

# Co-Management of Electricity and Groundwater: An Assessment of Gujarat's Jyotirgram Scheme

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In September 2003, the government of Gujarat introduced the Jyotirgram Yojana to improve rural power supply. Two major changes have since taken place: (a) villages get 24 hour three-phase power supply for domestic use, in schools, hospitals, village industries, all subject to metered tariff; and (b) tubewell owners get eight hours/day of power but of full voltage and on a pre-announced schedule. It has, however, offered a mixed bag to medium and large farmers and hit marginal farmers and the landless. This article offers an assessment of the impact of Jyotirgram, and argues that with some refinements it presents a model that other states can follow with profit.

**D**espite massive public investments in canal irrigation, Gujarat agriculture has come to depend heavily on irrigation with wells and tubewells.

## 1 Backdrop

During the 1950s and 1960s, farmers used mostly diesel engines to pump groundwater. However, as rural electrification progressed, they began switching to submersible electric pumps especially as diesel pumps were unable to chase declining water levels. The major expansion in the use of electric pumps occurred during the late 1980s as the Gujarat Electricity Board (GEB) changed to flat tariffs linked to horse power of pumps. Until 1988, farmers were charged based on metered use of electricity. However, as electric tubewells increased to hundreds of thousands, meter reading and billing involved rampant corruption. Farmers also complained about the tyranny and arbitrariness of GEBs meter readers.

The new flat tariff system introduced in 1988 produced major beneficial productivity and equity impacts on smallholder irrigation. Since the marginal cost of electricity to tubewell owners was zero, they were induced to aggressively sell water to their neighbours, typically marginal farmers and sharecroppers unable to afford their own tubewells. Competition among sellers pared down the prices of pump irrigation service in local informal water markets greatly benefiting the poor. Flat tariffs also expanded groundwater irrigation, increased the utilisation of tubewells and reduced the GEBs cost of metering and billing over electric tubewell connections. However, the ill-effects of a flat tariff were serious as well. It led to groundwater over-exploitation. It meant that farmers had to pay electricity charges even during the monsoon when they used little irrigation. Most seriously, flat tariff became sticky and gradually increased GEBs losses in supplying power to agriculture. These could have been controlled if the GEB had gradually raised the flat tariff in tandem with the increase in power consumption in agriculture. However, farmer lobbies strongly opposed government efforts to raise the flat tariff, leading to mounting losses to the GEB on the agricultural account [Joshi and Acharya 2005].

Given the circumstances, the government had no option but to gradually reduce power supply to agriculture. During the 1980s, farmers got 18-20 hours of three-phase electricity/day; this came down to 10-12 hours by the turn of the millennium. Moreover, the quality and timing of power supply deteriorated, too. Power supply came with low voltage, often during the nights and with frequent trippings damaging motors. Poor and

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inadequate power supply to agriculture became the key issue in Gujarat's mass politics.<sup>1</sup>

The GEB also found it difficult to ration power supply to tubewells without hitting power supply to domestic and other rural uses. Normally, single-phase power that can run domestic appliances was provided 24 hours but three-phase power required to operate tubewells, grain mills and other heavy equipment was restricted to 10-12 hours. To beat this system, farmers everywhere in Gujarat began using capacitors (locally called 'tota') to convert two – or even single-phase power – into three-phase power to run their tubewells. This reduced the voltage downstream affecting the village community, while tubewells continued to operate unhindered for 18-20 hours/day. The rural society and its non-farm economy were held hostage by the burgeoning groundwater economy of Gujarat. Power engineers consider capacitors to be the gateway to improved power factor (pf);<sup>2</sup> but in rural Gujarat, farmers turned these into an instrument for power-theft.

The way out of this imbroglio, it was commonly argued, was to meter tubewells, improve the amount and quality of power supplied to farmers, and charge metered tariffs. Shah et al (2003) had, however, argued that, though correct in principle, taking this route in present conditions would resurrect the logistical problems of metering to resolve which Gujarat (and other Indian states) had changed to flat tariff in the first place. They argued that this would attract massive farmer opposition, and, if the experience in other states was any indication, imply political harakiri for any leader who championed it. Instead, Shah et al argued for the second-best solution of separating feeders supplying power to tubewells from other rural feeders and undertaking intelligent rationing of power supply to tubewells in a way that mimics a high-performing canal irrigation system. In particular, Shah et al recommended that: (a) flat tariff on farm power use should be raised gradually to approach the average cost of power consumed by a tubewell; (b) low-cost off-peak night power should be judiciously used to keep the average cost of farm power supply low; (c) intelligent scheduling and management of rationed power supply to the farm sector should be the central element of the strategy of effective co-management of groundwater and electricity use in agriculture. Shah et al anticipated that "Farmers will no doubt resist such rationing of power supply; however, their resistance can be reduced through proactive and intelligent supply management" by: (a) enhancing the predictability and reliability of power supply; (b) improving the quality in terms of voltage and frequency, and minimising trippings; and (c) better matching of power supply with peak periods of moisture stress.

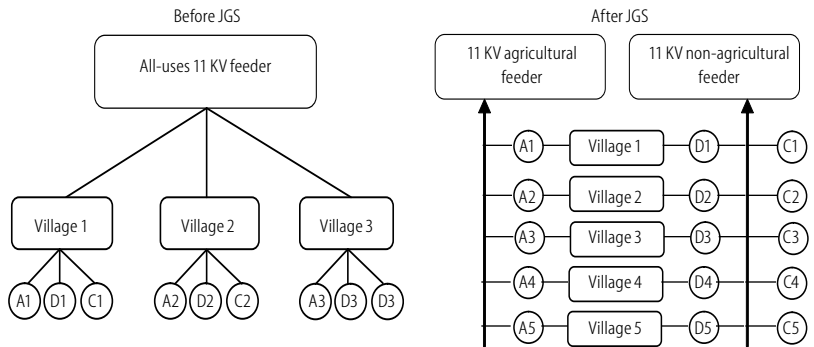
During 2001-02, this proposal, henceforth referred to as the IWMI proposal, was presented and discussed in several workshops and conferences in Gujarat as well as in other states. In Gujarat, the IWMI proposal was shared with the minister of power, Gujarat Electricity Regulatory Authority as well as the chairman of the GEB. The IWMI proposal seemed timely since around then,

Gujarat was in the midst of major power sector restructuring exercise with a loan from the Asian Development Bank (ADB). Power generation and transmission/distribution were unbundled with the latter task taken over by five regional power distribution companies, each mandated to operate on commercial principles. The key impediment in the exercise was farm power. The ADB's answer was metering of farm power supply. But in view of stiff farmer opposition, the government of Gujarat had to go slow on this move; as a result, the ADB suspended the release of the loan instalment. Instead of metering tubewells, however, in September 2003, the government of Gujarat launched the 'Jyotirgram Yojana', which included some of the key recommendations of the IWMI proposal but went far beyond them, and unleashed a new wave of rural development in the state.

**2 Jyotirgram Scheme**

The Jyotirgram Scheme (JGS) was launched initially in eight districts of Gujarat on pilot basis, but by November 2004, it was extended to the entire state. By 2006, over 90 per cent of Gujarat's 18,000 villages were covered under the JGS. This was a massive operation.<sup>3</sup> It meant laying a parallel rural transmission network across the state at an investment of Rs 1,170 crore. Feeders supplying agricultural connection were bifurcated from those supplying to commercial and residential connection at sub-station itself. Meters on distribution transformer centres were also installed on both the sides of feeders to improve the accuracy for energy accounting [MGVCL 2007].

**Figure 1: Electricity Network Before and After JGS**



Pre-JGS, at the lowest level, 11 kv feeders served a group of two to five villages wherein all connections in these villages (domestic, agricultural as well as commercial) were through this feeder (Figure 1). Post-JGS however, the feeders were bifurcated into agricultural and non-agricultural feeders. This meant that certain feeders only served farm consumers and connections while the rest served the domestic and commercial customers. Meters on agri-feeders were meant to identify the source of any significantly-greater-than-expected demand. In rural Gujarat thus rewired, two changes occurred: (a) the villages began to be provided 24 hour power supply for domestic use, in schools, hospitals, village industries; (b) farmers began getting eight hours of daily power supply but of full voltage and on a pre-announced schedule. Every village got agricultural power during the day and night in alternate weeks that were pre-announced.

JGS is held out as a win-win solution for everyone involved. Studies by the Institute for Rural Management and (IRMA) as well as by the Centre for Environment Planning and Technology (CEPT) narrated myriad ways in which JGS has improved village life [IRMA and Hemchandraacharya North Gujarat University 2004]. Both these studies, however, glossed over the new dynamic that the JGS had catalysed in Gujarat's agriculture. In early 2007, IWMI undertook a quick assessment of the impacts of the JGS in 55 villages spread over 10 districts with the help of local researchers. The study laid particular emphasis on its impact on Gujarat's groundwater economy. This paper synthesises these case studies to evolve a first-cut assessment of JGS, and its lessons for co-management of electricity and groundwater. Our findings are in total agreement with the highly positive assessment of the IRMA and CEPT studies: therefore, we deal with these in summary form but discuss in greater detail the agrarian impacts of JGS that have so far remained unexplored.

### 3 Impact on Quality of Rural Life

Thanks to the JGS, rural Gujarat today enjoys 24-hour power supply of quality unrivalled in rural areas elsewhere in India. All our case studies uniformly attested that for common villagers of the state, JGS has resulted in tremendous improvement in the quality of daily life. Power cuts, which were endemic, have mostly gone; and so have voltage fluctuations. For a long-time before the JGS, rural life as well as economy were afflicted by unpredictable and frequently interrupted power supply of low quality that made it impossible to organise daily chores or economic activity.

Women were constantly worried about securing domestic water supply; livestock keepers had to time milking and feeding of cattle according to power supply; schoolteachers and students were anxious about power outages while using laboratory equipments, computers and television sets. During Gujarat's hot summer, the inability to operate fans made the afternoon heat insufferable in schools, shops, workshops, homes and rural hospitals.

JGS has helped to bridge a major divide between rural and urban life. Improved power supply has led to better drinking water supply for longer hours, improved street lighting, use of television, radio, kitchen gadgets and fans. Women in many villages used time saved from household chores in supplemental income generation. JGS paved the way for better functioning of schools, primary health centres, dairy co-ops, and better communication.

### 4 Impact on Non-farm Rural Economy

JGS has given a big shot in the arm to existing and new non-farm economic enterprises generating new livelihoods and jobs. JGS has reduced the cost of non-farm businesses such as flour and rice mills which now do the same amount of work by consuming less power because they get full-voltage, uninterrupted three-phase power supply round the clock.<sup>4</sup> Many of those we interviewed reported 30-35 per cent fall in their bimonthly power bill post-JGS. Many rice mills owners we met increased their daily output by three times, created more local employment opportunity and reduced maintenance and repair costs, breakdowns and working capital requirements. Many shops, especially those vending perishable food items, telephone exchanges and STD

booths, computer training centres had to make significant investment in invertors or generators. Inverters and generator sets have by and large disappeared; and commercial outfits are now able to operate in a continuous manner.

In Banaskantha as well as Bhavnagar villages, we found diamond polishing units shifting to villages to save on expensive space in towns; the resultant demand for labour has been so strong as to create farm labour shortages especially during harvest time. In some of the villages, flour mills were running at great cost with diesel engines pre-JGS; now these have turned electric. In Bhavnagar district, JGS stimulated growth in employment, and wage rates, in diamond polishing, tailoring, knitting, cold drink, vending, welding and small oil mills. Many women, unable to commute to urban centres of diamond polishing trade, have now begun to work in newly opened diamond cutting/polishing units in their own villages. According to a local leader, "thanks to JGS, Bhavnagar villages have witnessed more progress and better incomes during the last three years than in 50 years before". According to another, "JGS has good and bad things for farmers; but it has only good things for the village as a whole".

In most districts, electronic and electrical repair shops experienced major improvements in efficiency and speed. Welding machine owners and tyre puncture shops improved their business substantially. Demand for electronic products – TV sets, DVD players, tape recorders – increased rapidly.

There is one sector of the non-farm economy which, however, was hit hard by the JGS: the motor/pump repair and service industry. During recent decades, rural Gujarat has witnessed booming ancillary trade tied to tubewell irrigation. Some of this involved drillers, rig owners, cement pipe manufacturers, gangs specialising in laying buried pipeline networks, specialists for taking submersible motors out of tubewells and for installing them inside tubewells, specialists for adding new columns to chase falling water levels. Some more had to do with maintenance and repair of tubewell equipment, especially pumps and motors, manufacturing and installing capacitors (tota's). This second trade proliferated as rapidly as Gujarat's farm power supply deteriorated. Thanks to JGS, these pump repairing units and motor-winders have fallen on bad days. It is said that JGS has killed three birds with one stone: it has provided succour to tubewell owners by easing the huge burden of maintenance and repair that they had to shoulder all these years; it has saved GEB from big losses; it has also saved groundwater tables from receding.

### 5 Impact on Tubewell Owners

Farmers we interviewed welcomed five major changes that the JGS has brought about:

- (1) Continuous power supply: Before JGS, constant tripping in farm power supply made it impossible for farmers to keep their irrigation schedules. Frequent tripping wasted water and power; motors suffered increased wear and tear; tubewell owners, water buyers as well as hired labourers suffered forced idle time during the power outages. By providing power with greater continuity and fewer interruptions, JGS has benefited farmers.
- (2) Full voltage: Low and fluctuating voltages, in part due to rampant use of tota's by farmers themselves, was another problem.

This resulted in frequent burn out of motors, and high wear and tear. Post-JGS, it is almost impossible for most farmers to use capacitors, which besides improving voltage also helped to improve order and discipline in electricity use in agriculture.

(3) Reliability and predictability: Before JGS, farmers never knew in advance precisely when power would be supplied and withdrawn. Tubewell owners and their customers were always on tenterhooks, waiting all day for power to come so that they could begin irrigation. Auto switches were widely used on tubewells which got switched on as soon as power supply started. After the JGS, farmers get their ration of eight hours of power during a fixed time schedule, known to everyone, during day and night in alternate weeks, making irrigation scheduling easier for tubewell owners and their customers.

(4) Externally imposed restraint: Some farmers grudgingly recounted, that the JGS successfully attacked the common-property externality inherent in groundwater irrigation. It did this by effectively putting a cap on collective groundwater withdrawal, in a uniform and just manner. Farmers everywhere recognised that unbridled pumping of groundwater must eventually prove the highway to disaster; and that on their own, farmers would never forge collective self-regulation. JGS has done it for them by rationing power uniformly on all tubewells across the state.

A similar sentiment expressed about the use of capacitors (tota's). Many farmers felt guilty about the use of tota's but used them simply because everyone else did so. Post-JGS, all farmers have been forced to give up on tota's. With the separation of tubewell and non-tubewell feeders, use of tota's to run tubewells has become technically impossible for most farmers. Moreover, the use of tota's is also vigorously monitored and heavily penalised. The sense of relief was particularly notable in hard rock areas like Sabarkantha, where wells run out of water before pumps run out of power during a day. Before JGS, there was a mad race amongst tota-using tubewell owners here to pump as much groundwater as they could under a "use it or lose it" regime. By abolishing tota's, the JGS took the first big step towards a sustainable groundwater management regime that most tubewell owners welcomed.

(5) New connections: When the JGS was completed, the government of Gujarat lifted the virtual embargo on new tubewell connections and began offering new connections in a planned manner depending upon the availability of groundwater and power.<sup>5</sup> In parts of Saurashtra, where the profusion of check dams and recharge structures have increased recharge to the hard-rock aquifers, new connections were released. This was also the case in some parts of central and south Gujarat.

## 6 Negative Perceptions of Farmers

If the discussion so far suggests that all farmers are unreservedly happy with the JGS, nothing could be farther from the truth. In fact, the negative sentiment among farmers is stronger and more widespread than the positive feeling. Farmers viewed full-voltage, reliable power supply as nothing more than sugar coating for the bitter pill of rationed power supply. Particularly peeved were tubewell owners in groundwater abundant areas of central and southern Gujarat who operated their tubewells for up to 18-20 hours daily using capacitors (tota's). Now they are forced to make

do with just eight hours. Vibrant water markets have been central to Gujarat's groundwater irrigation economy, and essential for the viability of tubewell investments now for eight decades [Shah 1993; Hardiman 1998]. But these are now under siege, thanks to effective power rationing.

Farmers we interviewed were bitter about promises unkept, of eight hours of continuous, full voltage, three-phase power.<sup>6</sup> Farmers still face frequent trips, lower than full voltage and effective hours of daily power supply of six to six and a half hours against the promised eight. Night power supply, every alternate week is another sore point: night irrigation is inconvenient and hazardous; and finding labour to work in the fields at night is trying. The crucial issue, however, is effective rationing. Many farmers complained that "it is unfair on the government's part to divert agricultural power for residential users. Agriculture is the back bone of the village economy. When agriculture itself is threatened, how can a village enjoy better life?" In Vadodara, farmers lamented that "the government has pursued rural development at the cost of agriculture". In Dahod, tribal farmers complained, "but for us farmers, Jyotigram has benefited all else". In Kheda, all our respondents, including women members of families, strongly felt that villages should not enjoy 24 hour power supply if it comes at the cost of agriculture. Some suggested that 24 hours single-phase power should be supplied to the residential users; but three phase power line to industries and water works should also be separated, and a uniform 12 hours continuous power supply should be ensured to farm and non-farm producers.

## 7 Impact on Marginal Farmers and the Landless

The brunt of the adverse socio-economic impact of the JGS fell on water-buying marginal farmers, tenants and landless farm labourers. This large section of Gujarat's agrarian poor depends upon tubewell owners to sell them reliable pump irrigation at an affordable price; and ironically, the much-despised tota system ultimately benefited these classes. With drastic diminution in pump irrigation sales, the agrarian poor are left in the lurch. We encountered only three situations where this did not happen.

First, in water-stressed hard-rock areas like Bhavnagar where, thanks to limited availability of water in wells, pump irrigation markets here were all but absent even before JGS. Small and marginal farmers here were rain-fed before the JGS and they are rain-fed now, without any further worsening in their position. Second, in canal irrigated areas where canal irrigation, high tubewell density, high water tables and good well yields combine to make eight hours of power sufficient for meeting the villages' irrigation demand. Post-JGS, terms of sharecropping have remained largely unchanged, which means that landowners have absorbed the JGS shock. Third, in the prosperous and groundwater rich south Gujarat where most farmers had their own electrified bore-wells and water markets were limited. Post-JGS, what little pump irrigation trade existed shrank even further; although we found no major increase in water price.

Almost everywhere else, our researchers found that marginal farmers and landless labourers were hit hard in several different ways: (a) groundwater markets shrank, and irrigation access to buyers declined; (b) pump irrigation prices in cash sales post-JGS

increased by 40-60 per cent or more everywhere; (c) landless labourers cultivating leased land faced reduced availability of irrigation; (d) they also faced reduced opportunities for farm work as total irrigated area declined.<sup>7</sup> Often the bottom of the agrarian pyramid comprises of migrant tribal labourers, dalits and low castes who are often the least skilled and adapted to non-farm trades where JGS has opened up new vistas for growth and prosperity.

## 8 Assessment

Evaluations of JGS so far have focused mostly on the non-farm economy and the quality of domestic life – where JGS impacts are unambiguously salutary. Our study has a larger ambit in that it covers JGS's impact on the political economy of groundwater irrigation in Gujarat. As a result, it also points out some negative impacts that need addressing. Our assessment of the impacts of JGS on different stakeholder groups is summarised in the table.

In tribal districts like Dangs and Dahod, where the groundwater economy is small and primitive, JGS' impact is noticed in the quality of rural life as well as in the non-farm sector but its agrarian impact is subdued. Here, groundwater use in agriculture is small; exchange of pump irrigation service is often a kinship based transaction; and eight hours, if provided, is too much power supply for most wells which in any case operate often with diesel pumps. Here, then, people's perception of JGS is entirely positive because they see its impact on shop keepers, artisans, local employment, PHCS, schools. However, the agrarian dynamic of JGS comes to the fore only in areas where agriculture and rural livelihoods have come to depend critically on the working of groundwater markets.

### 8.1 Political Master-Stroke

JGS offers a case study of astute political management of intervention in an arena surcharged with animated mass politics. International lenders and power sector professionals have been surprisingly naive in coming to grips with the politics of metering tubewells. A study of farmer attitudes towards tubewell metering by Joshi and Acharya (2005) in north Gujarat puts in bold relief the overpowering sense of antagonism and suspicion farmers displayed on the issue. Over the past decade, mass-based resistance to metering has put a spade in the moves by several other states in this direction. Yet, the ADB made universal metering a condition for its power sector reform loan to Gujarat; and in 2002, withheld the release of funds when Gujarat failed to make progress on metering tubewells.

The IWM1 "second-best strategy" – designed to minimise farmer resistance – too would have invited some resistance. However, the Gujarat government's strategy of projecting JGS

as an intervention to "to provide continuous three phase power supply to the rural area for upliftment of rural population" [EPD 2007] was a political master stroke to create a powerful rural support base to counter tubewell owners' resistance to power rationing.<sup>8</sup>

Before JGS, farmers, their families and most others viewed farmers as victims of a reformist government insensitive to their plight. JGS, however, won supporters even within farm families, and even amongst some farmers. JGS was not imposed; it was actually marketed to village communities; a village panchayat had to pay a registration fee of Rs 1,000 and 30 per cent of the cost of rewiring. It was first launched in poorest districts such as Dangs where its impact was bound to dazzle. It was also implemented early on in prosperous districts like Anand with high water tables. Here, non-farmers placed a high value on improved power supply environment, and farmers were less worried about power rationing. Last to be covered were north Gujarat and

Saurashtra districts where farmers would be hit hard by power ration. Village contribution was waved in all these "problem" districts with high groundwater dependence and low water levels.

JGS could do this because it realised that over decades, rural life – homes, shops, schools, public health centres – had become hostage to the groundwater irrigation economy.

By far the majority could not realise that they had to suffer power cuts, low voltages, frequent outages and trippings largely because of tubewell irrigation. By separating tubewells from the rest of the village, JGS liberated the village life and economy from the shackles of the political economy of power subsidies to tubewells.

### 8.2 Jyotigram and the Energy-Irrigation Nexus

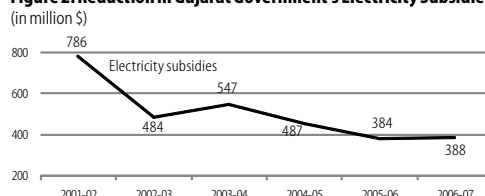
Against its original objectives of improving the rural power scenario and the viability of the GEB, the JGS has proved an outstanding intervention. During the past five years, Gujarat has emerged as one of the best performing states in the management of its power sector. The GEB is turning around, with its annual losses falling from Rs 2,200 crore in 1999-2000 to Rs 475 crore in 2002-03 and perhaps even more since then.<sup>9</sup> Farm power tariff, which stagnated at Rs 350 and Rs 500/HP/year for pumps less and more than 7 HP respectively, has been raised to Rs 800/HP/year.<sup>10</sup> Agricultural power subsidies were a millstone around the neck of Gujarat's electricity industry. It is still an issue, but JGS has created a wherewithal to "manage" farm power subsidies within acceptable limits. As the IWM1 proposal had pointed out,

the problem with pre-JGS power tariff policy was not only that it led to large power subsidies; the problem was also that the government had no control over the volume of subsidy extracted by tota-using tubewell owners. With effective power rationing in place, the JGS has transformed a degenerate flat

**Table: Impact of the Jyotigram Scheme on Different Stakeholder Groups**

Stakeholder Group	Positive (+)/Negative (-)
Rural housewives, domestic users	+++++
Students, teachers, patients, doctors	+++++
Non-farm trades, shops, cottage industries, rice mills, dairy co-ops, banks, cooperatives	+++++
Pump repair, motor rewinding, tubewell deepening, etc	----
Tubewell owners: quality and reliability of power supply	+++
Tubewell owners: no. of hours of power supply	---
Water buyers, landless labourers, tenants	----
Groundwater irrigated area	---

**Figure 2: Reduction in Gujarat Government's Electricity Subsidies**



Source: Patel 2007.

tariff into a rational flat tariff, with the government having firm control on the total volume of farm power subsidy.

Since over 90 per cent of groundwater withdrawal in Gujarat occurs through electrified tubewells, electricity consumption is an accurate surrogate of aggregate groundwater withdrawal. Government figures suggest that farm power use on tubewells has fallen from over 15.7 billion units/year in 2001 to 9.9 billion units in 2006, a nearly 37 per cent decline, resulting into halving of aggregate farm power subsidy, from \$ 788 million in 2001-02 to \$ 388 million in 2006-07 (Figure 2, p 63), and a considerable decline in the aggregate groundwater draft. 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.

### 8.3 Agrarian Impact

Dazzled by what 24 hour, three-phase power supply can do to village life and non-farm economy, many lay observers and even researchers like IRMA and CEPT have glossed over the agrarian distress JGS has been causing. True, some of the reduction in groundwater withdrawal represents saving of waste; but a good deal more represents reduced irrigation, lost output, livelihoods and employment. The angst this is causing among the farming community is all too clear from the accounts provided by our research partners. But the depth of the angst is not uniform as suggested in Figure 3.

The key determinants of farmer angst are size of the landholding and the nature of the aquifer. In depleted alluvial aquifers of Mehsana and Patan, where deep tubewells can be pumped, farmers continuously feel adversely affected because the power ration restricts their area irrigated. But farmers in hard-rock areas are less affected because the unavailability of water in their well during a day is more of a binding constraint on their pumping than the hours of daily power supply.

Figure 3: Jyotirgram's Impact on Diverse Sections of Gujarat's Farming Community



Small farmers owning tubewells are happy with improved power quality although they miss their water selling business. Landless sharecroppers and water buyers are adversely affected everywhere because water markets have shrunk and water prices have soared 40-60 per cent, driving many of them out of irrigated agriculture. The full import of 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 close to the ground. Come a drought year, and farmers will find the JGS ration of power inadequate to meet their irrigation needs.

It is very likely that Gujarat's agriculture is still in the transitory phase of adjusting to the post-JGS groundwater irrigation regime. Our hypothesis is that post-JGS, farmers will increasingly turn to water saving crops and irrigation technologies, experience renewed interest in gravity flow irrigation and give a new impetus to water harvesting and groundwater recharge work that can improve their well yields. The government of Gujarat is already doing a good deal to hasten movement in this direction. But more can and needs to be done to limit farmer distress arising from rationed farm power supply. A great deal of farmer frustration arises from promises un-kept. JGS promised farmers eight hours of continuous, full voltage daily power supply. These can be addressed by better housekeeping and tighter operational management. Pre-JGS, the GEB had perhaps some justification in not treating the farm user as a customer because he paid a subsidised rate; but under JGS, real farm power subsidies are a fraction of what they were pre-JGS; and therefore, it is time electricity companies began treating farmers as customers deserving quality service.

### 8.4 Who Benefited from Farm Power Subsidies?

It has always been a matter of intense debate in India that on precisely who centred the electricity subsidies under flat tariff benefit. Most analysts have argued that farm power subsidies essentially benefit the large farmers who own most electric tubewells. The analysis offered by Howes and Murgai (2003) for Karnataka was a classic statement of the perverse nature of the electricity subsidy under the flat tariff regime which distorted power economics, depleted groundwater and enriched the rural rich [also Narendranath et al 2005].

All the evidence we collected suggests that the brunt of rationed power supply under JGS has fallen not on the tubewell owners but on marginal farmers and landless labourers. To ascertain this position better, our research partners went back to their respondents for a second round of enquiry. This confirmed that post-JGS, groundwater irrigation through water markets has seriously shrunk in many districts, hitting the water buyers hard. In response to rationed power supply and the abolition of the use of the tota, tubewell owners have made good their loss from the reduced volume of pump irrigation sales by a 30-60 per cent increase in pump irrigation price, reduced the cost of wear and tear and enhanced bargaining power to make favourable deals with marginal farmers and sharecroppers. It is the latter who have lost from the abolition of the 'tota' system and from the shrunken pump irrigation markets. This is evident in reduced opportunities to do irrigated sharecropping, and in marginal farmers being eased out of the pump irrigation economy. The JGS experience shows that controlling electricity subsidies and groundwater overdraft do not come without a significant social cost in the form of growing immiserisation of the agrarian poor.

The government of Gujarat has made metered tariff mandatory for all new tubewells. Our studies also suggest that metering too

comes with a “welfare cost”. This is because metered tubewell owners manifest a markedly less interest in selling water to their poor neighbours than flat tariff paying tubewell owners even though the former pay highly subsidised rate per kWh. In Rajkot, after the JGS, “farmers having meter-charged power have stopped selling water”. In Kheda, our researcher wrote, “it is true that metered tubewell owners are less interested to sell their water when compared to flat tariff tubewells”. In Sundha village of Banaskantha, we found farmers with 20 hp flat tariff tubewell “sell at Rs 40/hour while Rs 60/hour is taken by metered tubewell owners with 20 hp pumps”. In Patan district, our research partner wrote: “tubewell owners under flat charge sell more to other farmers and irrigate more land but those with meters use their tubewells only for their own irrigation and prefer not to give water to other farmers...they are always conscious that the meter is running and therefore refuse to irrigate others’ land...”. In Anand, “farmers having flat rate electricity connection maximise their sale through reducing water rates, provided a buyer is available...”. Our researcher found the water-price formation to be a complex affair but “generally, flat rate connections supply water at a cheaper rate than metered connections”. In Sabarkantha, “metered tubewell owners are less prepared to sell water while flat rate tubewells are more eager to sell provided they have surplus power.. In Bavsar village, flat rate tubewells of 10-15 hp sell water at Rs 25-30/hour while metered tubewell owners charge Rs 35-40/hour.”

In course of our interactions, a major area of farmer concern was the growing tension between farmers and distribution company field staff. Our research partners felt that the electricity companies need to allay farmers’ fear of their staff, especially now that the practice of using capacitors is nearly abolished. Before 1988, farmer resistance to metering arose in some part because of the tyranny and arbitrariness of the meter readers. Flat tariff was comforting because it minimised the contact between farmers and electricity board staff and contained the latter’s arbitrariness. We found that this antipathy is returning.

An area of priority action should be to establish a relationship of trust between farmers and electricity company staff. One way to do this is to rethink the purpose of metered tariff collection in a regime of stringent power rationing. When power consumption at feeder level is tightly metered and monitored, metering each tubewell offers limited scope to improve energy budgeting and accounting. However, from the viewpoint of improving irrigation access to the agrarian poor and reducing farmers’ antipathy towards distribution company field staff, metering of tubewells may have serious adverse impacts.

Even if tubewells are metered for energy audit purposes, if their owners are subjected to flat tariff, their behaviour would change instantly: instead of reticent water sellers charging high monopoly premia from their poor buyers, metered tubewell

owners in groundwater abundant areas would turn into aggressive water sellers expanding groundwater irrigation opportunities for the poor in their neighbourhood.

### 8.5 The Case for the Last IWM1 Recommendation

The only recommendation of the IWM1 proposal that the JGS did not incorporate was the need to target maximum power supply during periods of peak irrigation demand [Shah et al 2003]. The IWM1 proposal argued that farmers’ derived demand for power is unlike that of domestic or industrial users who need 24-hour power supply. Farmers need power most on 30-40 days of the year when their irrigation need peaks. A farm power regime that supplies maximum power to agriculture on those carefully selected 30-40 days and reduces daily power supply during the rest of the year to a maintenance ration of 3-4 hours would help farmers more than a uniform eight hours/day of power supply.

Under JGS, the government has committed to supplying 2,880 hours of farm power/year. There are a number of ways this same quota can be delivered to maximise its beneficial impact on the agrarian poor and on agriculture as a whole. In order to surface farmers’ preferred season-adjusted power supply schedules, in our second round of enquiry, we asked our respondents to allocate an annual ration of 3,000 hours of farm power (at 8.30 hours/day) over the 12 months. The responses we received showed considerable variations across districts; however, everywhere, farmers allocated more hours to November-March months than the rest of the year. Aggregating the preferred schedules provided by all the respondents suggested two distinct patterns displayed in Figure 4: (a) in a year of normal or good monsoon, farmers would

like power-hours reduced during kharif and increased to 11-12 hours/day during rabi season and eight to nine hours/day during summer; (b) during a drought year, however, farmers would like 12-14 hours/day during kharif, 10-11 hours/day during rabi and a smaller ration of five to six hours/day during summer months.

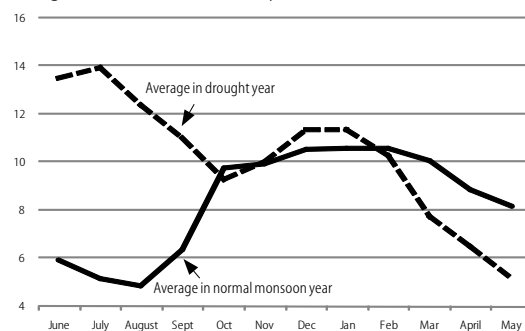
Another way power supply regime can be fine-tuned to create value for farmers is to adjust it to regional

hydro-geological specificities. True, matching rationed power supply to each individual farmer’s need is impossible; but it is possible to make adjustments according to broad regional parameters. In hardrock areas, where wells run out of water after a few hours of pumping, it would help farmers a great deal to provide their power rations in two daily shifts, as is already being done in some parts of Sabarkantha.

## 9 Grand Promise of Jyotigram

In our assessment, the JGS has pioneered real time co-management of electricity and groundwater irrigation. It has unshackled domestic and non-farm rural electricity supply from the clutches of the insidious political economy of farm power subsidies. Its highly beneficial and liberating impacts on rural women, school children,

**Figure 4: Aggregated Preference of Farmers about Daily Power Supply during Different Months (in hours/day)**



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 indicators suggest that this will be significant and deepen over time. Thanks to the JGS, Gujarat is well on its way to putting its electricity industry on a sound footing in just over five years. Thanks also to the JGS, Gujarat now has a kind of switch-on/off groundwater irrigation economy in which the administration has a powerful handle for groundwater demand management. Elsewhere, governments have tried, mostly in vain, to manage groundwater by making laws that are unenforceable, or by vague notions like tradable groundwater rights.

Gujarat under the JGS has shown that effective rationing of power supply can indeed act as a powerful, indeed all powerful, tool for groundwater demand management. It can be used to reduce groundwater draft 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. It can be used to reward "feeder communities" that invest in groundwater recharge and penalise villages that overdraw groundwater as if there is no tomorrow.

A big breakthrough is the control government now has on the size of the farm power subsidy: pre-JGS, tota-using tubewell owners subject to flat-tariff availed of all the power they wanted with the government and electricity board being helpless bystanders. Now, the tables are turned; tubewell owners have to manage with the power they are provided. In this sense, JGS has

transformed what was a highly degenerate power-pricing-cum-supply regime into a rational one.

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 groundwater irrigation itself. There is no way of eliminating this completely except by increasing hours of power supply – and subsidy – that tubewell owners everywhere are crying for. However, the JGS can significantly reduce the misery of the agrarian poor by adjusting the schedule of power supply to match peak irrigation periods, especially for the rabi season. Providing the daily power supply in two or more instalments to respond to the behaviour of wells in hardrock areas can further help the poor. Charging a common flat tariff to all tubewells regardless of whether metered or not can also stimulate metered tubewell owners to share irrigation with the poor.

The JGS has lessons of enormous significance for eastern Indian states. That, under the degenerate flat tariff regime, rural electrification is held hostage to farm power subsidy is nowhere more evident than in eastern India where the country-side has got all but "de-electrified" [Shah 2001], holding up rural development in that entire region. Orissa has tried to reverse this retrogression by metering tubewells; and West Bengal is preparing to take that route. But this runs the risk of throwing out the baby with the bathwater. Gujarat's JGS experience offers an important alternate model which we consider superior in many respects.

## NOTES

- 1 For a background to this entire problem, see Shah et al (2003).
- 2 Motors running irrigation pumps have a pf of 0.7-0.8, which the use of a capacitor can raise to 1. A 100 kVA transformer can be connected to 26 motors of 5 hp with capacitors instead of 18 without getting overloaded. Capacitors improve the voltage and reduce the load on the transformer and in general curtail power loss in distribution. See, Prayas (2004).
- 3 It involved total rewiring of rural Gujarat. 48,852 km of high tension lines and 7,119 km of low tension wires were added. 12,621 new transformer centres were installed. 1.2 million new electricity poles were used. 1,470 specially designed transformers were installed. 1,82,000 km of electricity conductors and 6,10,000 km of low tension PVC cables were used. 30,000 tonnes of steel products were used.
- 4 Thus, non-farm units making illegal use of tota's paid commercial rate for power on metered basis and did not extract a subsidy, which tota-using farmers did.
- 5 Every year, the government determines how many new connections can be given out in the entire state depending on the groundwater level and power available. Allocations are made to districts, circles, divisions and feeders, an advertisement is put in the local newspapers inviting applications for new 'Tatkal' connections. The connections are then given out on a first-come-first-serve basis. Such a system ensures that the GEB has a fairly strong control over new tubewells in the state.
- 6 ToI 2002. *ADB Loan to Gujarat in Doubt*, Times News Network, August 7, [http://timesofindia.indiatimes.com/articleshow/18397858.cms]
- 7 See, *Naya Padkaar*, January 12, 2007, for an example of these impacts in Dharmaj village of central Gujarat where tubewell owners raised water prices from Rs 20/hour to Rs 50 post-JGS.

- 8 "The central purpose of this project...[is] to remove disparities between urban and rural areas in power supply and in other services available to the people" [MGVCL 2007].
- 9 *Madhya Gujarat Vij Company*, the new corporatised version of GEB in central Gujarat made operating profits in 2005-06, for the first time in several years.
- 10 This has not been easy with strong farmer organisations resisting all moves to rationalise tariff. In 2002, chief minister Narendra Modi tried to raise this from Rs 350-500 to Rs 1,260/HP/Yr and the move was immediately opposed by the Bhartiya Kisan Sangh (BKS). After sustained agitations, the rate was fixed at Rs 850/HP/Yr. For metered connections, the tariff remains Rs 0.50/kWh; and for Tatkal connections, it is Rs 0.70/unit.

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