater and hence, reforms in this sector profoundly affect the groundwater sector.

Given that both water resources and electricity are state concerns in India, individual states have chosen to implement power sector reforms differently, keeping in mind the political exigencies faced by these states. The states of West Bengal in the east and Uttarakhand in the north have embarked upon the path of universal metering of agricultural electricity consumers mainly because there are no strong farm lobbies in the state to oppose such a move. This shift from a flat rate tariff (signifying a zero marginal cost of pumping) to a pro-rata tariff, altered the cost and incentive structure for the pump owners and hence affected their pumping behaviour. In contrast, the government of Gujarat, in the face of strident opposition from farmers, decided not to meter tubewells. Instead, they separated agricultural feeders from non agricultural ones, improved the quality of the power supply and rationed the number of hours of electricity to agriculture to just 8 hours a day. This initiative of the government of Gujarat is called the Jyotirgram Yojana. Figure 1 shows the location of West Bengal, Uttarakhand and Bihar.

The purpose of this paper is to analyze the possible impacts of these reforms on the pumping behaviour of pump owners, on the informal groundwater markets through which water buyers would be impacted, and on the revenues of the state electricity boards. The paper is divided into five sections. After the first introductory section, the second section

Figure 1. Location of study states

describes the groundwater and electricity situations in the three states. The third section discusses the process and implementation of the power sector reforms in each of these states, while the fourth section analyses the impact of these on groundwater use and on groundwater markets.

Groundwater and electricity situation in West Bengal, Uttarakhand and Gujarat

West Bengal, an eastern state of India, receives an annual rainfall of around 2000 mm and has a groundwater potential of 31 billion cubic meters (BCM), most of which is available at shallow depths. Only 42% of the total available groundwater resources in the state have been utilised so far (WIDD, 2004). While West Bengal has plentiful groundwater resources that can be furthered developed, the state has, for various political reasons (Mukherji, 2006), adopted one of the most stringent groundwater regulations in India. For instance, procuring electricity connections for tubewells needs permission from multiple sources, such as the State Water Investigation Directorate (SWID) and village level bodies (panchayats) and the process is fraught with red tape and corruption. The result is that West Bengal has the lowest proportion of electric tubewells to total tubewells in India (GOI, 2003). The farmers in West Bengal, until 2007, also paid the highest flat tariff (Rs. 2160/HP/year, where HP = horse power) for electricity among all Indian states. Agricultural consumption of electricity accounted for only 6.1% of total electricity consumption (WBSEB, 2006) and unlike other states, where the electricity subsidy forms a major share of state fiscal deficits, in West Bengal this was negligible (Briscoe, 2005). The existence of a very high flat tariff, coupled with small land holdings and abundant groundwater resources had led to the emergence of competitive informal groundwater markets here, and small and marginal water buying farmers benefitted substantially through these markets (Mukherji, 2007). The main irrigated crop in the state is summer paddy, called boro paddy. Average annual pumping hours vary from 1500 to 2100 for centrifugal and submersible pumps respectively.

The state of Uttarakhand in the northern part of India was formed in 2001 – earlier it was a part of Uttar Pradesh state. Uttarakhand is a pre-dominantly hilly state with the bulk of its agricultural lands limited to the southern Terai parts of the state. The mean rainfall in the state is around 1500 mm. The state has an annual net available groundwater resource of 2.10 BCM, of which 66% is being utilised presently (CGWB, 2006). The depth to the water table depends on the sub-surface lithology and varies from less than 2 m in the Terai region to as deep as 50 m in the Bhabar zone. Agriculture uses only 12% of the total electricity consumed in the state, though nearly 70% of all tubewells run on electricity. Until 2007, Uttarakhand too had a high flat tariff (Rs. 1512/HP/year) compared with other Indian states. Though unlike West Bengal where tariff recovery is very high (more than 90%), in Uttarakhand it is as low as 25% (personal communication with an official of the SEB). One of the main reasons for such a low tariff recovery is the high tariff rate coupled with periodic waivers of electricity dues by the politicians, which lessens the incentive to pay bills in a timely manner. The main irrigated crop in the state is kharif (or monsoon) paddy and rabi (or winter) wheat. The average annual pumping hours are only 800 because the water requirement of the wheat crop is not extensive. Water markets are less developed than in West Bengal, mostly because of the larger land holding size, which makes it economical for farmers to invest in their own tubewells. Another reason is the wide prevalence of government tubewells; we found that almost every village had a government tubewell and they were functioning satisfactorily.

Gujarat, a western state of India, receives an average annual rainfall of 1243 mm, though with wide regional variations. South Gujarat receives the bulk of the rainfall, while western parts of the state (Saurashtra and Kutch) are distinctly arid. The state has an annual, replenishable groundwater potential of 15.81 BCM, of which 76% (11.49 BCM) is withdrawn every year. This is a state where groundwater is used intensively and 61% of the administrative blocks are over-exploited, critically or semi-critically as per the norms of the Central Groundwater Board (CGWB). North Gujarat, which on average receives 500–700 mm of rainfall in a year, has deep alluvial aquifers and is a prime example of the unsustainable use of groundwater. In many ways, the state of Gujarat epitomises the groundwater crisis in India. Yet, surprisingly, the state has been registering an agricultural growth rate of 10% for the last 7–8 years and this surpasses that of other states better endowed with water resources (Gulati et al., 2009). Here, farmers have also increasingly moved away from cereal crops to high value crops, such as Bt cotton, tobacco, dairy, orchard and commercial crops, so as to maximise value per drop of water. Gujarat also has strong farmers' lobbies that have, time and again, successfully thwarted any attempts to curtail their access to groundwater (Mukherji, 2006). Gujarat, until the recent reforms, had one of the highest electricity subsidies in India (Briscoe, 2005). Given the heavy losses sustained by the state electricity board, there was a rapid deterioration in the quality of the power supply in the state, thereby negatively affecting the quality of life in rural areas. Gujarat, like West Bengal, also supports a vibrant groundwater market. Indeed, groundwater markets in Gujarat pre-date those of other regions in India (Shah, 1993). Table 1 summarises the agricultural and groundwater situation in these three states.

Indicator	West Bengal	Uttarakhand	Gujarat	Source
Level of development of groundwater in 2004 (%)	42	66	76	CGWB, 2006
Number of over-exploited blocks in 2004 (and as a % of all blocks)	0 (0%)	2 (2.5%)	31 (16.8%)	CGWB, 2006
Normal average annual rainfall (mm)	2074	1523	1243	CGWB, 2006
Nature of aquifer	Alluvial	Alluvial	Alluvial & hard rock	CGWB, 2006
Percentage of electric tubewells to total tubewells (2001)	8.2	70	54.5	GOI, 2003
Agricultural electricity consumption (MkWh) in (2000–2001)	1360	5122	14507	Mukherjee, 2008 for West Bengal and Gujarat and ICICI, 2000
Share of agriculture to total electricity consumption (2001–2002) (%)	6.1	12.0	45.9	Planning Commission, 2002
Transmission and distribution losses (%)	25.9	34.2 (includes Uttar Pradesh)	28.5	Narendranath et al., 2005
Flat tariff (2007) (Rs/HP/year)	1760–2160	1512	850	Mukherji, 2008
Electricity subsidy as % of fiscal deficit (2000–2001)	0.8	10 (includes Uttar Pradesh)	56	Briscoe, 2005
Percentage of households reporting hiring irrigation services from others (1997–1998)	67.2	N.A., but groundwater markets are thin	N.A., but groundwater markets are all-pervasive	NSSO, 1999
Average hours of operation of electric tubewell in a year	1000–1500	600–800	1000–1200	Authors' fieldwork
Main crops grown	Paddy in monsoon and winter season	Paddy in monsoon and wheat in winter	Less than 50% of area devoted to cereal crops, rest to cotton and other high value crops	Authors' fieldwork

Table 1. State of groundwater, electricity and agriculture in West Bengal, Uttarakhand and Gujarat

The process of reform in three states

Metering in West Bengal and Uttarakhand

As already mentioned, both the states are in the process of metering their agricultural tubewells. While the aim of the metering is the same, namely, to facilitate the efficient use of groundwater through marginal cost pricing, better energy audits and smaller transmission and distribution losses, these two states have adopted entirely different processes of metering.

The Government of West Bengal (GoWB) has adopted a hi-tech approach to metering through the installation of remotely sensed, tamper-proof meters which operate on the Time of the Day (TOD) principle. TOD is a demand management tool whereby by differentiating the cost of electricity during different times of the day, consumers are discouraged from using pumps during peak evening hours, while they are encouraged to use them during the slack night hours. There are three metered tariff rates: the normal rate from 6 am to 5 pm (Rs. 1.37/kilowatt hour (kWh)), the peak rate from 5 pm to 11 pm (Rs. 4.75/kWh) and the off-peak rate from 11 pm to 6 am (Rs 0.75/kWh). On average, these rates translate to around Rs. 6/hour inclusive of Rs. 22/month as meter rent. The new meters use technologies such as GIS (geographic information systems) and GSM (Global System for Mobile Communications) and are read remotely (Figure 2). These new meters solve many of the traditional problems of metering, such as tampering, under-reporting and under-billing by the meter readers in collusion with the villagers, curbing the arbitrary power of the meter readers and the physical abuse that the meter readers were subject to at times at the hands of the irate villagers. Meters are now remotely read and the reading is transmitted

Photo: Mats Lannerstad

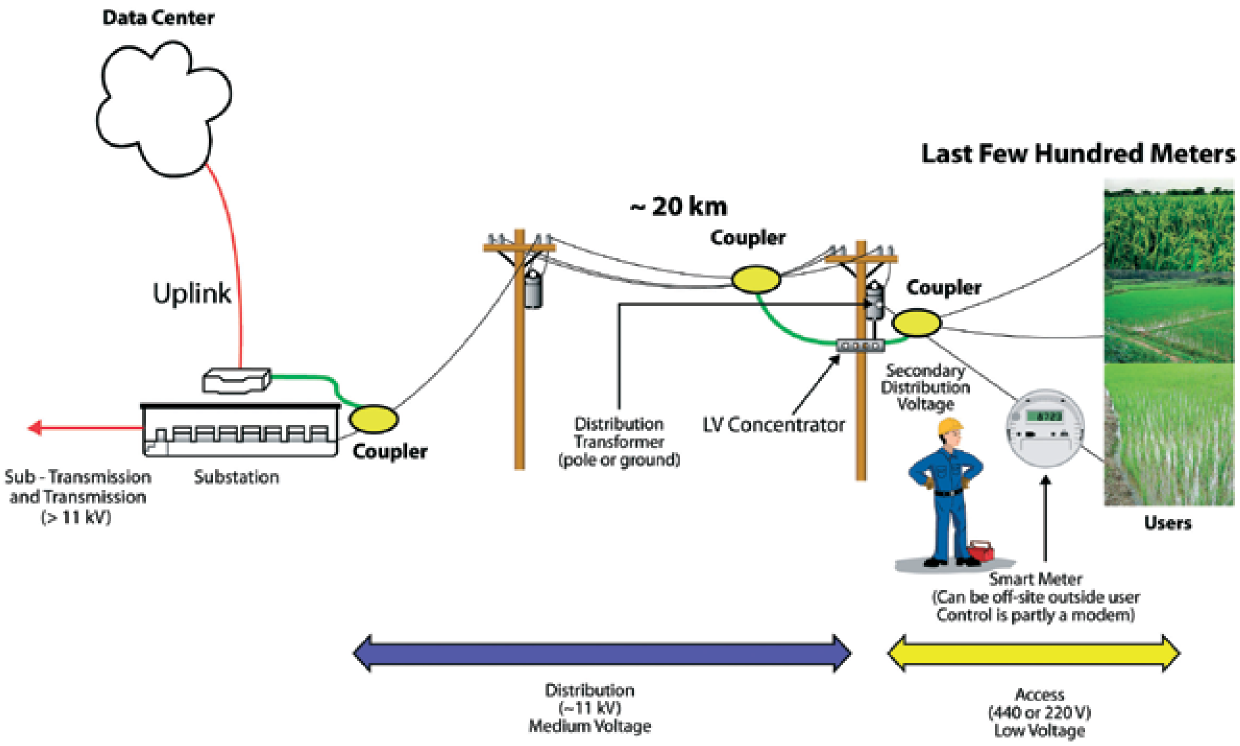

Figure 2. A schematic diagram of a generic IT Power Distribution System that is being used in West Bengal (LV = low voltage)
Source: Adapted from Tongia (2004)

directly to the commercial office. The meter reader does not know and cannot tamper with the meter reading.

The Government of Uttarakhand (GoU) has installed electronic meters, but it has chosen the conventional form of billing which relies on manual billing by the meter readers. No TOD system has been adopted here and the metered tariff has been fixed at a low rate of Rs. 0.70/kWh, which is even lower than the lowest off-peak tariff in West Bengal. This works out to be even much lower than the current flat tariff rates of Rs. 126/HP/month. So far, meters have been installed for 70% of the agricultural tubewells. During our survey in 2008, we did not find a single instance where a farmer reported receiving bills based on the actual meter readings. The reason for this is the paucity of field staff in the electricity department and there are no chances that new meter readers will be recruited in the near future. The electricity department has undertaken some half-hearted efforts at involving village self-help groups for meter reading, but we did not gauge much enthusiasm for this among the villagers. On the whole, the farmer leaders and the villagers, as well as the electricity department officials, believe that metering in its current form is unlikely to succeed and that the government would go back to the flat tariff system, albeit at even lower rates than at present.

Decoupling agriculture from non-agricultural use of electricity: the Jyotirgram Yojana in Gujarat

In September 2003, the Government of Gujarat (GoG) pioneered a bold scheme – the Jyotirgram Scheme (JGS) – to separate agricultural feeders from non-agricultural ones. JGS was launched initially in eight

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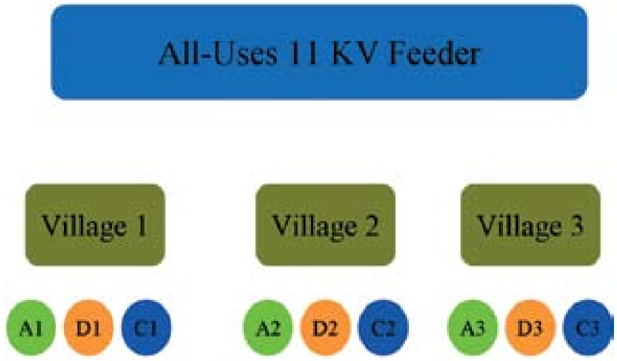

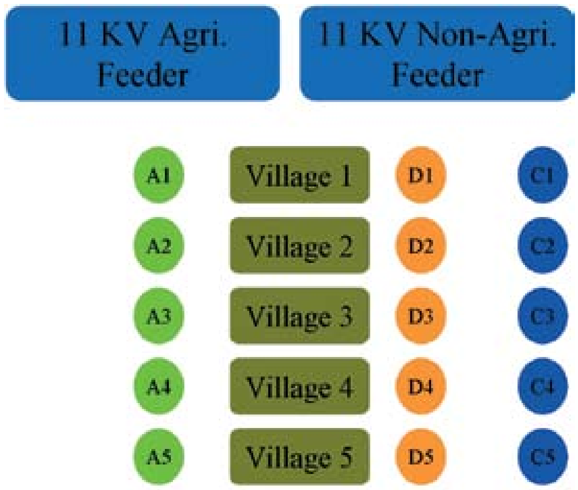

Figures 3a and b. Electricity network before and after the Jyotirgram Scheme (JGS)
A1, A2 etc refers to agricultural electricity connections; C1, C2 etc refers to commercial electricity connections; and D1, D2 etc refers to domestic electricity connections.

districts of Gujarat on a pilot basis. The early results were so encouraging that the scheme was extended to the entire state by 2004. By 2006 over 90% of Gujarat's 18,000 villages were covered under JGS and the total investment in the scheme amounted to Rs. 11,700 million. Feeders supplying agricultural connections were bifurcated from the supply to commercial and residential connections at the sub-station level and these feeders were metered to improve the accuracy of the energy accounting. Figures 3a and 3b show schematic diagrams of the electricity network before and after JGS.

Under the JGS, the villages began to be provided with a 24 hour power supply for domestic uses, and for schools, hospitals and village industries; and farmers began getting 8 hours of daily power supply, but at full voltage and on a pre-announced schedule. Every village is to get agricultural power during the day and night in alternate weeks that are pre-announced.

Impact of electricity reforms on groundwater use, water markets, quality of rural life

Impact of metering in West Bengal

In West Bengal, groundwater markets emerged in response to the high flat rate tariff, whereby the tubewell owners were under pressure to sell water just to recover the costs of the electricity bill, given their own land holding was not sufficiently large to justify the high electricity cost. This compulsion on the part of tubewell owners also meant that water buyers, who happen to be mostly small and marginal farmers, had sufficient bargaining power over the water seller. That this reasoning is correct is shown by the fact that while flat tariff rates increased around 10 fold from 1991 to 2006 (from Rs. 1100/year to Rs. 10,800/year), the price of water only rose 3 times, from Rs. 300/acre in 1991 to Rs. 1800/acre in 2006 for summer boro paddy (Mukherji, 2007).

However, metering the supply of electricity has changed the incentive structure and now the water sellers are no longer under a compulsion to sell water because they will pay only for as much as they pump. So, soon after metering, the pump owners increased the rates at which they sell water by 30–50%, even though, assuming the same hours of usage as under the earlier flat tariff, we found that they would have to pay a lower electricity bill under the metered tariff than before. The pump owners have, therefore, benefitted under the current meter tariff regime in two ways: (1) by having to pay a lower electricity bill than before for the same hours of use and (2) by being able to charge a higher water price than before and therefore increase their profit margins for selling water. It is to be noted that there are only 100,000 or so electric pump owners in the state and they constitute less than 2% of the total, farming households. It is this small group of wealthier farmers who have benefitted directly from metering.

In contrast, the water buyers have lost out in two ways: (1) by having to pay a higher water charge than before and (2) by having to face adverse terms and conditions for buying water (e.g. advance payments, not being able to get water at desired times, etc.). At the current tariff rates and assuming the same usage pattern, the SEB too will lose out in terms of revenues, but it may gain through a decrease in transmission and distribution (T&D) losses. The actual impact of metering on the size of the groundwater markets (i.e. whether they will expand, contract or remain the same) and the volume of groundwater extracted cannot be predicted a priori and has to be answered only empirically (Mukherji et al., 2009).

Impact of metering in Uttarakhand

In Uttarakhand, under the existing metered tariff rates, all tubewell owners will gain by having to pay less than one-third of the electricity bill that they would have paid under the flat tariff rates, but as we found, very few paid anyway. In this state, the main irrigated crops are kharif (monsoon) paddy which needs supplementary irrigation and rabi (winter) wheat which needs between 4 and 6 irrigations. As such, average annual hours of operation of a tubewell are only 600–800. Informal groundwater markets exist, but they are not as developed here as they are in West Bengal or in Gujarat. The main reason for the relatively small number of groundwater markets in Uttarakhand is that land holding sizes are relatively large and most farmers prefer to install their own tubewells than depend on other farmers for irrigation. Besides, almost every village has a government tubewell, most of them constructed after 2001 when the state was formed, and these function reasonably well and supply water to farmers at rates cheaper than private tubewells. In addition, the types of crops grown ensure that there is not a very large demand for water as is the case for summer paddy in

West Bengal. All these reasons explain why groundwater markets are relatively less developed in this state. Here, we found that the metering of tubewells has had no impact on water prices. Water was sold at a rate of Rs. 50/hour before metering, and the same rate continued even after metering. In Uttarakhand, similar to West Bengal, the state electricity utility would earn less revenue than before. Given the very low metered tariff rates, it is unlikely that there would be any impact on the volume of water pumped either (Mukherji et al. 2008).

Impact of JGS in Gujarat

Jyotirgram has radically improved the quality of village life, spurred non-farm economic enterprises, halved the power subsidy to agriculture and reduced the groundwater withdrawal. It has also offered some advantages, such as a high quality electricity supply, to medium and large farmers, but hit marginal farmers and the landless. These depend for their access to irrigation on water markets, which have shrunk post-Jyotirgram and water prices charged by tubewell owners have soared between 30% and 50%. Table 2 summarises the impact of the scheme on different groups of rural residents, including pump owners and water buyers.

Stakeholder group	Positive (+)/ Negative (-)
Rural housewives, domestic users	+++++
Students, teachers, patients, doctors	+++++
Non-farm trades, shops, cottage industries, rice mills, dairy co-ops, banks, co-operatives	+++++
Pump repair, motor rewinding, tubewell deepening, etc. (Pump mechanics)	- - - - -
Tubewell owners: quality and reliability of power supply	+++
Tubewell owners: number of hours of power supply	- - -
Water buyers, landless labourers, tenants	- - - - -
Groundwater irrigated area	- - -

Source: Shah and Verma (2009)

Table 2. Impacts of the Jyotirgram scheme on different stakeholder groups

Since over 90% of the groundwater withdrawal in Gujarat occurs through electrified tubewells, electricity consumption is an accurate surrogate for the aggregate groundwater withdrawal. Government figures suggest that farm power use on tubewells has fallen from over 15.7 billion kWh/year in 2001 to 9.9 billion kWh in 2006, a decline of approximately 37%. Unfortunately, pre-JGS figures for agricultural power use are residual figures, containing a portion of the T&D losses in other sectors, and therefore significantly inflate the extent of pre-JGS farm power use. However, even if we discount the 2001–2002 figures, there is still a very substantial decline in agricultural power use, and a halving of the aggregate farm power subsidy, from US$788 million in 2001–2002 to US$388 million in 2006–2007. From this, we can infer that annual groundwater use in Gujarat agriculture has declined significantly over the same period. True, some of the decline may be caused by two successive good monsoons in 2005 and 2006; but there is unmistakable evidence of tubewell irrigation shrinking.

Finally, the JGS has brought about an unprecedented improvement in the quality of life of rural people by creating a rural power-supply environment that is qualitatively identical to an urban one. The new era of a high quality, uninterrupted power supply in the countryside will, without doubt, unleash myriad impulses for socio-economic development and growth in non-farm livelihoods in rural areas.

However, JGS's impact on the farming community has been generally negative. The intensity of this negative impact depends on the size of the land holding and the nature of the aquifer. In the depleted alluvial aquifers of North Gujarat, farmers who can pump their deep tubewells continuously feel adversely affected because the power ration restricts the area they can irrigate. But farmers in hard-rock areas are less affected because the amount of water available in their well during a day is a more binding constraint on their pumping than the hours of daily power supply. Small farmers owning tubewells are happy with the improved power quality although they miss their water selling businesses. Landless share croppers and water buyers are adversely affected everywhere because water markets have shrunk and water prices have soared between 40% and 60%, driving many of them out of irrigated agriculture. The full import of the rationed power supply has yet not been felt by the farmers because 2005 and 2006 were both good monsoon years when wells were full and water levels were close to the ground. Come a drought year, farmers will find the JGS ration of power is too meagre to meet their irrigation needs.

Conclusion and policy implications

India is in the midst of power sector reforms and states have chosen different pathways to reform based on their political constituency. In this paper, we have documented the impact of electricity reforms on

Photo: Mats Lannerstad

Indicator	West Bengal	Uttarakhand	Gujarat
Key component of power sector reforms as it affected the groundwater sector	Metering of agricultural tubewells	Metering of agricultural tubewells	Separation of feeders supplying electricity to the agriculture and non-agricultural sectors
Degree of competency shown in implementing power sector reforms	Very high	Low	Very high
Use of modern information and technology in carrying out reforms	Very high	None	Moderate
Level of impact on groundwater users	Very high	Low to no impact	Very high
Degree of heterogeneity of impacts on different user groups	High. Electric tubewell owners gained, while their water buyers lost out in the process	No impact on any user group at all	Very high. The non agricultural rural sector benefitted the most, followed by electric pump owners, while water buyers lost out
Possible ways of reducing negative impacts or creating positive impacts on users	Lower entry barriers into groundwater markets by making it easy to get new electricity connections and provide a one-time capital cost subsidy to small and marginal farmers	Substitute manually read electronic meters with machine readable meters and ensure regular meter reading and billing	For agricultural users, shift to intelligent, demand-based power rationing; charge all consumers on a flat rate basis and continue energy auditing at the feeder level

Table 3. Summary of findings and impacts of electricity reforms on groundwater use

groundwater use in three Indian states. Table 3 summarises our main findings, while the rest of the section discusses some of the policy implications.

While most Indian states have resisted metering of agricultural tubewells, the states of West Bengal and Uttarakhand have embarked upon the metering of all tubewells. This paper compares and contrasts the initiatives of the two states in terms of the processes of metering and the impacts of this on groundwater use and users (including water buyers). It finds that both states have adopted vastly different attitudes to metering.

West Bengal, by adopting a hi-tech approach has successfully overcome some of the traditional problems of metering, such as meter tampering, collusion between the meter readers and the villagers and lack of manpower on the part of the electricity utilities. However, the state of Uttarakhand has done none of this and has deployed traditional ways of metering and billing. Given their lack of manpower and other logistical difficulties, it is fairly certain that metering efforts will fail in the state. This is quite unfortunate since metering (at existing rates) would have benefitted the tubewell owners without creating any negative effects on the water buyers, who, anyway, are few in number. In West Bengal, however, metering has benefitted a small section of wealthier pump owners at a cost to the majority of small and marginal farmers who have to buy water. The incentive structure inherent in the earlier flat tariff system, which encouraged pump owners to proactively sell water, has been lost. The main finding of this paper is somewhat of a paradox: it shows that where metering could have generated a win–win situation (as in Uttarakhand), the government has adopted a very ad hoc and ill planned approach to metering. However, in West Bengal, where the majority of the groundwater users (water buyers in this case) would be harmed, the government has taken a well-thought out approach.

In view of this, our recommendations are as follows:

- The GoU should learn from the GoWB example and introduce tamper-proof and remotely sensed meters to overcome the problems associated with meter reading and billing. This will of course necessitate additional funds.
- In West Bengal, to safeguard the interest of the water buying farmers, the government should ease the process of electrification of tubewells and provide a one-time capital subsidy for constructing tubewells, especially for the small and marginal farmers. This will lead to an increase in the number of electric tubewells and enhance competition in the water markets through which water prices may come down in the future.
- Village level governments (panchayats) can play an important role in West Bengal by regulating the price at which water is sold to the buyers.

The Jyotirgram Scheme in Gujarat has pioneered real-time co-management of electricity and groundwater irrigation. It has unshackled domestic and non-farm rural electricity supplies from the clutches of an invidious political economy of farm power supply. Its highly beneficial and liberating impacts on rural women, school children, village institutions and the quality of rural life are all too evident. Its impact on spurring the non-farm rural economy is incipient, but all the indicators suggest that this will be significant and deepen over time. But above all else, the Jyotirgram Scheme has created a switch-on/off groundwater economy that is amenable to vigorous regulation at different levels. It can be used to reduce groundwater withdrawal in resource-stressed areas and to stimulate it in water-abundant or water-logged areas; it can be used to stimulate conjunctive use of ground and surface water; and it can be used to reward "feeder communities" that invest in groundwater recharge and penalise villages that overdraw groundwater.

Elsewhere in India and the rest of the world, groundwater management has experimented with diverse sets of resource governance regimes – using water laws, tradable groundwater rights, economic incentives and disincentives – to achieve improved groundwater demand management for productivity, equity and sustainability. These regimes have proved ineffective, costly and time-consuming. In comparison, Gujarat under JGS has shown that the effective rationing of the power supply can indeed act as a powerful tool for groundwater demand management. And in so far as metering over 600,000 electric tubewells scattered over a large area of countryside may entail very substantial transaction costs which JGS saves, it may well be the "best" and not a second-best solution to the farm power imbroglio that all western and southern Indian states are confronted with.

However, as it is managed now, JGS has a big downside: its brunt is borne largely by marginal farmers, and the landless because of the shrinking of water markets and of irrigated agriculture itself. There is no way of eliminating this completely except by increasing the hours of power supply and introducing a subsidy, both of which will defeat the purpose of the entire initiative. JGS can significantly reduce the misery of the agrarian poor by replacing the present rationing schedule by intelligent, demand-adjusted power rationing. The equity impact on the poor can be further enhanced by providing the daily power supply in two or more instalments to respond to the behaviour of wells in hard-rock areas. The equity impact can also be enhanced a great deal by charging a common flat tariff to all tubewells regardless of whether they are metered or not. This would turn a large number of metered tariff paying tubewell owners from reticent sellers to aggressive water marketers to their poor neighbours.

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