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# In Pursuit of Energy Efficiency in India's Agriculture: Fighting 'Free Power' or Working with it?

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# Summary


While about 70% of Indian electricity is carbon-based, a quarter of the nation's consumption goes into agriculture, to extract groundwater for irrigation. Improving the energy efficiency of Indian agriculture is thus a critical issue for the world at large, from both a climate change and energy security perspective. Yet, the picture is made immensely complex given the entrenched policy of providing "free power" to farmers since the Green Revolution of the 1970s. Over the past two decades, a neo-liberal discourse shared by many Indian and international technocrats has emerged that frames "free power" as a unilateral problem that leads to economic inefficiencies affecting utilities, the state governments but also the farmers themselves through the unfair allocation of subsidies. The solution that is hence most advocated is to revise and increase tariffs and to improve the technical efficiency of India's 23 million pumps. Key international donors have promoted this line of thinking, making higher tariffs and universal metering a pre-condition for financing power-sector reforms.

Through qualitative data gathered in interviews and fieldwork in four Indian states (Andhra Pradesh, Maharashtra, Gujarat and West Bengal), this work challenges this perspective. It contends that the raising of electricity prices would deeply and unavoidably aggravate rural poverty as well as endanger food security. Whether one likes it or not, moreover, electricity subsidies have become a cornerstone of rural politics in India, as the Congress Party hegemony was challenged by regional parties with strong support among the peasantry. Both pragmatism and effectiveness now call for looking at "free power" as a constraint to work with, rather than a problem to work against. At the same time, concentrating solely on technically improving the efficiency of pumps might further aggravate the speed at which water tables are depleted. There is thus a need to first optimise water demand in agriculture through a broader approach to the water-energy nexus. This would include massive state investments to improve surface irrigation, groundwater table management, irrigation technologies, agricultural practices (including organic agriculture and crop diversification) as well as India's food procurement policies. The support of the international community, we believe, should be rethought in this light.

# Introduction

## Backdrop

Free power[1] for farmers is a unique feature of the Indian electricity supply industry. Most Indian states have ensured agricultural consumers a free, or highly subsidised, often unmetered electricity supply. After electricity was put under public control and local states received the authority to set electricity prices in 1948 following the Electricity (Supply) Act, electricity pricing[2] rapidly emerged as a powerful political tool and stake (Swain, 2006; Badiani and Jessoe, 2010). Since then, political parties have campaigned for a subsidised or free electricity supply for agricultural consumption, in anticipation of capturing farmers' political support. Free power has become such a political node that, in recent years, it has gained a prominent place in party manifestoes. Elections are sometimes won or lost on the basis of political parties' commitment to this policy.[3] Although the free-power policy is implemented as a political or vote-gaining tool, it has been marketed as a policy for increasing agricultural yields, ensuring food security and reducing rural poverty.

However, in recent years, the free-power policy has been criticised as a populist paradox. Since the launching of economic liberalisation in the early 1990s, it has become highly vexatious. The policy has been criticised on various grounds. First, the free-power policy does not so much help the farmers, particularly the poorest among them, as this free electricity is largely being stolen by non-agricultural consumers or captured by a few large landed farmers (Gulati and Narayanan, 2000; Gulati and Narayanan, 2003; Howes and Murgai, 2003). Second, implementation of a free-power policy, even after cross-subsidisation from industrial and commercial consumers, has driven the electric utilities and state governments into financial crisis (Sankar, 2004). In many cases, as in Andhra Pradesh and Punjab, the amount of the agricultural electricity subsidy is much higher than the state's spending on health or education (Birner *et al.*, 2007: 69). Third, free-power policy has prompted the unaccounted and uncontrolled use of electricity, resulting in the agricultural sector consuming one-fourth of the country's total electricity supply.

Consequently, this policy has been blamed as one of the major sources of the current electricity crisis in India. Finally, the policy has also been blamed due to its environmental implications. It has prompted the overuse of groundwater for irrigation, resulting in the depletion of water tables, something that poses a serious environmental threat. This depletion has a compounded impact on electricity consumption: as the water table goes down, the amount of electricity required for extracting water goes up, further adding to carbon emissions *via* the extra electricity generated.

1 In a narrow sense, free power means supplying electricity at zero cost to the user. In this work, however, we use a broader definition of "free power" to include absolutely free (zero cost) supply of electricity, as well as highly subsidised (nearly zero cost) electricity supply, often unmetered, particularly to agricultural consumers in India. While most Indian states have been following one of these two policies, very few states, like West Bengal and Jharkhand, have started measuring agricultural consumption, though the price has been kept artificially low. When there is a fee without metering, the farmers are charged a flat rate tariff on the basis of pump capacity.

2 Though the erstwhile State Electricity Boards have the authority to set the tariff, electricity pricing has often been at the discretion of the state governments (Gulati and Narayanan, 2003). Even after the creation of the independent Electricity Regulatory Commissions with the mandate to set tariffs, state governments still have a strong influence over electricity pricing.

3 The election of the State Assembly of Andhra Pradesh in 2004 offers an example of this situation (Narendranath *et al.*, 2005). While the ruling Telugu Desam Party (TDP) was planning to phase out high electricity subsidies to agricultural consumers, the competing Congress Party promised to provide free power to farmers. As a result, the Congress Party won the election with a huge margin. Even though the TDP government was arguably doing well for the overall development of the State, its opposition to free power led to defeat in the elections. The Congress Party after winning the elections has kept its promise for free power and extended the policy to its second term in 2009, even at the cost of a continued crisis.

Box 1: An introduction to electricity subsidies

Subsidies to utility customers are a salient feature of the electricity industry worldwide. The sources of these subsidies vary. In some cases, subsidised electricity supply is funded through transfers from general tax revenue in the form of either capital projects or regular transfers to bridge the revenue gap. The retail electricity price is also subsidised by less-visible input subsidies to utilities, like subsidised fuel for electricity generation. In some cases, subsidised electricity to one category of consumer is funded through cross-subsidisation from other consumers. In other cases, where the utilities lack adequate funding for a subsidy, they simply absorb the revenue loss, gradually wearing down capital stock and pushing repair and maintenance costs off into the future (Komives *et al.*, 2005).

The total value of electricity subsidies, particularly in the case of underdeveloped and developing countries, can represent a substantial share of public expenditure and utility costs. The most striking examples of state-funded electricity subsidies comes from countries of the former Soviet Union, with estimated funding of more than 10% of gross domestic product (GDP). India spends around 1.5% of GDP to fund subsidised electricity. In addition, electricity subsidies in India are funded through subsidised inputs to utilities and cross-subsidisation from industrial and commercial consumers. Even then there is a revenue gap, which the utilities are forced to absorb.

Electricity subsidies are widely popular among policy makers, politicians, utilities and consumers; yet they remain the subject of much controversy. The key driver for electricity subsidies has been removing disparity in access to electricity services among income groups within a particular jurisdiction. The underlying belief is that poor consumers would be unable to afford electricity service without a subsidised price. In practice, the benefit of electricity subsidies is spread across all the stakeholders: the politicians gain votes by using subsidies as a political tool; utilities benefit as they cover up their inefficiencies through subsidised consumption; and the consumers benefit from the low cost.

The controversy comes from the adverse consequences of subsidised electricity that are perceived to work against the quality of service for existing consumers and extending access. Subsidies may promote inefficient use of resources and thus indirectly raise the cost of service provision. Subsidies tend to produce financially weak utilities with stagnating service areas and declining service quality, as subsidies are not often adequately funded. The impact is worst for the poorest as they lack access to service and depend on other high cost alternatives (Komives *et al.*, 2005).

In this context, are subsidies needed in the short or long run? Are they a good use of public funds?

From the viewpoint of the Indian government, as well as international donors who are hoping to help India better manage its energy landscape, this raises the difficult question of whether they should work towards eliminating the free-power policy or rather working with it as a unavoidable constraint.

Though there has been consensus among Indian policy makers on the phasing out of electricity subsidies to agriculture, there has also been increasingly stiff resistance to any attempt in that regard. Abolishing the free-power policy may be desirable from the perspective of improving the financial status of state governments, improving the quality of the electricity supply and of the environment, yet it may also render the agricultural sector more vulnerable and reduce food production.

The rationalisation of electricity subsidies in agriculture, however desirable it may be, is a major policy challenge and would entail a drawn-out process. Addressing this challenge would require manoeuvring at the policy and implementation level to eliminate opposition, create a support-base and provide an enabling environment. Too frequently, the efforts to address the problem of free power have been promoted as a strategy for reducing the fiscal burden on states and utilities, and perceived as a strategy to remove support from the farmers. Giving primacy to fiscal concerns creates a win-lose situation where the states gain at a cost to farmers;[4] hence, opposition from the losers. There is a need to create a win-win situation, where both the state and farmers gain while reducing the consumption of electricity and groundwater. This paper attempts to propose a win-win situation by taking a wider approach to the problem.

## Research questions and methodology

This paper is an attempt to understand India's free-power policy from three different perspectives: environmental, economic and socio-political. By looking at the issue from these different angles, a range of rationales for and against free power will emerge. We shall then argue whether policy makers and international donors should fight against "free power" or rather work with it as a constraint. Analysing and building on existing experience, the article aims to identify effective ways of ensuring the energy efficiency of irrigation in Indian agriculture. Finally, it also identifies areas for intervention by the international community and makes recommendation on how it may better intervene. The challenge of free power is too often analysed from one single perspective, whether economic or socio-political or increasingly, environmental. Consequently, proposed solutions tend to be narrow and restricted, and fail to address simultaneous concerns. Here we shall be looking for a more embedded solution.

This study relied on a qualitative approach for data collection and analysis. It is based on information collected through documentary analysis, semi-structured interviews and observation of the policy process through attendance of meetings and policy dialogues. Guided by the existing literature, a wide range of documents were reviewed, including policy documents, statistical reports and media reports. A set of relevant actors, institutions and knowledge sources were identified for primary information collection based on the literature review, internet searches and information from initial interviewees (an anonymous list of key information providers is listed in Table 1). These sources were interviewed between August and November 2010.

[4] Drawing back free power and thus reducing the fiscal burden on states is not necessarily an anti-poor measure. The underlying rationale is that high subsidies in electricity have affected the quality of other public services by limiting public spending for the latter. There is a need to redirect state spending in electricity subsidies, which are captured by a small group and do not benefit the intended beneficiaries, towards other social sectors like health and education. In that sense, though the farmers will lose in the short-run as the electricity subsidies are reduced, they might benefit in the long-run from improvement in other public services.

**Table 1: Interviewed stakeholders and key information providers**

| Type | Andhra Pradesh | Maharashtra | Gujarat | West Bengal | National | Total |
|---|---|---|---|---|---|---|
| Farmers | 20 | 18 | 15 | 0 | 0 | 53 |
| Utility Staff | 5 | 5 | 4 | 4 | 0 | 18 |
| Government Agencies | 7 | 7 | 3 | 3 | 5 | 23 |
| Representatives | 4 | 3 | 3 | 0 | 2 | 12 |
| NGOs | 4 | 5 | 2 | 0 | 3 | 14 |
| Academia/Journalists | 3 | 5 | 4 | 2 | 6 | 20 |
| Total | 43 | 43 | 31 | 9 | 16 | 142 |

## Case Studies

This study draws from free-power policy and practice in three Indian states: Andhra Pradesh, Maharashtra and Gujarat. It analyses how this policy emerged and was implemented over time and what effects it has produced. It also examines the initiatives taken by these states to rationalise free power policy.

These states are highly dependent on agriculture and are major contributors to the food security of India. Their farmers have benefited from modern technology, the high-yielding seeds and fertilisers introduced during and through the Green Revolution. Though food production has increased, thanks to rising yields and a shift away from mono-cropping to multiple cropping, this has created a very large need for irrigation. Simultaneously, there has been rising and strong demand from farmers for subsidised inputs, including electricity for irrigation. In response, these states have a highly subsidised electricity supply for agriculture. At present, Andhra Pradesh provides electricity at zero cost[5] to farmers, while Maharashtra and Gujarat provide it at highly subsidised flat rate based on pump capacity. Consequently, the number of connected pumpsets and the amount of electricity consumed in agriculture and ground water extraction have increased dramatically over the past years. Agriculture now accounts for one-third of the entire electricity consumption of these states.

These developments have resulted in depletion of the water table and a power crisis, among other problems in the states. Based on fieldwork interviews and documentary analysis, Table 2 summarises how different actors view and interpret the situation across the three states.

**Table 2: Free-power scenario: what does it mean for the stakeholders?**

| Actors | Situation |
|---|---|
| Farmer | • Poor quality of supply and service<br>• High real cost, while the tariff is artificially low<br>• Low water-use efficiency, inefficient irrigation<br>• Resistance to metering and tariff increases<br>• Competitive well dependency, resulting in high initial investment<br>• State subsidy not targeted well |
| Utility | • Lower revenue; hence, limited interest in serving agricultural consumers<br>• Shortage of human resource leading to poor maintenance<br>• Political pressure to retain free power<br>• Low awareness and motivation for energy efficiency |
| State Government | • Subsidies are burden on the state<br>• Political obstacles to implement groundwater regulations<br>• Easy path of short-sighted competitive populism |
| Society | • Overuse of groundwater leading to depletion of a limited resource<br>• Growing inequalities in groundwater access leading to social conflicts<br>• Village power supply is often linked to agricultural power supply; hence, rural homes bear the burden of lower-quality power for limited hours |

5 However, there is a fixed cost of Rs 20 per connection, per month.

In recent years, the state governments have realised the need for rationalising electricity and water use in agriculture. In response, the three states have taken different types of initiatives, with varying degrees of success, while continuing to espouse populism (*i.e.* a subsidised tariff). The Andhra Pradesh government has worked to increase pumping efficiency through improved equipment. Maharashtra has started replacing the existing pumpsets with more energy-efficient ones. The Gujarat Government has tried to ration the electricity supply to agriculture – a move that was followed by incremental tariff hikes within the affordability of farmers, under the *Jyotigram* scheme. In addition to the efforts in these states, the study reviews (more briefly) yet a different initiative and policy approach carried out in West Bengal: metering of the agricultural electricity supply and charging farmers based on their consumption, though at a subsidised rate. The purpose of this initiative is to rationalise electricity consumption in the agriculture sector. This paper then reviews the successes, failures and implications of these different approaches to the problem of "free electricity".

## Scope of the study

This paper is organised as follows. Section 1 analyses the agricultural sector as an underestimated area for climate mitigation. It argues that the agriculture sector, apart from being the most vulnerable sector from a climate-change point of view, has high potential for climate mitigation. By exploring climate-change impacts and mitigation opportunities, we find that adaptation and mitigation measures can go hand-in-hand in the Indian agriculture sector. However, the sector has received little attention in terms of energy efficiency, even though it accounts for around one-fourth of total electricity consumption at the national level. Explanations are provided for this situation. Section 2 offers an analysis of the technocratic discourse on free power. It finds that this discourse takes a limited approach; the pricing of electricity (or water) does not provide an effective solution to a multi-dimensional problem. This section concludes that pricing electricity, in the absence of adequate supporting mechanisms and enabling environment, may lead to other socio-political problems. Section 3 provides a social-political analysis of the free power issue. It identifies, with evidence from the three states, a range of socio-political rationales for subsidising the electricity supply for agriculture. It concludes that free power is a medium-term constraint that the states have to work with and phase out gradually. Section 4 analyses various initiatives taken by different states to rationalise free power, their success or failure, and the effectiveness of the initiatives within the Indian context. It concludes that the initiatives taken so far are partial and narrow in focus. Section 5, finally, offers suggestions for shifting towards a more embedded approach to free power and provides a range of related recommendations for improving energy and water efficiency. It further tries to understand how agents of international cooperation can better factor in local dynamics and power relations when designing their tools and interventions on these issues.

# 1. Agriculture: an underestimated area for climate mitigation

Since the introduction of neo-liberal reforms in the 1990s, free power supply for agricultural consumption has been condemned for the collateral damage it creates for utilities and consumers. In the last decade, criticism has intensified owing to the identification of negative environmental impacts. Free-power policy has been deemed to induce over-extraction of groundwater and over consumption of electricity, which has resulted in the depletion of water tables and higher consumption of fossil fuel for electricity generation. In a climate-constrained world, a key concern is how to mitigate these impacts. This section aims to analyse free-power policy from a climate-change perspective. It explores the impacts of climate change on Indian agriculture, and analyses how they can be addressed. Finally, this section questions India's current position on mitigation in the agricultural sector.

With more than two-thirds of the population dependent on agriculture, the impacts of climate change on this sector are very significant for India. At the same time, the agricultural sector is a significant contributor to greenhouse gas emissions[6] in various forms. While the impacts of climate change on agriculture have been studied extensively, the mitigation potential of the sector has been underestimated. The debate around climate change and agriculture has often been biased towards the sector's vulnerability and adaptation to climate change impacts, although the agricultural sector itself has high potential for climate mitigation.

In this chapter, we analyse mitigation opportunities in the Indian agricultural sector, with an emphasis on energy efficiency. Consuming around one-fourth of the electricity produced in India, the agricultural sector has high potential for energy efficiency. By exploring climate change impacts and mitigation opportunities, we find that adaptation and mitigation measures can work hand-in-hand in the Indian agricultural sector. Even so, the agricultural sector has received little attention in terms of energy efficiency promotion. This section also aims to explore the rationales behind this paradox.

## 1.1 Adapting Indian agriculture to climate change: the need for water management

The Indian economy is heavily dependent on the agricultural sector: 68% of the population depends on it for its livelihood; and it accounts for around one-sixth of GDP. Growth in agricultural output will be critical in reaching the Millennium Development Goal of halving the number of poor people by 2015. However, the growth in agricultural productivity has slowed in India (World Bank, 2009: 97). The share of agriculture's contribution to Indian GDP is on a declining trend; it has decreased from 56.7% in 1950-51, to 39.9% in 1980-81, and to 16.1% in 2009-10. Yet, India ranks second worldwide (after Indonesia) in farm output. The sector employs 52% of India's labour force (CIA, 2011).

Moreover, agriculture is greatly affected by climate-change processes; despite all technological advances, weather is still a key factor in agricultural productivity. With a wide

[6] The agricultural sector contributes 17.6% of GHG in India (INCCA, 2010). Apart from that, the sector accounts for additional GHG emissions in the form of electricity consumption for irrigation.

range of terrain, including alpine conditions, arid deserts and tropical regions, India's climate is varied. Though climate change is a global phenomenon, its impact on agriculture is dependent on the variation in local climates, rather than on global climate patterns. Increases in temperature and changes in precipitation patterns are expected to affect agricultural yields to varying degrees. While some parts of the world may benefit from such changes, most of the developing world, including India, would experience a decrease in crop yields.[7]

There is growing scientific consensus on the physical manifestations of climate change, in particular increased temperatures and precipitation (IPCC, 2007*b*). There is a strong consensus that climate change is likely to have severe consequences for the agricultural sector and the rural poor in South Asia (Cline, 2007; Cline, 2008; World Bank, 2009). By 2080, Cline (2007) estimates a dramatic decline of 28.8% in agricultural output (with the favourable effect of carbon fertilisation), and 38.1% without carbon fertilisation. Guiteras (2007) estimates the medium-term (2010-2039) impact on yields to be a negative 4.5% to 9%. Since agriculture contributes around 16% of GDP, climate change impacts on Indian agriculture could cost 0.7% to 1.5% in GDP growth in the medium term, and 4.6% to 6.1% in the long run.

There is a wide array of literature on the impact of climate change on Indian agriculture. Though there is some variation in estimates regarding the economic impacts, there is a strong consensus that climate change will negatively affect the agricultural sector in India. Mall *et al.* (2006*b*) provide an interesting review of estimates regarding the impact of climate change on Indian agriculture, with an emphasis on physical impacts. Their review finds evidence in support of a significant drop in yields in important cereal crops like rice and wheat. But it concludes that the impacts of climate change on Indian agriculture are uncertain. Kumar and Parikh (1998) show that the economic impact of climate change would be significant even after accounting for farm-level adaptation. Sanghi *et al.* (1998) suggest that in a best-guess climate change scenario of a 2°C temperature increase and 7% increase in precipitation, and accounting for adaptation measures, Indian agriculture would face adverse impacts, with a loss of 12.3% in total net revenue.

Kumar and Parikh (2001) estimate the functional relationship between farm-level net revenue and climate variables using time-scale and cross-sectional data. They suggest a loss of a little less than 8.4% in total net revenue from agriculture in a similar best-guess climate change scenario. TERI (2003) finds that agricultural productivity in India is sensitive to direct effects from changes in temperature, precipitation, and $CO_2$ concentration and indirect effects through changes in soil moisture and the distribution and frequency of infestation by pests and diseases. Kumar (2009*a*) re-enforces the climate sensitivity of Indian agriculture by claiming that climate change impacts are increasing over time, indicating the growing climate sensitivity of Indian agriculture.

Existing assessments suggest six different ways that climate change might affect the agricultural sector in India. While most of these effects have economic implications for the country, some also bear direct social implications. Though some of the impacts would mean a positive outcome for agricultural productivity, the cumulative impacts are overall adverse. While some of these impacts raise global concerns, most of them would lead to regional distress.

### Increase in Temperature

It has been established that climate change has resulted in increasing the temperature, and in the coming years it will result in still higher temperatures. However, there is some uncertainty as to the temperature rise that can be expected, because that partly depends on mitigation measures taken in the coming years. Beyond a certain temperature range, warming tends to reduce yields because crops speed through their development, producing less grain in the process. Plants' ability to get and use moisture is also affected by higher temperature. As temperature rises, evaporation from the soil accelerates and plants increase transpiration, *i.e.* lose more moisture from their leaves.

[7] IPCC assessment suggests there would be a decline of 30% in crop yields in South Asia by the mid-21st century (IPCC, 2007*a*). Cline (2007) finds the impacts of climate change on Indian agriculture sobering.

The combined effect is called "evapotranspiration" (Cline, 2008: 24). Though there will be higher precipitation, as will be discussed later, the effects of evapotranspiration will override higher precipitation effects and water availability. Aggarwal (2008) projects a loss of 4-5 million tonnes in Indian wheat production with every 1°C rise in temperature throughout the growing period, given current land use. This is empirically validated by Samra and Singh (2004) with empirical evidence. In March 2004, temperatures were higher in the Indo-Gangetic plains by 3-6°C, which is equivalent to almost 1°C per day over the whole crop season. As a consequence, the wheat crop matured 10-20 days earlier and wheat production dropped by 4 million tonnes in the country. There was significant loss in other crops like mustard seed, peas, tomatoes, onion, garlic and other vegetables (Samra and Singh, 2004).

### Atmospheric $CO_2$ Concentration

Another impact of climate change will be higher $CO_2$ concentration in the atmosphere, which might act as an aerial fertiliser and boost crop growth. Higher $CO_2$ concentration is expected to increase the rate of photosynthesis and, consequently, crop yields (Cure and Acock, 1986), referred to as the "carbon fertilisation" effect in the literature. The effect of carbon fertilisation will increase the yield of C3 crops (such as wheat, rice and soybean) and thus contribute to rising nutrition levels. But C4 crops (such as sugarcane and maize), which account for about one-fourth of all crops by value, will not benefit much from carbon fertilisation. A recent meta-analysis of $CO_2$ concentration experiments in the field has shown that 550 ppm $CO_2$ leads to an 8%-10% increase in the yields of wheat and rice, up to a 15% increase in soybeans and a negligible increase in maize and sorghum (Long *et al.*, 2005). However, the science is still far from certain on the benefits of carbon fertilisation (Cline, 2008).

### Stress on Water Resources

The IPCC (2007*a*) suggests that climate change could aggravate the periodic and chronic shortfalls in water, particularly in the arid and semi-arid areas of the world. Most parts of India being arid and semi-arid, the country will be one of the most affected regions.[8] Though India is endowed with extensive sources of water, access and utilisation rates are not optimised due to pollution, salinity and a lack of a proper river management programme (Lal, 2005). Of the total water requirement in India, around three-fourths comes from the agricultural sector (Majumdar, 2008). With an increase in evapotranspiration, due to climate change, there will be a stiff rise in water demand by the agricultural sector. Although there is evidence of an increase in the precipitation rate, the periodicity of rainfall is highly unreliable. In the absence of effective rain-water harvesting, higher precipitation will not help much to meet the widespread demand for water in agriculture. Climate change is expected to bring on a race between higher evapotranspiration and higher precipitation, a race typically won by the former (Cline, 2008). Srivastava *et al.* (2010) claim that a complete recovery in yield losses (given a temperature rise of 2°C or more) may not be attained even with a doubling in the rainfall. As a consequence, there will be higher demand for groundwater to meet irrigation needs.

Unfortunately, due to rampant drawing of the groundwater, the water table in many parts of the country has dropped significantly in recent years, resulting in a threat to groundwater sustainability. A drop-off in groundwater levels leads to the ingress of seawater into the coastal areas, making the water saline. India, with its large coastline, is very susceptible to increasing salinity in its groundwater as well as in its surface-water resources. This is especially true along the coasts, due to an increase in sea level as a direct impact of global warming. An increase in sea level leads to the intrusion of saline water far into the land mass as the rivers drain into the sea, and it also increases groundwater contamination by making water saline. As the water table becomes depleted, water gets contaminated with arsenic and fluoride. Several states in India have been experiencing water contamination problems in recent years (Lal, 2005). Finally, there are projections for more frequent water-related extreme events, like drought and flood, as an

[8] Mall *et al.* (2006*a*) provide an extensive review of the literature regarding climate change impacts on the water resources of India.

outcome of rising temperatures and intensified rainfall (Mitchell *et al.*, 2006; World Bank, 2008). Most of the states in India, including Andhra Pradesh, Maharashtra and Gujarat, are prone to extreme events.[9] These not only reduce agricultural productivity, but they also have serious implications for state budgets.[10]

### Stress on Food Security

As discussed in the previous sections, climate change will result in considerable seasonal/annual fluctuations in food production. On the other hand, due to population growth, it is estimated that by 2020 the requirement for food grains will increase between 30% and 50% compared to 2000 (Paroda and Kumar, 2000). Though the level of global food security will be almost stable, owing to higher food production in the developed world (Cline, 2007), Indian food security will be stressed, due to increased population growth and decreased food production.

### Aggravating Rural Poverty

Climate change, with its negative impact on rural, agriculture-based income, will aggravate rural poverty. In the projected climate-change scenarios, it will not only be difficult to meet the Millennium Development Goal of halving the number of people living in poverty, but the problem will be exacerbated since more people depending on agriculture will fall into the poverty trap. With reduced food availability, and particularly the lack of cereals and grains, the nutrition level in rural areas will go down. Ligon and Sadoulet (2007) estimate that each 1 percentage increase in GDP due to agricultural output, increases expenditures by the poorest decile by more than 6% and has a significantly disproportionate effect on expenditure growth for all but the top two deciles. In that case, even the short-run climate change impacts on agricultural production could have serious impacts for the poorest.

### Social Unrest

The impact of climate change on the agricultural sector also has some indirect effects in the form of social unrest. As we discussed earlier, climate change impacts are unevenly distributed, in that the poorest are hurt the most. It has the potential to widen the existing economic inequalities[11] within rural society. Many of the poorest farmers have been getting heavily into debt to cope with climate-change impacts. For example, many farmers have become indebted (See Table A.1 in the Appendix) to arrange for irrigation facilities given climate-induced water scarcity. When they can't pay the debt, due to continuous crop failure (another climate-change impact), they often choose to commit suicide. The increasing number of farmer suicides (See Table A.6 & A.7 in the Appendix) has been a matter of serious concern in India (Shiva *et al.*, 2002; Sainath, 2010).[12] Finally, the decline in agricultural production and income has been forcing migration from rural to urban areas. Many male members of rural society have been migrating to urban areas in search of alternative sources of income (TERI, 2009). Apart from other developmental implications, this creates a vacuum in the agricultural labour force and destroys the rural social system.

From the above discussion, what can be concluded is that it is water that matters. The most direct and intense impact of climate change on agriculture is stress on water resources. While there are many impediments to agricultural growth in India, given the current climate-change scenario, the one that threatens the most is the rapidly deteriorating water situation (World Bank, 2009). As Cline (2007) rightly claims, the outcome of climate-change impact on agriculture will largely depend on the availability of water for irrigation. Adaptation efforts thus largely need to focus on improving water availability – possibly through improved water management and water-use efficiency.

9 Extreme events like frequent and intense rainfall, long dry periods, droughts and floods also affect agricultural productivity indirectly by increasing plant infestation by pests and disease.

10 In Maharashtra, a single drought in 2003 and one flood in 2005 absorbed more of the budget (Rs 175 billion) than the entire planned expenditure (Rs 152 billion) on irrigation, agriculture and rural development from 2002-2007 (World Bank, 2008).

11 Existing economic inequalities within rural India are demonstrated by the inequality in land ownership and agricultural income. Farmers owning a large amount of land have benefited from the new technologies introduced through the green revolution, while small farmers with limited landholdings did not benefit much from the new technologies (Freebairn, 1995). Climate-change impacts will make small farmers even more vulnerable as they lack adequate resources to cope with the changing climate.

12 Maharashtra and Andhra Pradesh are the top two states in terms of farmer suicide.

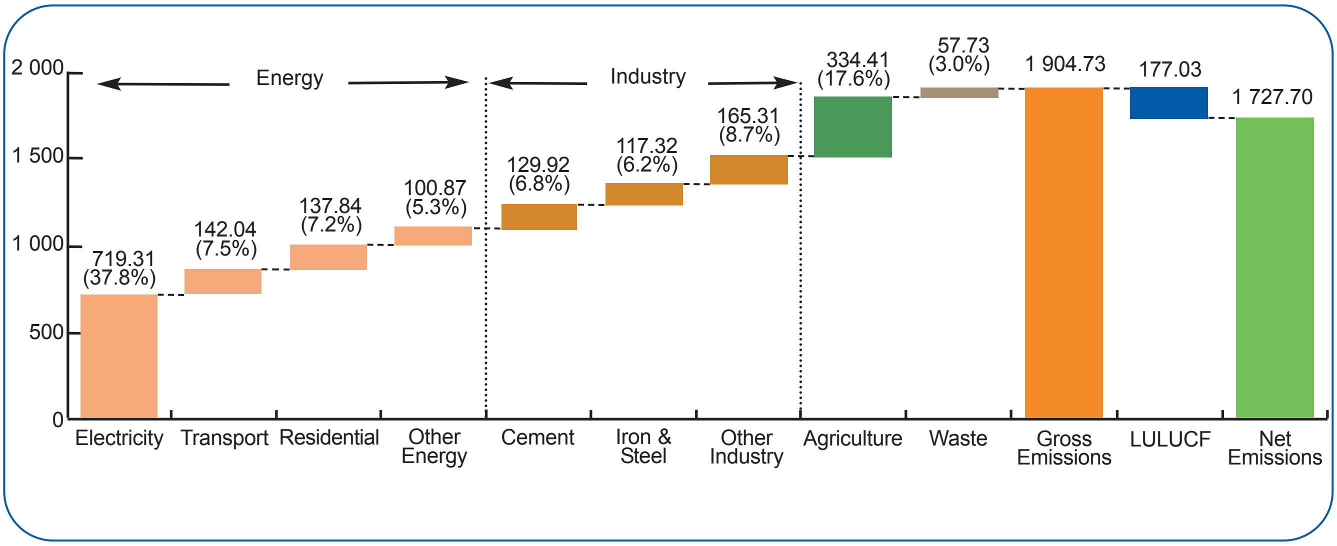
## 1.2 Mitigation opportunities in agriculture: the case for an energy efficiency approach

While being most vulnerable to the impact of climate-change, the agricultural sector in India is also the second-highest contributor to greenhouse gases (GHG), at 17.6% of the total. Apart from that, the agricultural sector indirectly accounts for another 9% in GHG emissions since it consumes one-fourth of the country's electricity output. That makes the agricultural sector one of the highest emitting sectors in India. Interestingly, agriculture is a sector that contributes to both the emission and sequestration of carbon. While the agricultural sector directly emits 334.41 million tons of CO2 equivalent (and around 180 million tons indirectly through electricity consumption),[13] croplands absorb only 207.5 million tons of $CO_2$ (INCCA, 2010).

Yet, there is high potential for climate mitigation within this sector. Being the second-highest contributor to greenhouse gas emissions, a sizeable reduction in emissions within the agricultural sector, would have significant implications for India's commitment to climate mitigation.

**Figure 1: GHG emissions by sector in 2007 (million tons of $CO_2$ eq.)**

*(Figures on top indicate the emissions by sector and in brackets indicate percentage of emissions of the category with respect to the net $CO_2$-equivalent emissions)*




*Note:*

- *Other Energy: includes GHG emissions from petroleum refining, manufacturing of solid fuel, commercial & institutional sector, agriculture & fisheries and fugitive emissions from mining, transport and storage of coal, oil and natural gas.*
- *Other Industry: includes GHG emissions from production of glass and ceramics, soda ash, ammonia, nitric acid, carbides, titanium dioxide, methanol, ethylene oxide, acrylonitrile, carbon black, caprolactam, ferro alloys, aluminium, lead, zinc, copper, pulp and paper, food processing, textile, leather, mining and quarrying, non specific industries and use of lubricants and paraffin wax.*
- *Agriculture: includes GHG emissions from livestock, rice cultivation, agricultural soils and burning of crop residue.*
- *Waste: includes GHG emissions from municipal solid waste (MSW), industrial and domestic waste water.*
- *LULUCF: includes GHG emissions and removals from changes in forest land, crop land, grass land, wet land, settlements and combusion of fuel wood in forests.*

*Source: INCCA (2010).*

13 In addition, the agricultural sector also accounts for other indirect emissions in the production of inputs like fertiliser and farm equipment.

Agricultural processes release three major greenhouse gases, *viz.* carbon dioxide ($CO_2$), methane ($CH_4$), and nitrous oxide ($N_2O$).[14] The greenhouse gases released by agriculture have three major sources: first, methane emissions from irrigated rice production; second, nitrous oxide emissions from the use of nitrogenous fertilisers; and finally, the release of carbon dioxide from energy sources used to pump groundwater for irrigation (Nelson *et al.*, 2009). The third component is often excluded while calculating agricultural GHG emissions, since it is already counted as part of energy related emissions (Schneider and Smith, 2009). Because this paper focuses only on the agricultural sector, we consider irrigation-related $CO_2$ as a key component of agricultural GHG emissions.

Mitigating the first two components of agricultural emissions would require major changes in agricultural practices, including land-use and cropping patterns. Schneider and Kumar (2008) suggest that mitigation can be achieved through intensification and extensification. Intensification may increase emissions per hectare, but total agricultural emissions can be decreased, since less land would be used to meet food demand, and the newly available land could be used for carbon sequestering plantation. Extensification of land use would reduce emissions per hectare. Though the total land requirement may increase, a reduction in total emissions could be achieved (Schneider and Kumar, 2008). However, Burney *et al.* (2010) favour intensification over extensification and suggest that improvement in crop yields should be prominently featured in a portfolio of strategies to reduce GHG emissions. Nelson *et al.* (2009) suggest that a single mid-season drying would substantially reduce methane emissions from irrigated rice with only a small reduction in yields. The loss to the farmer could then be compensated with environmental service payments funded from the world carbon market. Agricultural practices, such as conservation agriculture and conversion of low-productivity cropland to pasture or forests, can significantly reduce emissions.

However, these measures are complicated to implement as they require behavioural changes and mass awareness. Moreover, they involve some component of loss for farmers, for which they would need to be compensated. Effective implementation would require long, drawn-out changes in institutional and incentive structures.

Conversely, mitigation through energy efficiency in agriculture may be looked upon as relatively "low-hanging fruit"[15]. The effects of energy efficiency policies can be rather immediate and come with built-in incentives, whereby many stakeholders are simultaneous winners. When the electricity supply is metered,[16] farmers can gain from lower electricity bills, the utilities from a reduced peak load, and the State can benefit from reduced energy demand and thus reduced need for additional generating capacity. Moreover, energy efficiency requires neither additional inputs nor does it affect agricultural yields. Implementing energy efficiency in agriculture would indeed present a win-win situation.

Taken in a broad sense, energy efficiency in agriculture includes, and can promote, water-use efficiency as a key component. Electricity and water use in agriculture are clearly linked. Increased demand for irrigation water, as a consequence of climate change, would require higher electricity consumption. As the water table goes down, the amount of electricity required to draw water will increase.

In other words, water-use efficiency is required to reduce climate-induced stress on water resources, which would also lead to greater energy efficiency. A more detailed explanation of this linkage is provided later in this paper.

Thus, electricity and water-use efficiency offer synergies between adaptation and mitigation. Klein *et al.* (2007) emphasize that such synergies can increase the cost-effectiveness of actions and make them more attractive to stakeholders, including potential funding agencies. As people's capacities to adapt and mitigate are driven by a similar set of factors, such an integrated approach can be more effective in promoting both adaptation and mitigation.

[14] However, standard international practice is to present greenhouse gases in $CO_2$ equivalents ($CO_2$ e). Accordingly, one unit of $CO_2$ is equivalent to 25 units of $CH_4$ and 298 units of $N_2$ O.

[15] The phrase was used by an energy auditor interviewed on 17 October 2010, Delhi.

[16] Although at present most of the electricity supplied to agriculture is not being metered, the state and utilities intend to meter in the coming years. Some of the states, like West Bengal, Chhattisgarh and Gujarat, have already started metering agricultural electricity supply.

## 1.3 Energy efficiency in agriculture: an underestimated area

Over the last decade, India has been actively taking initiatives to promote energy efficiency in different sectors. It started with the enactment of the Energy Conservation Act in 2001 and the establishment of the Bureau of Energy Efficiency in 2002 to implement the provisions under the Act. Immediately after its formation, the BEE prepared an Action Plan for Energy Efficiency for the wider dissemination and implementation of standards set by the Bureau. The Action Plan gave a thrust to energy efficiency in the industrial sector, the setting of standards and labelling of appliances, agricultural and municipal demand-side management, energy efficiency in commercial buildings, capacity building of energy managers and auditors, energy performance codes and manuals preparation among others. Since its establishment, BEE has taken several initiatives across different sectors, based on the Energy Conservation Act and the Action Plan for Energy Efficiency. These energy efficiency schemes were designed in such a way that their implementation would promote and improve energy efficiency for all four categories of consumer for Indian electricity.

However, all the schemes were not implemented with equal vigour. As a consequence, outcomes vary across schemes and across consumer sectors. While standards and labelling schemes have been successful, the status of agricultural demand-side management is appalling. The first agricultural demand-side management project is yet to be executed, two years after the fact. However, there is growing interest in these schemes; more states have expressed not only interest but have initiated implementation of these schemes.

Though the initiatives taken by BEE are commendable, there is a paradox in the implementation of these initiatives: implementation is lower where the energy savings potential is higher. According to some estimates, the potential for energy savings is highest in the agricultural sector followed by the domestic (household) sector. The agricultural sector has a potential to save 27.79 billion kWh electricity, which is 30% of the sectoral consumption and more than 36% of total energy savings potential (NPC, 2009). According to this estimate, the agricultural sector offers the highest collective return in terms of energy savings and should be the priority area for energy efficiency initiatives. However, implementation by BEE shows a contradictory trend, whereby the industrial sector is being emphasised. Most of the BEE activities revolve around the industrial sector, while the agricultural sector is completely neglected. What drives this trend? Why is implementation high in the industrial sector even though the potential for energy savings is highest in the agricultural sector?

A possible explanation could be low incentive at the individual level for energy efficiency in the agricultural sector, although the collective incentive is high. Implementation of energy efficiency measures is higher when the individual incentive is high. The benefit accrued from energy efficiency for the individual owner of a pumpset in the agricultural sector is quite minimal, compared to that of an industrialist. This makes it difficult to motivate the pumpset owners to opt for energy efficiency and make the upfront investment. Also, the number of industrial and large commercial consumers is few, making it easier to target them. By contrast, the agricultural consumers are large in number and dispersed, making it difficult for BEE to reach them. BEE does not have the institutional capability to reach each and every consumer, but must work at this in coordination with other agencies.[17] Finally, the technocratic orientation of the Indian electricity sector[18] (Harrison and Swain, 2010) has led to an over-emphasis on technology based solutions for energy efficiency, even though promoting energy efficiency in the agricultural sector requires governance innovations along with technology. The technical solution promoted for energy efficiency in agriculture is the replacement of existing pumpsets with energy efficient ones. A detailed analysis of the effectiveness of this solution is provided in Section 5, drawing on a case study from Maharashtra.

17 Interview with a senior official at BEE, September 16, 2010.

18 The Indian electricity sector is largely populated with engineers who tend to prefer technocratic solutions rather than governance fixes, even for governance problems. The electricity reforms during 1990s would be an example of this.

Another possible explanation for the little attention paid to energy efficiency in the agriculture sector, even though this has the potential to produce real gains for all the stakeholders, lies precisely in the free-power policy.[19] It is assumed that a free-power policy provides a negative incentive for energy efficiency. The incentive to save through energy efficiency is absent, when farmers get electricity for free. As there is no incentive, there is no willingness.[20] Moreover, farmers have developed a perception that "energy efficiency is a strategy to squeeze money out of them".[21] That further reduces willingness to implement related measures.

To what extent is this true? Does free-power policy really reduce the incentives and willingness to implement energy efficiency measures? If so, how can an incentive structure within a free-power framework be created? The following sections address these questions, drawing on an analysis of free-power policies from an economic and socio-political perspective.

## 1.4 Conclusion

There is scientific consensus that Indian agriculture is highly vulnerable to climate change. The projected impacts have serious economic and developmental implications for the country. In the projected scenario, while there are many impediments to agricultural growth in India, a rapidly deteriorating water situation emerges as the biggest threat. The actual impact of climate change will thus largely depend on the availability of water for irrigation in the coming years. At the same time, the agricultural sector is the largest contributor to India's greenhouse gas emissions, and thus it has high potential for mitigation. The level of mitigation achieved in the agricultural sector will largely determine India's path toward low-carbon development.

Adaptation and mitigation measures can thus go hand-in-hand in the Indian agricultural sector in the effort to achieve energy and water efficiency. If implemented effectively, energy efficiency measures may thus create a win-win situation. Yet, the mitigation opportunities in Indian agriculture have been largely underestimated – if we are to judge by the level of attention provided by policy makers. When it comes to mitigation, the agricultural sector has been largely neglected. While it can offer the highest collective returns in terms of energy efficiency (compared to other economic sectors), India's implementing agencies have paid little attention and failed to spur any significant dynamics. Low individual returns and diffused interests may largely explain this situation (Charnoz and Swain, 2012). Yet, utilities and public agencies often declare that the free-power policy is the main reason for the lack of attention and action in regard to this sector. The no-tariff policies are deemed to provide negative incentive for energy efficiency and conservation. An economic and rather technocratic discourse on the need to "stop free power" has thus emerged and has been adopted by a growing number of Indian policy makers and observers. In the next section, we analyse it in depth and provide a critical look at this set of ideas.

19 Such a view was expressed by most of the utility staffs and government officials interviewed during fieldwork.

20 Interview with an Engineer at BEE working on agricultural energy efficiency, September 17, 2010.

21 Interview with an Energy Manager at an energy services company involved in an agricultural demand-side management project, October 19, 2010.

# 2. Pricing electricity for agriculture? Questioning the technocratic-neoliberal discourse

In the previous section, one issue that figured prominently in terms of Indian agriculture is the crucial role of water for irrigation. In the projected climate-change scenario, while there are many impediments to agricultural growth in India, a rapidly deteriorating water situation emerges as the biggest threat. In this context, a policy discourse has emerged in India that holds that a major cause of the current water situation is precisely the free-power policy. This discourse, based on scientific reasoning, is advocated and supported by domestic technocrats and many leading international agencies. In their view, free-power policies have promoted the overuse of groundwater as well as creating immense financial troubles for Indian states.

Economists claim that prices for irrigation water are absurdly low compared with its scarcity value, and at such prices there is no incentive to conserve water. While the cost of water has been kept low in case of direct supply to surface-irrigated areas, the cost of electricity, the primary input for groundwater extraction, has been subsidised to keep the cost of water at par with what is paid in groundwater-dependent areas. Maintenance of these subsidies has haunted the budgets of state governments in India. Given that state finances themselves are in the doldrums, these subsidies have attracted a lot of attention recently. The electricity subsidies provided for irrigation, usually to privately owned operations, constitute the subject of this paper.

In this Section, we analyse the technocratic-neoliberal discourse that underpins such views and the solutions it suggests. We try to evaluate the extent to which it is legitimate. Is free-power policy an economic disaster or rather an unavoidable social need? Can rationalising electricity prices help in addressing the perceived adverse impacts of free power?

This Section is organised as follows. The first part demystifies the concept of "free power" by briefly reviewing the electricity subsidies provided to agriculture, discussing their emergence and measurement. Next, we analyse the economic impact of free-power policy and how it affects the farmers, utilities and state finances. The solutions proposed under what has become the mainstream technocratic approach are discussed. The key recommendation is to "get the price right". To analyse the outcomes and effectiveness of this solution, sub-section 3.4 gathers insights from West Bengal where a reform for electricity pricing has been carried out. The conclusion discusses the limitations of this approach and provides concluding thoughts.

## 2.1 Demystifying free-power policy: the technocratic discourse on subsidies as politics

Although the organisational inefficiency of utilities has contributed significantly to their financial disarray, the chief factor usually cited relates to the pricing of electricity for the agricultural sector and the burden that the growing share of agricultural consumption entails.[22] Until the implementation of the 2003 Electricity Act, the pricing policy was the responsibility of the respective utilities or the erstwhile State Electricity Boards (SEBs). With the implementation of the 2003 Act and the establishment of State Electricity Regulatory Commissions (SERCs), the responsibility for

[22] In 1950, the agricultural sector consumed a meagre 3.9%. The share of agricultural consumption of electricity has increased almost continuously, reaching 23% in recent years.

tariff-setting has shifted to these commissions. The method followed currently by the SERCs for pricing electricity supply is the traditional cost-plus method. However, none of them have developed a method to account for the cost of electricity to agriculture.

Even at the aggregate level, the costs that the tariff-setting agencies consider are average costs, whereas economic theory suggests linking the electricity tariff to the long-term marginal cost. Moreover, even if the average-cost method is acceptable, there is no rational basis for the way costs are allocated to the various consumer categories. Power supply along low-tension lines to agricultural and domestic consumers works out to be the most expensive, while the cost of electricity supplied to industrial consumers *via* high-tension lines is much lower. However, in contrast to international practice[23] and the standard economics of distribution costs, industrial consumers in India pay the highest tariffs, followed by commercial consumers. The lowest tariffs are paid by agricultural consumers, with domestic consumers (households) paying the second-lowest rates.

The tarriff structure for electricity supplied to agriculture is standarized neither in method nor in magnitude – and as explained earlier, “free power” usually means highly subsidised tariffs. This is because the autonomous state-level institutions (formerly the SEBs and now the SERCs) have a certain degree of freedom in designing the tariff structure. Indian states have followed three different methods for pricing the agricultural electricity supply. First is “metered tariff” which means a charge per unit of energy consumed. This may be a constant rate or may vary with different blocks or slabs of electricity consumption. Second, “fixed tariff” is a rate based on the capacity of the irrigation pump, *i.e.* its horsepower. It may be a flat rate for each capacity range or it could be a flat rate for each installation. Finally, the “two-part tariff” is in some sense a hybrid of the fixed and metered rates, where there is an energy charge and then a fixed charge linked to the capacity of the pumpset.

Some states have consistently used a single method for levying tariffs, be it fixed, metered or two-part. Other states have tried different methods at different points in time. However, most of the states have chosen a flat-rate tariff system, particularly when they have started subsidising the agricultural electricity supply. The flat-rate tariff system means there is no measurement of the electricity supplied and no meters, which has resulted in a lack of reliable estimates regarding agricultural electricity consumption. Besides the monthly tariff, there is also a one-time fixed charge, generally called a “connection charge”, that farmers pay when getting their pumps electrified for the first time.

It is interesting to look at the motivating factors for each state in choosing a particular tariff structure. In the past, it has often been a process of trial and error often guided by other than economic reasons. This has been true not only in the choice of method but also in the level of tariffs. In particular, the setting of electricity tariffs has been, more often than not, at the discretion of the state governments and politicians rather than the SEBs or SERCs. The politicians have manoeuvred to keep agricultural electricity prices artificially low in order to gain political support from the agricultural community.[24]

In the absence of actual data, there are varying estimates for the level of electricity subsidies to farmers. Two important estimates are based on either financial subsidies or economic subsidies. Financial subsidies indicate the difference between total revenues generated from the sale of electricity to agriculture and the total financial cost of providing electricity to this sector. Economic subsidies, on the other hand, indicate the difference between total revenues and the economic cost of the electricity supplied. Though financial subsidies can help determine the actual monetary value of electricity subsidies to the agriculture sector, this approach is difficult to apply in the absence of a reliable method for calculating the cost of electricity supplied to agriculture. The most commonly used method

23 Gilbert, Kahn & Newbery (1996), studying the international experiences in the electricity sector, claim that in most countries, the financial burden of investment in electricity is typically carried by smaller consumers, particularly the commercial class. "Most countries recognize an economic need to keep industrial rates relatively close to marginal costs. Politically, it is useful to provide some subsidies to residential customers. This leaves the financial burden with the commercials” (Gilbert *et al.*, 1996: 15).

24 The end of metering and the introduction of flat-rate tariffs were manoeuvres by politicians not only to subsidise the electricity supplied to farmers, but also to cover actual consumption. These manoeuvres have also pleased the influential elite of large farmers, who get maximum benefit from the subsidy policy through higher consumption.

to calculate these subsidies is to subtract the electricity tariffs paid by the agricultural sector from the average cost of supplying electricity to all sectors taken together, and to multiply the difference with the quantity of electricity supposedly supplied to agriculture. According to this method, in 2008-09 the estimated electricity subsidy to agriculture in India (at current prices) was Rs 296,650 million, which represents an increase of more than 80 times over the 1980-81 figure (at current prices) and about a 20-fold increase in terms of constant prices (PFC, 2010). At the state level, indeed, many states spend more on subsidising electricity than on important social sectors like health or education.

This dramatic rise in subsidies represents not only an increase in agricultural electricity consumption but also an increase in the volume of the subsidies. At present, farmers in some areas are paying as little as Rs 0.04 per Kwh (*e.g.* Andhra Pradesh) compared to an average supply cost of Rs 3.40 per Kwh. By contrast, agricultural electricity tariffs until the late-1960s were in line with the cost of supply and were close to the tariffs paid by industry in all the Indian states.

The trend in subsidising agricultural consumption emerged in the late 1960s, immediately after the 1969 mid-term elections, which was a landmark in Indian politics. The hegemony of the Congress Party over India was then challenged by some newly emerging regional parties in some of the states. These parties, with a strong base among farmers, had gained political support with promises of subsidised inputs for agriculture, including electricity for irrigation. When elected to power, these parties kept their promise. Not to be outdone, the ruling Congress Party has used the same tool, *i.e.* subsidised agricultural inputs, to retain its political hold (Swain, 2006). Punjab was the first state to lower agricultural electricity tariffs by introducing a flat-rate system, following the 1969 mid-term elections (Ruet, 2005).

The trend was immediately followed in other northern states like Uttar Pradesh and Haryana, while the southern states started on this course in the late 1970s. The emergence of powerful new farmers' organisations in the 1960s and 1970s[25], as well as associated political formations within the Indian states, were an important contributing factor. Such groups demanded increased support for agricultural inputs, particularly for irrigation and fertiliser. Subsidised agricultural inputs (particularly electricity for the purpose of irrigation) had broad appeal because this seemed to be accomplishing two important political goals: achieving food security while increasing the profits of farmers, who could thereby be organised into large vote banks (Dubash and Rajan, 2001).

It is observed that the decision to subsidise (and further subsidise) electricity prices for agricultural consumption was always taken by politically unsecure governments or parties in order to gain political support and come into power or to retain power. For example, the Andhra Pradesh government started a flat-rate tariff system on 1st November 1982 as an electoral strategy. The incumbent Congress Party, envisioning a challenge from the newly created Telgu Desam Party (TDP), offered a subsidised flat-rate tariff for agricultural consumption on the basis of pumpset capacity, in order to create a political base among the peasantry, a vote bank of farmers. Although the Congress Party lost the election, the TDP, once in power, did not want to displease the farmers. In 2004, the Congress Party again used the same tool to come to power, *i.e.* promising free electricity to farmers, and it has kept its promise for the last seven years. Although the regional parties have always promised subsidised electricity supply, in most cases the subsidy policies have been implemented by the nationally based Congress Party. The subsidy policies are often implemented in states where the Congress Party hegemony has been challenged by a regional party with a political base among the peasantry.

While there is enough evidence to say that subsidised electricity supply to farmers via a flat-rate tariff system was a politically motivated policy decision, the utilities often cite technical and economical reasons for flat-rate tariffs. The utilities prefer an unmetered, flat-rate tariff system over a

25 These new farmer organisations were a direct outcome of the Green Revolution, which increased agricultural income in parts of India.

metered subsidised tariff. They claim that in a subsidised pricing system, the metering and monitoring of agricultural consumption has high transaction costs.[26] However, the removal of meters from agricultural electricity connections was "the biggest mistake" within free-power policy. It has not only made it difficult to target intended beneficiaries and to fairly distribute subsidies, but has also made it difficult to address the free-power problem, even though there is some agreement on fixing the problem.[27]

## 2.2 Implications of free power: economic inefficiencies

Agreeing on the political roots of free-power policy and its technical failure to measure subsidies, the technocratic discourse then identifies several economic impacts of the policy on farmers, utilities and state governments. The technocratic discourse claims that subsidising electricity prices for agricultural consumers has resulted in economic inefficiencies in the electricity supply system, while the policy has failed to be effective in achieving its goals. Although several studies acknowledge social and political benefits accrued through the policy, they emphasise the negative economic impacts of the subsidies. In this section, we review the discourses on these "negative impacts".

### 2.2.1. Roots of the power crisis

It is strongly believed that subsidised electricity fosters excessive use of water and electricity (Planning Commission, 2006; Badiani and Jessoe, 2011). With increasing subsidies, the amount of electricity consumption has gone up over the years. Though utilities' inefficiencies, particularly transmission and distribution (T&D) losses, have significantly contributed, agricultural over-consumption is often blamed for the current power crisis in India. It is partly substantiated by the fact that higher agricultural consumption implies higher T&D losses due to extension of distribution lines to rural areas. While the demand-supply gap at the national level hovers around 12%, it is more than 20% in states like Andhra Pradesh and Maharashtra. To fill these gaps and meet peak demand, the utilities have to procure electricity from surplus states at a much higher cost (often at double the price). This has seriously impaired the fiscal status of utilities.

**Table 3: Agricultural and industrial sales (% of total sales) and revenue (Rs/Kwh), 2008-09**

| State | Utility | Sale | | Revenue | |
|---|---|---|---|---|---|
| | | Agricultural | Industrial | Agricultural | Industrial |
| Andhra Pradesh | APCPDCL | 29.00 | 43.29 | 0.10 | 3.15 |
| | APEPDCL | 17.02 | 40.64 | 0.09 | 3.44 |
| | APNPDCL | 51.68 | 15.69 | 0.07 | 3.84 |
| | APSPDCL | 28.98 | 27.40 | 0.04 | 3.83 |
| Gujarat | DGVCL | 6.42 | 66.96 | 1.89 | 5.34 |
| | MGVCL | 15.13 | 42.33 | 2.39 | 5.35 |
| | PGVCL | 34.45 | 40.62 | 1.89 | 5.36 |
| | UGVCL | 55.77 | 27.43 | 1.86 | 5.49 |
| Maharashtra | MSEDCL | 21.90 | 45.62 | 1.94 | 4.78 |
| West Bengal | WBSEDCL | 4.78 | 32.04 | 1.68 | 4.17 |
| All India | | 22.87 | 35.42 | | |

*Source: PFC (2010).*

[26] Interview with an ex-Chairman of Andhra Pradesh SEB, October 21, 2010, Hyderabad.
[27] Interview with a senior energy economist at ASCI, October 22, 2010, Hyderabad.

**Table 4: Agricultural and industrial sales (% of total sales) and revenue (Rs/Kwh), 2008-09**

| State | Agriculture (% of Total Energy Sold) | Agriculture (% of Total Revenue) | Industrial (% of Total Energy Sold) | Agricultural (% of Total Revenue) |
|---|---|---|---|---|
| Andhra Pradesh | 31 | 1 | 35 | 47 |
| Gujarat | 32 | 15 | 43 | 58 |
| Maharashtra | 22 | 11 | 46 | 56 |
| West Bengal | 5 | 2 | 32 | 34 |
| All India | 23 | 6 | 35 | 47 |

*Source: PFC (2010).*

Although the agricultural sector accounts for the consumption of around one-fourth of total electricity in India, the revenue from this sector is very low (See Table 3 & 4). While agricultural consumption at the national level is around 23%, the revenue leverage from this sector is just 6% of the total revenue from all Indian electric utilities. This has resulted in the deteriorating financial status of electricity utilities. To cope with this structural financial deficit, utilities have been cutting down investment in maintenance and the development of distribution systems, which has seriously affected the quality of service for all categories of consumer.

To fill the revenue gap, state governments have been encouraging the utilities to cross-subsidise agricultural consumption with higher prices to be paid by industrial and commercial consumers. The utilities have indeed made all possible efforts to extract the losses made in the agriculture sector from the industrial consumers (See Table 3 & 4). As a result, while the industrial sector consumes 35% of the electricity nationwide, it contributes 47% of the total revenue of the electricity supply industry. More recently, showing their dissatisfaction with increasing cross-subsidisation, many of the industrial consumers are moving towards captive generation technologies and direct purchase from generators[28], leaving the utilities in further financial distress.

### 2.2.2. A drain on state economies

Yet, even after cross-subsidisation from industrial consumers, there still remains a large revenue gap for the utilities (See Table 5). This gap has been filled through state governments' regular subventions, since the state governments are then obligated to pay for subsidising the agriculture sector. The amount of such subsidies consumed by the utilities has been continuously increasing.[29] During the 2008-09 fiscal year, they amounted to Rs 296,650 million against Rs 195,180 million in the previous year (PFC, 2010). This is equal to about 12% of India's gross fiscal deficits for the same year. These subsidies have thus been contributing to a large extent to the gross fiscal deficit of India (Sankar, 2004).

28 The new governance regime, based on the Electricity Act of 2003, allows large industrial consumers to set up their own generation plants, and any surplus generation is guaranteed purchase by the utilities. As an alternative, they can also choose to buy directly from generating facilities through open access to the transmission network. In this case, the consumers have to pay a transmission charge but can avoid excess charges for cross-subsidisation.

29 The Indian agricultural sector is more dependent on input subsidies than that of other large emerging economies. In 2007, India's input subsidies were about 12% of the value of its total agricultural output compared to less that 5% for Brazil, Russia and China.

**Table 5: Agricultural and industrial sales (% of total sales) and revenue (Rs/Kwh), 2008-09**

| State | Utility | Subsidies booked (Rs million) | Subsidies received (Rs million) | % of subsidies booked to revenue (from sales of power) |
|---|---|---|---|---|
| Andhra Pradesh | APCPDCL | 33,720 | 33,720 | 53.32 |
| | APEPDCL | 6,720 | 0 | 25.58 |
| | APNPDCL | 20,400 | 8,430 | 135.39 |
| | APSPDCL | 18,960 | 4,000 | 60.58 |
| Gujarat | DGVCL | 760 | 760 | 3.14 |
| | MGVCL | 4,030 | 4,030 | 8.33 |
| | PGVCL | 5,710 | 5,710 | 16.27 |
| | UGVCL | 3,600 | 3,600 | 16.40 |
| Maharashtra | MSEDCL | 0 | 0 | 0 |
| West Bengal | WBSEDCL | 0 | 0 | 0 |
| All India | | 296,650 | 183,880 | 19.09 |

*Source: PFC (2010).*

Although the state governments have been providing a subvention equivalent to the subsidies booked by utilities, there has been a retreat since mid-1990s. Due to the growing fiscal deficit in state budgets and the ever increasing subsidy amounts, many of the states have reduced the subvention amount, and some states have stopped providing subventions, leaving the utilities in despair. During the year 2008-09, the subsidies provided by the state governments have been about 62% of the subsidies booked by the utilities (See Table 5). This has further damaged utilities' finances and ability to efficiently deliver good quality service.

### 2.2.3. Collateral Damage

Free-power policy not only damages utilities' efficiency and state-government finances, but also has negative impacts for the farmers. The overuse of water, induced by subsidised electricity, has in turn led to soil degradation, soil nutrient imbalance and groundwater depletion, all of which might cause a decrease in agricultural production. In such a situation, the subsidised input policy contributes to further degradation.

On the other hand, financially weak and over-bordered utilities are not in a position to deliver good quality electricity service to agricultural consumers. High subsidies result in a demand that is too heavy for the under-financed utilities to satisfy. If they are to survive financially, they inevitably opt to prioritise delivering better service to high-paying industrial consumers. The farmers have to bear with poor-quality electricity service in the form of inadequate voltage, limited hours of supply and frequent breakdowns, even though they get electricity for free or at a greatly reduced price. Poor-quality power has indirect costs for the farmers. Frequent breakdowns result in the unavailability of water at peak irrigation times when it is most needed. Adding to the indirect cost, poor service requires investment in backup arrangements like diesel pumps. On the other hand, frequent motor burnout due to low voltage results in extra money and time to repair or reinstall motors.

### 2.2.4. Regressive benefits

Like any other price subsidies, agricultural electricity subsidies tend to be "regressive", meaning that they disproportionately benefit larger farmers over smaller farmers (Sant and Dixit, 1996; Howes and Murgai, 2003). The large farmers who consume more of the electricity benefit more from the policy (World Bank, 2001). The rural economy is a place where the large farmers, who gain disproportionately from this policy, form dominant interest groups and exercise control over smaller farmers through patriarchal relations. These large farmers are the winners in the subsidy regime and are framed as the losers from any reform in agricultural electricity pricing. So they have been pushing for the status quo in the agricultural electricity pricing regime. The number of such large farmers who gain from the subsidies varies markedly across states (Birner *et al.*, 2007) and that determines the intensity of the subsidies in the respective states.

## 2.3 Solution: get the price right!

From the discussion above, it is evident that the policy debate is dominated by technocrats' emphasis on those impacts of free-power policy that pertain to economic efficiencies. Economists claim that the absurdly low price of electricity is one of the major reasons for irrigation inefficiency and the inefficiency of electricity utilities. Given this backdrop, the policy debate in India has been largely concerned with which technocratic solutions work best (Birner *et al.*, 2007).

The most recommended solution, which has gained support in domestic policy debate as well as from the international community, is to "get the price right". Indian and international technocrats often refer to the low price of electricity as the root cause of all problems. Therefore, they claim that getting the price right, *i.e.* to reflect the supply cost based on consumption, will address all the problems around free-power policy. First, raising the price is expected to rationalise electricity and water consumption, improve irrigation efficiency and promote conservation by farmers. Efficient use of water and electricity in irrigation is required given the changing climate.

Second, charging the farmers based on their consumption and the cost of delivery would improve the fiscal status of electricity utilities. Financially stable electric utilities are expected to supply better-quality electricity, which would relieve farmers from the indirect expenses incurred to cope with poor-quality service. Third, financially stable utilities would no longer be a burden on the state economy. The vast amount of money transferred to utilities to sustain subsidies could be invested in other development sectors. Finally, when farmers rationalise electricity consumption there should be a significant reduction in the load from the agriculture sector, which in turn will help the country move past the current power shortage.

Based on these assumptions, since the introduction of economic liberalisation in the early 1990s, international development agencies have been pushing for the metering of agricultural electricity connections and an increase in agricultural electricity prices. The World Bank and ADB have made increases in tariffs, coupled with universal metering, a pre-condition for financing power-sector reforms. There were some efforts made to reform agricultural electricity supply during the 1990s, in line with the liberalisation of the Indian economy. In 1991, a high-level committee of six chief ministers, along with the finance and power supply ministers, recommended that the government adopt a minimum agricultural tariff. In 1996, a conference of chief ministers agreed to set a minimum tariff of Rs 0.50 per Kwh and increase it within three years to 50% of the average cost of supply (Dubash and Rajan, 2001). After one and half decades, none of the states have implemented this policy, even though it has been reiterated time and again. Rather than implementing the above guidelines, an increasing number of states have decided to supply electricity free of charge.

Empirical studies conducted on agricultural water and electricity consumption claim that an increase in the electricity tariff could result in efficiency improvements in irrigated agriculture (Moench and Kumar, 1994; Kumar and Singh, 2001). Moench (1995) argues that electricity prices can be used as a tool for managing groundwater resources. Though the study does not propose full-cost recovery *via* agricultural electricity prices, it finds that subsidised consumption-based charges could be effective. Kumar (2005) points out the positive impact of electricity price shifts (*i.e.* the induced marginal cost of electricity on the physical efficiency of water use) on water and energy productivity in agriculture. Kumar (2009*b*) claims that introducing marginal-cost pricing for water and electricity promotes not only efficient use of water, as manifested by higher farm-level water productivity, but also more sustainable use of water.

A study conducted by the World Bank claims that improving the quality of electricity services to agriculture, and therefore improving farmers' income and agricultural growth, requires reforming the pricing structure. Measuring agricultural consumption by installing meters and charging farmers the marginal cost of electricity supplied, based on their consumption, can create a win-win situation for the farmers, utilities and state governments. Drawing on two empirical cases studies, in Andhra Pradesh and Haryana, it finds that farmers are willing to pay for better-quality electricity service (World Bank, 2001).

However, the "getting the price right" solution does not have enough empirical validity. It is not clear to what extent this solution can address the problems inherent in a free-power policy. Recently, some of the Indian states have started to slowly implement this solution; states like West Bengal and Uttarakhand have started metering the agricultural electricity supply. The following section aims to analyse the outcomes of this approach based on the experience in West Bengal.

## 2.4 Insights from West Bengal

As part of electricity reform, West Bengal has implemented technocratic solutions by metering agricultural connections in a high-tech way and charging a time-of-day tariff. In this section, we aim to analyse the implications of these reforms for agricultural electricity pricing. How does this affect the farmers, utilities and the state finances? Who are the winners and losers? How are they coping with the situation? To find answers to these questions, we need to understand the local context in West Bengal, under which these reforms were implemented.

West Bengal is one of the few power-surplus states in India. With slightly more than one million agricultural consumers, the agricultural electricity load of the state is relatively small. Agricultural consumers comprise only about 2% of the total consumers in the state. Together they accounted for less than 5% of total electricity consumption and contributed a little more than 2% of the total electricity revenue in 2008-09 (PFC, 2010). Such low demand for electricity by the agriculture sector is partly explained by the fact that West Bengal has a favourable agro-climatic condition. The state has annual rainfall of around 200 cm[30] and groundwater potential of 31 billion cubic meters, most of which is available at a shallow depth. While the groundwater-irrigated area of the state is 59% of the net irrigated area, only 42% of the total available groundwater resources in the state have been utilised (Mukherji, 2006).

Though West Bengal has plentiful groundwater resources that can be further developed, the state has adopted some of the most stringent groundwater regulations in India. Procuring electricity connections for tubewells requires permission from multiple agencies, including the State Water Investigation Directorate and local government institutions (the Panchayats). The process of getting these permissions is fraught with red tape and corruption, making it more difficult. On the other hand, the farmers of West Bengal were being charged the highest flat-rate tariff (Rs 2160/horse power/year) among all Indian states, until metering was started in 2007 (Mukherji *et al.*, 2010).

While other states have been unable to do so, for various political reasons West Bengal has implemented the most stringent groundwater regulations in India (Mukherji, 2006). Does that imply West Bengal has a more favourable political environment for groundwater regulation? The answer is related to the strength of the local farmer lobbies. Those states with an overwhelming dependence on groundwater also have formidable farmer lobbies. For instance, agricultural electricity pricing has been a central election issue in states like Andhra Pradesh, Maharashtra, Gujarat, Punjab and Haryana, where organised farmer lobbies oppose metering and tariff hikes. On the contrary, farmer lobbies are almost absent in the eastern states such as West Bengal, Orissa and Bihar. Though these eastern states have a history of agrarian movements, a struggle of the "have-nots" against the "haves", the new agrarian movement has taken a different form and location.

The new agrarian movement, emerging after the success of the Green Revolution, took place in the states affected by the Green Revolution and was led by a new class of

30 It is almost double the amount of rainfall received in Andhra Pradesh, Maharashtra and Gujarat.

farmer, the "bullock capitalists" (as defined by Rudolph and Rudolph, 1987); it closely followed the Green Revolution and the subsequent tubewell revolution. As a consequence, states with strong farmer lobbies are also states that make the most use of groundwater and agricultural electricity, while farmer lobbies are not developed in the states where groundwater use is more recent.

Another reason for the presence of strong farmer lobbies in some states is the presence of medium-sized and large land-holding farmers. While they are only 2.1% of total farmers in West Bengal, they constitute over 20% of all farmers in states like Andhra Pradesh, Maharashtra and Gujarat (Mukherji, 2006). Finally, the political ideology of the party in power is also an important factor in the shaping of farmer lobbies. The Communist Party of India (Marxist), which ruled this state from 1978 until 2011, has drawn very few leaders from the farming community and is still dominated by the urban and educated intelligentsia (Rudd, 2003). Moreover, West Bengal has only one peasant organisation called the "Krishak Sabha" (the farmers' union), which has been co-opted by the ruling party and as such rendered ineffective in voicing the concerns of the various classes of farmers (Mukherji, 2006). All these political factors have contributed to a weak farmers' lobby in West Bengal, and consequently, the successful implementation of strong groundwater regulations.

Strong groundwater regulations and high electricity tariffs have together contributed to the emergence of a peculiar groundwater market in West Bengal. According to an NSSO survey, of the 6.1 million farming households in West Bengal, only 1.1 million reported owning pumpsets, even though 4.6 million farming households reported using irrigation. Of these, 3.1 million households (a little more than 50% of all farming households) reported purchasing water from other farmers (Mukherji, 2007).

While strong groundwater regulations make it difficult to own pumpsets, a high flat-rate electricity tariff has resulted in pro-active water-selling by the pump owners. In this situation, the pump owners sell a large volume of their pumped water to get a higher return on their investment. There is competition among the pump owners to serve the larger areas, which has resulted in reduced prices for the water buyers. The motivation on the part of the pump owners, to recover electricity costs by selling water, means that water buyers (mostly small and marginal farmers) have sufficient bargaining power in dealing with the water sellers (Mukherji, 2007). This has created a developed water market with positive impacts in West Bengal, where the small and marginal farmers benefit from reduced water prices and get the real benefit of subsidised electricity, although indirectly, through the large, pump-owning farmers.[31]

Though agricultural electricity subsidies are an insignificant part of the state budget and a negligible share of the state fiscal deficit in West Bengal (Briscoe, 2005), and they are well-covered through cross-subsidisation from industrial consumers, the utilities often blame the subsidies for their deteriorating fiscal status.[32] In response, the state has taken action to reform agricultural electricity pricing with a two-part measure. First, the West Bengal State Electricity Distribution Company Limited has installed hi-tech, GSM cellular-based meters for agricultural connections, which operate on the time-of-day (ToD) principle. These new meters solve many of the traditional problems with metering by allowing for remote reading (from a distance of 100 feet or more) and directly sending the readings to the regional and central commercial office in real time. These meters are also tamper resistant; any attempt to tamper with the meter is reported instantly to the central distribution office. Second, the state has started charging the farmers a ToD tariff based[33] on their actual metered consumption and marginal cost of supply. ToD is a demand-management tool for differentiating the cost of electricity based on the time of day, so that consumers are discouraged from using electricity at certain times; consumers are discouraged from using pumps during peak evening hours, while they are encouraged to use them during the slack night hours (Mukherji *et al.*, 2009). The

[31] It must be noted that this type of a market for groundwater has been made possible in West Bengal because of the local political and ecological context, which significantly varies from that of other states.

[32] As pointed out by the various staff of the utility and electricity regulatory commission in interviews conducted during November 2010 in Kolkata.

[33] The ToD tariff has three different time slots with different prices. First, a normal tariff is applied from 06:00 to 17:00 hours at the rate of Rs 1.37/kWh; second, a peak tariff is applied between 17:00 and 23:00 hours at the rate of Rs 4.75/kWh; third, an off-peak tariff is applied during the night (23:00 to 06:00 hours) at the rate of Rs 0.75/kWh.

objective of these reforms is to rationalise agricultural electricity consumption, reduce agricultural electricity subsidies, and phase out cross-subsidisation by industrial consumers.[34] Influenced by neoliberal policies and World Bank-led reforms, these measures were geared to improve the economic efficiency of utilities rather than conserving energy and water for climate mitigation, though they might contribute positively to that cause.

The reforms in agricultural-electricity supply have changed the incentive structure within West Bengal's groundwater market. As the pump owners now have to pay only for as much as they consume, they are no longer under the same compulsion to sell water. As a consequence, the pump owners have increased their water prices by 30% to 50% since the implementation of reforms, even though they are paying a lower electricity bill under the current metered tariff. This type of "technocratic reform" has helped the wealthier farmers in two ways. First, metering has reduced their electricity bill. Second, they are now able to charge higher water prices than before and thus increase their profit margins on selling water (Mukherji *et al.*, 2009; Mukherji *et al.*, 2010).

The reforms have transferred bargaining power from the water buyers to the water sellers. As a consequence, the water buyers lost out not only by having to pay higher prices than before, but also because they face adverse terms and conditions for buying water, such as advance payment and unavailability of water at the desired time. In the short run, the utility has also lost out through reduced revenue. But it has gained from reduced losses due to theft and reduced peak load (Mukherji *et al.*, 2009). In the long run, the reforms might have a significant impact on the groundwater market. Since the actual cost of electricity to the farmer has gone down, there might be an increase in the number of pump owners. Although the reforms have had some positive impact on the economic efficiency of utilities, they have seriously affected the level of equity in access to water – particularly for the poorer farmers – and they have not created any positive incentive for water conservation.

## 2.5 Conclusion

As explained in this Section, a technocratic discourse has emerged that sees free-power policy as the root of economic inefficiencies in electricity utilities, agricultural practices and the state economy. This discourse has identified several economic impacts of the policy for farmers, utilities and state governments. As a solution, it recommends reforming the agricultural electricity pricing structure. Such reforms not only have supporters at the domestic policy level but also in the large multilateral agencies. The latter have pushed these reforms through various developmental loans and aid programmes. However, implementing these reforms requires a favourable political environment, which is absent in most of the Green Revolution-affected states in India. States like West Bengal, which have a favourable political environment, have successfully implemented these reforms.

Insights from West Bengal suggest that the impacts of these reforms are not always encouraging. Although pricing electricity based on actual consumption and the cost of supply might improve the economic efficiency of the electric utilities, it might also produce negative social and political impacts. It might create a situation where equal access to water for irrigation is challenged, particularly for the small and marginal farmers, who are dependent on the informal groundwater market and are incapable of owning pumpsets due to the small size of their land holdings and the high initial investment. Because the informal groundwater markets do not have institutions for governance, the poorer farmers often lose bargaining power to the wealthier farmers. Moreover, there is no reason to believe that these solutions would improve electricity and water-use efficiency in the agricultural sector.

In this context, it is critical to better understand the socio-political rationales for free power. To what extent is free power a social and political necessity for sustaining agricultural development in India? Why are the farmers opposing reforms in free-power policy? Do farmers actually benefit from free power? Why are most of the state governments unable to implement the technocratic solutions? The following section is an attempt to answer these questions.

34 Interview with a member of the West Bengal Electricity Regulatory Commission, 17th November 2010, Kolkata.

# 3. Accepting “free power” as a constraint: a socio-political analysis

In the previous sections, we analysed free-power policy from an environmental and economic perspective. Both lead to a consensus that free-power policy is a problem that Indian states must fix in order to meet current environmental and developmental priorities. Subsidised agricultural electricity prices, as is often claimed, have contributed to environmental degradation by promoting overuse of groundwater and electricity, while contributing to economic inefficiencies among electric utilities and the state economy. Though agricultural electricity subsidies have been seen as a problem for more than two decades, Indian states have barely made a dent in the long-standing and ever expanding practice.

What can explain then the rising electricity subsidies for agricultural consumption? While there seems to be a strong rationale against these subsidies, how and why have the state governments continued to support them? Is there real demand for subsidised electricity from the farmers' community? Do farmers really benefit from subsidised electricity pricing? What are the socio-political challenges in getting the electricity subsidy policy fixed?

In this section, we aim to find answers to these questions through a socio-political analysis of free-power policies. We aim to identify the socio-political rationales that underpin the promotion and continuation of subsidies and question their justifiability. Analysing the origin of electricity subsidies, their intensities, beneficiaries and support base, this section concludes that electricity subsidies for farmers are not a “problem” that Indian states can get rid of in the short run, given the Indian social, economic and political context; rather they are a “constraint” that Indian states have to endeavour to work with in the medium term. Doing away with these subsidies, without risking the food security of the country and the livelihood of more than half the population, would require developing not only an entirely new enabling environment and institutional reforms but also an alternative incentive structure.

This Section is organised as follows. First, we present an analysis of the origin of electricity subsidies in India from a new perspective. To what extent are electricity subsidies merely a demand-driven populist policy or an important tool (or even a solution) for a range of developmental problems such as food security, poverty and livelihood? Section 4.2 analyses the hidden costs associated with electricity subsidies. Do the farmers get the real benefit of electricity subsidies or are these subsidies drained away by associated hidden costs? Section 4.3 tries to identify the winners and losers under the subsidy regime. Are the farmers, the indented beneficiaries, the real beneficiaries of the electricity subsidy policy? Section 4.4 identifies the support base for electricity subsidies and analyses the socio-political objections to reform. Section 4.5 then offers concluding thoughts and challenges on framing free-power policy as a “problem”. Rather, it proposes that free power be identified as a socio-political constraint to work with in pursuance of various environmental and developmental priorities.

## 3.1 It’s the water that matters: so why free power?

Subsidised agricultural electricity pricing has frequently been framed by many academics, policy makers and international agencies as a populist policy pursued by the state governments or political parties to gain the political support of peasantry community. It is argued that, after the Green Revolution, there was an organised farmers lobby for subsidised agricultural inputs, including subsidised electricity for irrigation. These demands were often supported by, and responded to, by the newly emerging regional political parties with a support base among the peasantry (Dubash and Rajan, 2001; Gulati and Narayanan, 2003; Birner *et al.*, 2007). With the emergence of these regional parties and their political success, agricultural subsidies have grown over time (Badiani and Jessoe, 2011).

However, this account of the origins of subsidised electricity pricing is narrow in its explanation. It is definitely true that there was a political agenda, and that free power has been used as a political tool over time. But there was an equally important developmental agenda in the origins of the policy. Electricity is not a direct input for agriculture; it is an input for irrigation based on groundwater extraction when direct water supply is not feasible or has failed. It is water that matters for agriculture. Why is there then a perceived demand for subsidised electricity, and not water, in agriculture? Did the farmers really demand subsidised electricity? At present, there is criticism of, and opposition to, subsidised agricultural electricity pricing from domestic as well as international interest groups. Why did this criticism and opposition not surface when the subsidies were first introduced? To understand the origins of it all, we need to look at the political economy of post-independence India and how it shaped agricultural policies.

During the mid-1960s, India’s economic condition was the worst it had been during the entire post-independence period; per capita income was at its lowest, major industries were severely hit by recession, and unemployment was mounting. At the same time, India was faced with a severe food shortage due to an ever-increasing population and several natural calamities that affected agricultural yields. As a result, the government was forced to import food grains from the United States at a heavy political cost. Moreover, there was uncertainty about the ability of the food-surplus countries to continue catering to the needs of the food-deficient countries (Dasgupta, 1977). After the drought of 1965-66, the food scarcity in India turned into horror: the Paddock brothers predicted that by 1975 there would be widespread famine in different parts of the world, including India, and that the United States (the only food-surplus country back then) would not be able to sustain India as it would adopt a policy of discriminating in favour of only those countries that could be saved (Paddock and Paddock, 1967).

In response to the situation, the Government of India rolled out a new deal for agricultural development to improve the food security of the country. Though food self-sufficiency was the primary concern, the new agricultural policy was expected to contribute to the economic development of the country through increased employment, income and livelihood security. The new deal, named the Green Revolution, involved the continued expansion of farming areas and multi-crop production on existing farmland through new technologies. A large amount of land was brought under cultivation. Hybrid seeds were introduced. Natural and organic fertilisers were replaced by chemical fertilisers, and locally made pesticides were replaced by chemical pesticides. The result was positive; by 1975, India had become self-sufficient in food production counter to the Paddock brothers’ prediction.

This radical agricultural programme received widespread support from all kinds of interest groups. The programme was well-received by political parties and state governments as it offered multiple benefits like food security, livelihood security, poverty eradication, increased GDP, and increased employment. The elite farmers with control over the farming community, who had been annoyed with the food procurement policy of the government, were happy with the new agricultural policy, which offered them higher income while reinstating their power relations with the smaller farmers[35] (Dasgupta, 1977). The industrial elites of India were supportive of the Green Revolution in anticipation of multiple benefits from the new programme. The programme was expected to provide a regular and cheap supply of food to their workers and to divert the precious foreign exchange formerly used to purchase food imports to the import of materials for industrial development. At the same time, the new agricultural strategy created new demand for manufactured products like fertilisers, pesticides and farm machinery, which was compatible with industrial development and its promotion. The new policy was also compatible with the interests of a large portion of the multinational firms that specialised in producing petrochemicals and farm machinery (Dasgupta, 1977). Moreover, international development organisations like the Ford Foundation, World Bank and USAID, which had been pushing for the modernisation of agriculture through the use of chemical fertilisers and high-yielding seeds (Shiva, 1991), supported the new agricultural policy and provided funding for its implementation. The new agricultural policy had effectively brought about a convergence of interests of the various power groups, including the rural elites, domestic industrial elites, multinational industries, international development agencies and domestic governments.

The Green Revolution, which popularised high-yielding seeds, was highly dependent on two additional inputs, *viz.* fertiliser and water. In the absence of these inputs, the high-yielding seeds, even with the new technologies, do not perform better than the indigenous seeds. Both these inputs are inter-dependent. Higher use of chemical fertilisers increases the nitrogen uptake of plants and upsets their carbon/nitrogen balance, causing metabolic problems to which the plants react by taking in extra water (Shiva, 1991). As FAO (2002: 69-70) notes: "Fertilizer use correlates positively with tubewell ownership and with the adequacy of irrigation supplies, and the marginal productivity of fertilizer is higher where households have access to adequate irrigation supplies. Fertilizer use also correlates with tubewell installation, as a reliable source of water enhances the productivity of land and fertilizer." The new agricultural programme, which was highly dependent on additional inputs, required long-term state subsidies and planning (Harriss-White and Janakarajan, 1997). Subsequently, the states responded with subsidised inputs, particularly fertiliser and electricity subsidies, which constitute a major part of the agricultural subsidies.

The Green Revolution was introduced in selected parts of India that had favourable conditions for the new technology and hybrid seeds. Based on its initial success, farmers in other parts of India wanted to use the high-yielding seeds and new agricultural technologies to increase their income. They also demanded the additional inputs required to use these seeds. But the initial demand was primarily for chemical fertilisers and access to water for irrigation.[36] As a senior agriculturalist suggested during an interview, "the farmers' demand during the late 1960s and early 1970s was access to surface irrigation through canals. The governments constructed several dams and reservoirs and extended canals. But it is almost impossible to connect canals to all the farmlands in a vast country like India."[37] When the state was unable to supply surface water to all the farmers, it promoted use of groundwater. "Farmers were encouraged to draw groundwater through electric pumps. Until then, electric pumps were not so much used in agriculture. Why would farmers demand electricity for irrigation, which requires a high initial investment [for pump installation], while the alternative [surface irrigation] does not require any investment? The state and politicians have endorsed electricity driven pumps to cover up their inability to effectively extend surface irrigation."[38] Another farmers' leader claims that "water is [still] the main concern of farmers, not electricity. Access to water was the concern then, and now it is the declining availability of water."[39]

35 The benefits provided under the Green Revolution were often mediated through the rural elites (the large farmers) who sustained their control over the peasantry and rural society. Even in the case of electricity subsidies, as we discuss later in this section, the benefits were delivered to a large number of small and marginal farmers through a small group of pump-owning large farmers.

36 Agriculture in most of India was dependent on monsoon water back then. Use of high-yielding seeds and multi-cropping required a stable water supply from alternative sources. So, water became the major resource demanded by farmers. However, fertiliser subsidies were provided by the national government and already available at national level to all farmers.

37 Interview with a senior agriculturalist, October 19, 2010, Hyderabad. This has been substantiated by other farm leaders in the three states studied.

38 Interview with a senior agriculturalist, October 19, 2010, Hyderabad.

39 Interview with a farmers' leader, November 20, 2010, Solapur.

Until that period, agricultural electricity consumers were paying a tariff close to the average cost of supply and based on actual consumption (Swain, 2006). As farm-level electricity consumption went up, owing to higher consumption of water, the electricity bills of farmers became huge, eating up a sizeable part of their agricultural income. On the other hand, the farmers who had access to surface water were getting it at a subsidised price, which was a small fraction of the electricity bills their groundwater-dependent counterparts paid. Yet, both categories of farmer got the same market price for their produce. In that sense, the groundwater-dependent farmers were at a disadvantage. Consequently, in some parts of India, demand emerged for subsidised electricity used to extract groundwater.

At the same time, the net barter terms of trade for agriculture declined during the 1970s, as the prices paid by the farmers for inputs increased faster than the prices received for their produce. Therefore, there was emerging demand for subsidies as compensation (Tyagi, 1987). In the prevailing political situation, subsidised electricity turned out to be an effective political tool for creating “vote banks” (Dubash and Rajan, 2001; Swain, 2006). As discussed earlier, the political parties have utilised this opportunity to the fullest possible extent, increasing the electricity subsidies in state after state.

These electricity subsidies had neither an economic basis nor any economic rationale. But they were justified on the grounds of equal access to water for irrigation, since electricity was the medium for accessing water, thus addressing rural poverty and other anticipated developmental benefits from agricultural growth. Though these subsidy policies were designed and implemented at the state level, there was passive support from the national government[40] since they facilitated the national goals of food security, poverty alleviation and political stability – not to mention that these subsidies were favourable for the rural elite and received their strong support. Even though the industrial sector currently opposes subsidised electricity for agriculture, it did not raise any opposition at the time as it could discern some indirect benefit from the policy (as discussed above) and did not then have to incur any new direct costs as a result.[41] On the other hand, the donor community was not at all sceptical as the Green Revolution had produced positive economic outcomes at the initial phase, and all the loans taken out to support the Green Revolution were being paid on time. For a long while, the burden of these subsidies was borne by the respective state governments, but this produced a higher return in the form of continued political support from the peasantry.

As we can see, at the outset subsidised agricultural electricity surely did not emerge as a “problem”. Rather, it was introduced as part of a solutions package for larger developmental problems like food scarcity and rural poverty. To a certain extent, agricultural electricity subsidies can be framed as an extension of the national policy for the provision of subsidised agricultural inputs, though designed and implemented at the state level.[42] Until these subsidies were over-politicised, resulting in negative impacts, there was some support for these policies from different types of interests.

40 It is observed that, in many cases agricultural electricity subsidies were introduced by state governments that were run by the Congress Party (for example in Punjab, Uttar Pradesh, Gujarat, Maharashtra, and Andhra Pradesh, and in Tamil Nadu by AIADMK, an ally of the Congress Party), particularly when the incumbents faced political competition from newly emerging regional parties (Swain, 2006). During that period, the national government was also run by the Congress Party. If the national government had been opposed to the subsidy policies, drawing on Article 254 of the Indian Constitution and the hierarchy within the political party, it could well have impeded implementation of the subsidy policies.

41 Subsidised electricity pricing, at its initial stage, was possible through state governments' subvention to the erstwhile SEBs. As the quantity of electricity subsidies increased over the years, the state governments, in order to reduce the fiscal burden on them, promoted cross-subsidisation by industrial and commercial consumers (Swain, 2006). This has resulted in an increasing direct cost on industry to subsidise agricultural electricity consumption.

42 The Indian Constitution exclusively authorises the state governments to make policies regarding irrigation and water supply. At the same time, enlisting electricity among the concurrent legislative powers has allowed the state governments to make policy decisions regarding the electricity supply. These two constitutional provisions have made it possible to subsidise the agricultural electricity supply in order to subsidise irrigation. The constitutional provisions also ensure that any form of irrigation and electricity subsidy is to be designed and implemented by the state governments.

## 3.2 Underestimated hidden costs: how "free" is free power?

By free power, in this paper we mean the un-metered supply of electricity at a subsidised flat rate, or completely free of charge. In that sense, it is assumed that farmers either do not pay anything or pay a small fraction of the cost of the electricity they consume. To what extent is this true in practice, however? Is there any hidden cost associated with subsidised electricity pricing? If so, how big are these costs? How does this affect farmers' income? Just as "there is no such thing as a free lunch", we argue there is no such thing as free power. The costs of free power, initially borne by the state governments, are now largely transferred to the electricity consumers, including the farmers. Most of these costs to farmers are indirect, hidden by nature and often underestimated. In this section, our focus is on the hidden costs of free power to the farmers, and how these affect their income. Yet, it is practically impossible to estimate the exact size of the costs. We merely aim here to identify their sources and how they affect farm income.

First, there is no doubt that electric utilities get the least amount of revenue from agricultural consumers, owing to the subsidised pricing. That has obviously influenced their attitude and service to agricultural consumers. The result is poor quality of service, defined by supply that is limited, low voltage, off-peak and unreliable. Though the utilities have formally agreed to supply electricity for seven to 12 hours a day, in practice the supply is for far fewer hours[43] and always during off-peak (late night) when the demand from other sectors is low. Second, agricultural load is always concentrated due to the limited hours of supply, resulting in low voltage at the tail-end pumpsets. Third, agricultural electricity supply is, in practice, directly linked to the demand from other sectors. Agricultural consumers are supplied only when the load from the other sectors is low, and they are disconnected when the load at the other end increases, resulting in unreliable supply.[44]

Fourth, within the limited hours of supply, electricity supply failure is frequent due to overload on the distribution transformer and the poor quality of the distribution network. As a farmer claimed, "low voltage and supply failure are perpetual problems."[45] Finally, the cost of supplying electricity to farmers may be higher than for other (high-transmission) consumers, but considering the low quality and time limitations, the real cost of supply could be much less. One of the interviewed farmers asserted that "the quality of electricity we receive is hardly worth paying for."[46] Since the farmers are typically supplied at off-peak hours, Sankar (2003) makes a case for excluding the fixed cost in the cost to serve agriculture. At the same time, an interruptible supply, in standard practice should entail a pricing benefit, *i.e.* a further price discount for the farmers. Based on these two factors, Sankar (2003) argues that the real cost to serve farmers is about 50% of the average cost for servicing. Moreover, the cost of metering and billing should be deducted when estimating the true cost to serve farmers, since they are charged on a flat-rate basis (Shah *et al.*, 2004*b*).[47] Therefore, it would be unfair to calculate the cost of the subsidy based on the average cost of supply.

The poor quality of the electricity supply has seriously impaired pump operating efficiency and resulted in financial costs for the farmers. Due to low voltage, tail-end pumpsets often do not work or have low discharge. In such a situation, the farmers are forced to make alternative arrangements for irrigation or endure crop failure due to the unavailability of adequate water. In the first scenario, the farmer makes an additional expenditure for irrigation, while in the second, the farmer loses a significant portion of his income due to crop failure. Low voltage, along with the failure of one of the phases at distribution transfer, is a major cause of motor burnout in pumpsets.

43 The duration of agricultural electricity supply varies across states and across seasons. In Andhra Pradesh and Maharashtra, the duration of supply is between two to four hours, while Gujarat has managed to ensure seven to eight hours of supply under the new arrangement. The duration declines even further during the summer, when farmers need it most, due to higher demand from other consumer segments.

44 Farmers in Andhra Pradesh and Maharashtra have complained that there is no fixed time schedule for electricity supply. But Gujarat has maintained a fixed schedule for agricultural electricity supply, which is preannounced to the farmers.

45 Interview with a farmer, Maharashtra, November 18, 2010.

46 Interview with a farmer, Andhra Pradesh, October 19, 2010.

47 Interview with a member of IWMI-India, Anand, September 8, 2010.

Anecdotal data collected during fieldwork suggests that the frequency of motor burnout, on average, is once every season for the working pumpsets. In such situations, farmers not only spend money for repairing the motor but also lose substantial man-hours to get the pumpset fixed during peak farming season. While the cost of each repair can be up to Rs 10,000, the cost of lost man-hours can hardly be evaluated. At the same time, overloading of the distribution transformer (due to concentrated demand) and poor maintenance result in distribution transformer burnout at regular intervals.[48] In case of transformer burnouts, the farmers not only bear the cost of arranging alternative irrigation, but also spend money collectively to take the transformer to the utility office for repairs.[49] As it takes a long time for transformer repair or replacement, the farmers incur large expenditures in arranging alternative irrigation. Those who cannot afford alternative irrigation, usually the small and marginal farmers, can lose their whole income due to crop failure.

Apart from these regular costs, there are some occasional costs like bribes and electrical-shock accidents. Getting help from the utility staff for any problem that the farmers cannot solve on their end[50] often requires a bribe, as the utility staffs are not accountable to the farmers as low-paying customers. Such interactions are occasional; interviewed farmers claimed that they interact at least once a year with the utility staffs. Due to a poor distribution network (low hanging wires, lack of grounding soil at the pumpset location, no neutral wire from the transformer, lack of insulation), farmers occasionally suffer electric-shock accidents, adding to their costs. Finally, farmers incur a high, one-time cost when they first install electric pumps[51], which could be anything in the range of Rs 0.1 million to one million rupees depending on the depth of the water table and pump capacity. Technically, the pumps have a good lifespan, but owing to the dropping groundwater table many pumps stop discharging after a few years and some do not start at all.[52]

All these costs together take a major share of farmers' income. Studies claim that given the current quality of supply, the real cost of groundwater irrigation, even with electricity subsidies, is a substantial proportion of farmers' income (World Bank, 2001; Dossani and Ranganathan, 2004). As we found in the three states, the typical (subsidised) electricity bill of farmers is as high as 12% of their agricultural income. But when we consider the above-mentioned hidden costs, irrigation takes up 20% to 25% of their income.[53] [54] All these costs are regressive in nature. The share of irrigation costs is higher in case of the lower-income small and marginal farmers, and it goes down with an increase in land and income. Though subsidised electricity was meant to reduce the cost of irrigation for groundwater-dependent farmers, it seems the policy has failed to keep irrigation costs low owing to increasing hidden costs. As Dubash (Dubash, 2007) rightly claims, adopting the technocratic solution of tariff increases, without upfront quality improvements, will place a real burden on the farmers.

48 Anecdotal information suggests that the frequency of transformer burnout is roughly once every two years. It takes a long time (up to two weeks) to get the transformer repaired and even longer for replacement when the old transformer is not repairable.

49 Repairing distribution transformers is the responsibility of the utility. However, the utilities are increasingly getting away from this responsibility, citing their financial inability as well as the high frequency of burnouts. Consequently, the electricity users (here farmers) are forced to share the cost. Moreover, as most of the farmers interviewed suggested, they find it an ordeal to deal with the utility staff and often have to bribe them for expedited solutions.

50 Farmers prefer to solve the problems at their end through the help of private electricians due to the irresponsive behaviour of the utility staffs.

51 Many farmers are not in a position to afford this high initial investment and often opt for loans at high interest rates. The interest keeps adding to the cost of irrigation. Ironically, in many cases, the pumps fail before the loan is paid, forcing the farmer into another loan. Farmers' inability to repay these loans has become a major challenge in India as it has induced farmer suicides. Andhra Pradesh and Maharashtra are ranked at the top for farmer suicides.

52 Some farmers complained that they could not retrieve water even after boring 200 feet down, while some others complained that pumps do not fetch water after a few years. But they keep these borings and electricity connections active in the anticipation that someday the water table will rise and they can then retrieve water.

53 The aggregate irrigation cost to farmers estimated here does not include repayment (and interest) on loans taken to install pumps.

54 The cost of irrigation presented here is estimated by the authors based on anecdotal information collected from 53 farmers in the three states. As the data source is limited, we do not generalise it or apply it at the national level. Yet, this is an indication of the share of farm income spent on groundwater irrigation.

## 3.3 Winners take all: the beneficiaries of electricity subsidies

One of the most contentious issues surrounding agricultural input subsidies is how much of the public money paid finds its way into the pockets of the farmers, and how much leaks out. Who benefits from agricultural subsidies is an open question; an accurate answer is yet to be found. Economic theory predicts that the entire subsidy incidence should be on the landed farmers or farmland owners. The prevailing perception is that large farmers capture higher benefits from the subsidy policy, the small and marginal farmers gain less, while landless farmers and agricultural labourers get no benefit. On the basis of this assumption, the technocratic discourse argues that agricultural subsidies have failed to target the poorest farmers who get little or no benefit from the huge amount of public money spent on subsidised agricultural inputs, while contributing to serious economic and environmental problems. A major portion of India’s agricultural subsidies is comprised of fertiliser and electricity subsidies.

Drawing on the practice of subsidised agricultural electricity pricing, in this section we aim to identify the winners and losers of India’s agricultural subsidy policy. Do the farmers get all the benefits from subsidised electricity? Does all the public money spent on subsidising agricultural electricity find its way into pockets of the needy farmers, the intended beneficiaries? If not, how and to whom do these subsidies leak out? The answers to these questions will partly explain why these subsidies are being pursued in the face of stark criticism.

There is widespread agreement that agricultural electricity subsidies benefit the large, pump-owning farmers. The small and marginal farmers, who cannot afford to own pumps, as well as the landless farm labourers, do not get any benefit from these subsidies as they do not consume the subsidised electricity.

This view can be challenged, however. Flat-rate-tariff electricity subsidies are certainly iniquitous. But it is not necessarily true that the pump-owning farmers are the only beneficiaries of this policy. First, among the latter, those with access to abundant water who are growing water-intensive cash crops capture most of the subsidies. They pay a much lower tariff (in Rs/kWh) and pay much less in terms of their farm income (Sant and Dixit, 1996). Farmers using deep-bore wells are expected to consume more electricity, and thus pay a lower tariff, than those using open wells. While access to water is an ecological feature, water-intensive production is a farmer’s choice, often undertaken by small and marginal farmers (as well as sharecroppers) for a guaranteed, higher return.[55] Hence, it is hard to pin down the incidence of electricity subsidies on farmers based on farm size.

Second, the inability of a sub-section of farmers to own pumps has resulted in the emergence of informal water markets[56], whereby the small and marginal farmers, as well as sharecroppers, buy water from pump-owning farmers in order to meet their irrigation needs. In these informal water markets, which are regulated through a form of social negotiation and bargaining between buyers and sellers, the price of electricity is a key element in determining what is deemed as a legitimate and acceptable price for water (Dubash, 2002; Mukherji, 2007). As was seen in West Bengal (see Section 3.5), metering of the agricultural electricity supply based on technocratic-neoliberal solutions has resulted in increasing water prices for small and marginal farmers. This implies that subsidised or free electricity to agricultural pump-owners transforms into cheap water for small and marginal farmers, and thus benefits them as well.

[55] A good number of small farmers interviewed confirmed that they prefer to grow water-intensive crops like rice for a minimum support price guaranteed by the government, while some others prefer to grow water-intensive cash crops like sugarcane and cotton for a higher return.

[56] These informal water markets exist in most parts of India. However, the size and norms of these water markets vary across states based on the local social, economic and ecological context. See Dubash (2002) and Mukherji (2007) for a detailed analysis of water markets in Gujarat and West Bengal respectively.

Third, electricity subsidies also have a spillover benefit for the farm labourers, whose income depends on agricultural activity. Cheap irrigation through subsidised electricity results in higher agricultural activity (intense farming and multi-cropping), which requires a larger labour force.[57] Consequently, it provides additional jobs (in terms of days worked) and better wages for the labourers (Shah, 1993). In many cases, it was found that farm labourers are able to demand, and get, higher wages during peak-farming seasons, than the minimum wage set by the government.

Fourth, agricultural electricity subsidies have a direct impact on food prices. Subsidising agricultural inputs is not only a strategy for ensuring food security[58], but also a strategy for controlling food prices. The cost of agricultural inputs is reflected in the market price of food products; a rise in input prices, particularly fertilisers and electricity, leads to an increase in the price of food grains. That is one of the reasons for developed countries to continue agricultural input subsidies, even when most of their agriculture is under corporate control. Considering that more than half of India's food crops are produced with groundwater irrigation (Birner *et al.*, 2011), agricultural electricity pricing has a significant impact on food prices. On that basis, a subsidised electricity supply for agricultural consumers benefits all the citizens (or food consumers) by contributing to low food prices. This way, electricity subsidies benefit the poorest segment of the population, who spend a large share of their budget on basic foods and who are the hardest hit by a rise in food prices.

Fifth, as we discussed earlier, agricultural electricity subsidies have increasingly been used as a political tool over time. Elections are being won and lost on the basis of political parties' commitment to subsidised electricity. Sustained electricity subsidies not only benefit the political parties in terms of getting votes but also ensure political stability and all its impacts.[59] Another set of winners is created from the subsidy policy, even though they are not the intended beneficiaries. While the state governments lose a substantial part of the state budget to agricultural electricity subsidies, which could have been used for other developmental activities, they gain from the increased political stability, and the politicians gain from sustained political support.

Sixth, electricity subsidy policy also has some economic benefits, though it has been criticised for the economic inefficiencies it produces. In a large country like India, more than 60% of the population is still dependent on the agriculture sector for its livelihood. Electricity subsidies, which induce higher agricultural activity in 55% to 60% of India's agricultural land (Shah *et al.*, 2004*a*), contribute to higher employment and enhanced livelihood for a substantial proportion of the Indian population. At the same time, electricity subsidies affect more than half of agricultural production in India and thus contribute significantly to the GDP of the country.

Seventh, the critics have emphasised that agricultural electricity subsidies have damaged the efficiency of electricity utilities. As Dubash (2007) points out, these subsidies are not the only, nor even necessarily the main, cause of the poor finances of electric utilities. Though a more detailed assessment needs to be done, there is emerging agreement on the impact of the high technical and commercial losses on the current fiscal condition of electricity utilities. Yet, the utilities and their staffs have significantly benefited from the subsidy policies. De-metering, under a flat-rate tariff system, has resulted in a culture of unaccountability in the sector, whereby the utilities have been hiding their inefficiencies (theft and line losses) as part of agricultural consumption. It has been pointed out that utilities staff have benefited from collusion in theft and have been successfully hiding this behind agricultural use. At the same time, an un-metered supply to agriculture has reduced administrative burden (no metering or billing) on the part of the electricity utilities. Consequently, they have been defending a de-metered, flat-rate tariff for agricultural supply, while demanding higher payment from the farmers.

57 The availability of irrigation for agriculture also reduces rural to urban migration, which is a major developmental challenge in India.

58 (Moench *et al.*, 2003: 5) claim that reliable water supplies, particularly those from groundwater, are the key input for increasing yields, reducing agricultural risks and stabilising farm incomes. Consequently, they make a strong argument that access to groundwater plays an instrumental role in food security. As we discuss throughout this paper, electricity subsidies are critical for access to groundwater.

59 The political parties in power at the state level, who have continued agricultural electricity subsidies without tampering, have often been re-elected to power. On the other hand, there is evidence that political parties that have tried to reform agricultural electricity subsidies (based on technocratic solutions), have failed to regain power. The failure of TDP in Andhra Pradesh in the 2004 State Assembly elections is a notable example.

Finally, agricultural electricity subsidies have been considered a bane for the industrial sector as the latter has been forced to cross-subsidise part of these subsidies. At the same time, the agricultural electricity subsidies have been a boon for the industrial sector by promoting the growth of certain industries. Availability of cheap water for irrigation made possible by electricity subsidies has created increasing demand for fertilisers and advanced farm equipment to intensify the level of farming. This has boosted the industries that manufacture fertiliser and farm equipment. Although the industrial sector loses out from the cross-subsidisation of agricultural electricity subsidies, part of the sector has substantially benefited (though indirectly) by these subsidies.

In conclusion, farmers are certainly the direct winners from subsidised agricultural electricity pricing, even after accounting for the hidden costs. Yet, contrary to the prevailing perception, we find that all the farmers, not only the largest, benefit from the subsidy policy, although at varying degrees depending on contextual factors such as crop choice, agricultural practice, depth of the water table, as well as the size of the landholding. As the cost of agricultural inputs (including electricity) influences the price of food products, and farmers do not have much control over the price of their produce, a substantial part of the subsidy (drawn from public money) filters back into the pockets of the public (food consumers). The general public also benefits through increased job opportunities within agriculture and allied sectors. At the same time, as a spillover effect, the subsidies create a different sets of winners, even though they are not the intended beneficiaries. In that sense, it would be wrong to say that agricultural electricity subsidies are a misuse of public money.

However, to be more effective and distributive and to reduce the economic and environmental inefficiencies, the electricity subsidies need to be reformed. In the past two decades, governments have taken several initiatives, though half-hearted, to reform the electricity subsidy policy. These reform initiatives have received opposition not only from the farmers but also from the unintended and partial beneficiaries of the subsidies. In the following section, we discuss in detail the socio-political opposition to reform in electricity subsidy policy.

## 3.4 Socio-political objections to reform in agricultural electricity subsidies

As discussed previously, the agricultural electricity supply has been plagued for decades by a set of interrelated problems: the unreliable and poor-quality of supply; subsidies creating a considerable fiscal burden for the states and being unequally distributed among the farmers; and a price structure that provides no incentive to conserve groundwater (World Bank, 2001; Dubash, 2007; Birner *et al.*, 2011). However, reducing these subsidies poses significant social and political challenges. Although in industrialised countries these types of subsidies are defended by small but powerful farm lobbies, in India the policy framework has created multiple interest groups that support the status quo. These interest groups in India are largely the unintended beneficiaries of electricity subsidies (as discussed in the previous section) who have gained from the flawed subsidy regime. In the face of rising criticism of, and a strong rationale against, electricity subsidies, the state governments continue to pursue these policies. What explains this situation? Why have the state governments sustained these subsidies?

There is agreement that the politicisation of the electricity sector and state governments’ intervention in tariff-setting have resulted in increasing the subsidies for agricultural consumers, as well as domestic consumers (households). As part of the structural reforms, independent electricity regulatory commissions were established to rationalise electricity tariffs for all categories of consumer in keeping with economic principles. Yet, there is hardly any progress towards the rationalisation of electricity tariffs. There seems to be demand from the people for the continuation of subsidies and governments’ intervention in tariff-setting.

Analysing the social opposition to electricity reforms in India, Santhakumar (2008) claims that most people who oppose reforms are doing so not because they are ideologically or culturally against it. In support of this opposition are rational reasons and self-interest. Contrary to the popular perception that agricultural consumers form the strongest opposition to reforms, Santhakumar claims that the subsidies for domestic (household) consumption are a far more decisive factor (than agricultural subsidies) in the opposition to electricity reforms. He points out that much of the opposition can be explained in terms of the short-term losses due to reforms. Although the study points out that households with agricultural connections, in anticipation of a tariff hike, are opposed to reforms in the electricity supply system (Santhakumar, 2008), it does not explain why and on what grounds they oppose it. Drawing on our experiences with agricultural consumers, in this section we analyse why and on what grounds farmers oppose tariff reform.

As we have discussed earlier, agricultural electricity subsidies are unequally distributed among farmers; studies confirm that some farmers pay lower tariffs (in Rs/kWh) than others. In an ideal situation, those who pay higher tariffs should not oppose reforms, or at least should not defend subsidies. However, we find there is support and demand for subsides across the peasant community irrespective of the amount of subsidy received. What explains this paradox? First, what matters for farmers is the absolute subsidy they receive, not the relative subsidy (Dubash, 2007). As discussed earlier in this section, though regressive, electricity subsidies benefit all farmers by not only increasing their yields but also by adding to their disposable income. Second, farmers' perception of water and electricity for irrigation has a profound impact on their objections to reform. Because water and electricity subsidies were introduced long ago, the current generation of farmers perceive these subsidies as entitlements. Some of the farmers interviewed asserted that “farming is like worshiping ‘mother earth’”, and to do so “water is a necessity, which is a right entitled to us by nature.” Moreover, they go on to claim that “as the natural flow of water is blocked [in dams] to produce electricity, we have an entitlement to [cheap] hydro-electricity to draw groundwater onto dry land.”[60]

Third, farmers have also been opposed to price reforms on equity grounds. They claim that water as an entitlement should be delivered to them at a modest price equal to that of the surface-water supply. As the government has been spending huge amounts of public money to subsidise surface irrigation, farmers in groundwater-dependent areas demand that the government make a similar investment to subsidise their input, *i.e.* electricity, for groundwater extraction.[61] Finally, it is important to understand the solidarity among farmers due to their shared experience of poor quality of the supply and bad service. Farmers, irrespective of their electricity consumption, share the common experience of a poor quality and unreliable supply, having to irrigate their land in the middle of the night, and dealing with unresponsive and arrogant utility staff.

These social factors, set against the backdrop of strong political relationships based on power and domination in rural India, encourage solidarity among farmers in opposing any reform proposal (Dubash, 2007). The socially based opposition to electricity reform on the part of farmers can be explained by the apprehension of short-term losses, *i.e.* price increases, and lack of confidence in the promised long-term gains, *i.e.* quality improvements. Taking into consideration these important qualifications, in the short run farmers' solidarity is less likely to breakdown in light of available information on the incidence of electricity subsidies. Any attempt to reform and rationalise electricity subsidies, without building farmers' confidence regarding the long-term gains, will not gain support from the farmers. The micro-politics of agricultural electricity subsidies give little hope that cracks will develop in farmers' demand for free or cheap electricity.

At the macro-politics level, political parties have strong incentives to include highly subsidised or free electricity in their election promises, even if they do not endorse this policy otherwise (Birner *et al.*, 2011). Though political

60 Interviews with several farmers in the three states studied.

61 Interview with a farmers' leader, Hyderabad, October 19, 2010.

parties have collectively agreed to reform electricity subsidies on several occasions, they have failed to enforce such an agreement. Moreover, as free-power policy has proved a successful election strategy in one state, parties in other states have simply followed it. Looking back at the recent past bears this observation out. Following the victory of the Congress Party in Andhra Pradesh during mid-2004, which prominently featured the promise of free power in its election campaign, other states fell in line in rapid succession. Within days, the government of neighbouring state Tamil Nadu scrapped its initiative to meter agricultural consumers and raise the agricultural tariff by issuing a statement that it would stop the metering initiative and restore the free power supply. Within a couple of months, and with an eye toward the forthcoming assembly elections, the Maharashtra government announced free electricity for farmers. Shortly afterwards, the Haryana government shifted from progressively increasing tariffs under a slab system to a flat-rate tariff for all farmers, whose pricing was set substantially below the lowest slab of the previous tariff structure (Dubash, 2007).

At the same time, introduction of technocratic, neoliberal reforms (metering and tariff hikes) without targeted subsidies poses the threat of an "agrarian crisis", as indicated by stagnating or declining farm income, increasing income disparity between rural and urban India, a high level of indebtedness, farmer suicides and drought (Birner *et al.*, 2011). Policy makers need to consider this threat of an agrarian crisis while taking initiatives to reform electricity subsidies. Moreover, in a globalised world Indian farmers are exposed to price volatility for agricultural products. Continued agricultural subsidies in the developed world, even though much of the farming in these countries is under corporate control, has resulted in falling prices for agricultural products in the global market.[62]

To compete in this volatile global market, Indian farmers need government subsidies for inputs (including electricity) to keep their cost of farming low. While there is agreement on the need for subsidies to farmers, in recent years there seems to be a shift towards more targeted and direct transfers in the form of cash and vouchers (Narayanan, 2011). These direct-transfer mechanisms come with formidable implementation challenges and their effectiveness is highly context-dependent. These alternative arrangements, with their high transaction costs, require effective implementation by public agencies. In the case of the agricultural electricity supply, the transaction costs include metering and billing for the agricultural connections, which the utilities have not incurred under the current subsidy regime. The utilities' reluctancy to take on these transaction costs (even though their staff sizes are guaranteed not to shrink under the reforms) has proven to be a challenge to the reform of agricultural electricity subsidies in India.

Although some farmers get more benefit from the free-power policy than others, there is solidarity across the peasantry in opposing any reform to this policy. This solidarity is driven by shared experiences and other social factors backed by strong political loyalties. While it is unlikely to breakdown in the short run, particularly in the absence of more directed and targeted transfers to the needy and less-served farmers, the state governments have also shown little, if any, will to reform. That is partly explained by the fact that political parties are one of the partial beneficiaries of the free-power policy as it helps them enjoy the continued political patronage of farmers, in return for subsidies. Moreover, short-term losses and initial transaction costs are key obstacles to reforming the policy, and none of the stakeholders are prepared to bear them.

62 Examples can be drawn from the experience of cotton-growing farmers in India. World cotton prices have witnessed a sharp and steady decline since agriculture opened up for free global trade in the post-WTO era. This is primarily because despite promises to cut subsidies in agriculture, there has been no reduction in the agricultural subsidies in the developed world. The resulting decline in cotton prices has pushed Indian farmers into indebtedness, often leading to farmer suicides. Cutting down on existing Indian subsidies, including electricity subsidies, will certainly aggravate the crisis situation.

## 3.4 Conclusion: problem or constraint?

In the neoliberal technocratic discourse, agricultural electricity subsidies have been framed as a problem that leads to inefficiencies in state finances, the electricity supply system and water use for irrigation. Thus, policy makers have emphasised the need to reform the subsidy policy in order to improve efficiency. However, the suggested fixes have tended to be strictly economic (recovering the cost of supply from farmers through price hikes) and/or technical (installing meters). The technocratic focus of such approaches, without any consideration of the entrenched socio-political nature of the problem, has lead to strong socio-political blockages and unsuccessful implementation.

Agricultural electricity subsidies, as introduced in the course of Indian history, were part of a solutions package for larger developmental problems such as food security and rural poverty. To a certain extent, the policy has been successful in producing the desired results. However, over the years it has been politicised by various interest groups and has turned into a problem as it has lead to economic and environmental inefficiencies. These interest groups, particularly the political parties that gain from a flawed subsidy regime, have defended the electricity subsidies for agricultural consumers. Analysing these interests and the benefits they receive, we conclude that it would be wrong to frame agricultural electricity subsidies as a waste of public money. Rather, they should be looked at as a constraint that governments have to manoeuvre to work with in the short and medium run. Yet, there is certainly a need for reforming the subsidy policy, to better target and manage subsidies so they can produce real gains for the poor and needy farmers and to put less pressure on the environment and economy.

Since the start of structural reforms in the Indian electricity sector, state governments have taken several initiatives to rationalise and reform agricultural electricity subsidies. In the next section, we analyse such initiatives and their outcomes in three different states: Andhra Pradesh, Gujarat and Maharashtra. Based on this analysis, in the concluding section we make a range of suggestions to improve energy and water efficiency while working with the constraint of a subsidised electricity supply to farmers.

# 4. Improving energy efficiency in a free power context: the limited scope and effectiveness of current initiatives

Since the early 1980s, agriculture has been identified as a critical concern for the electricity supply industry in India. Constantly rising electricity consumption in the agricultural sector and declining revenue realisation, owing to subsidised pricing and non-payment, have been two main concerns that have gained public and political attention. By the time neo-liberal reforms were introduced in the Indian electricity sector, it was emphasised that addressing agricultural electricity subsidies would be a prerequisite for the success of larger electricity reforms and efficiency improvements in the electricity supply industry.

In response, the national government and many of the state governments have undertaken several initiatives to reform and rationalise the electricity supply to agricultural consumers. These initiatives were often promoted and supported by international development organisations and multilateral development banks through pilot project demonstrations and project funding. The main objective of these early schemes, as we conclude in this section, has been to improve economic efficiency. The fixes that were introduced have tended to be economic (raising the agricultural electricity tariff) and/or technical (installing meters and/or improving water-pump efficiency). During the past two decades, Indian states have struggled to implement these reforms, largely unsuccessfully. Their failure has often been ascribed to a lack of "political will", while here we point to several other socially motivated objections, developmental concerns and welfare costs that have also likely played a part.

In this Section, we start by framing the debate on energy efficiency in the context of a subsidised agricultural electricity supply. Then, we provide a detailed analysis of current initiatives in the three states studied (Andhra Pradesh, Gujarat and Maharashtra). Part 4.2 discusses Andhra Pradesh and its programme to improve pumping efficiency in the context of free power. Part 4.3 analyses the Gujarat government's efforts to ration the electricity supply to agriculture, with the aim of improving energy efficiency in irrigation, and its outcomes. In part 4.4, we analyse the current programme of replacing existing agricultural pumps with (BEE-rated) energy efficient pumps implemented in parts of Maharashtra, based on BEE guidelines for agricultural demand-side management (Ag DSM). The conclusion (4.5) presents the limited scope and effectiveness of these initiatives, and the implications for other states as well as for future policy making. These findings shape our recommendations for efficiency enhancements in the use of energy and water for irrigation, presented in Section 5.

## 4.1 Energy efficiency in groundwater irrigation: the context

Following the Green Revolution, rising demand for electricity from the agricultural sector was observed, as evidenced in the increasing number of irrigation pumps electrified during that period. At the same time, a stark decline in revenue realisation from agricultural electricity consumers occurred, owing to the increasing subsidies introduced by state governments and non-payment by farmers. By the late 1980s, a consensus emerged that agricultural electricity subsidies were a danger for the electricity supply industry in India, as they impair utilities' economic and operational efficiency. In response, policy debates emphasised the need to improve efficiency in the agricultural electricity supply, an idea that gained support from the international development agencies, if not from India's regional governments.

By the time neo-liberal reforms were introduced in the Indian electricity sector, it was reemphasised that reform in the electricity subsidy policy for agriculture was a prerequisite for the success of electricity restructuring in India. There were several attempts to build political consensus around the need to reform the policy for agricultural electricity subsidies. The national government, realising the political nature of the problem and the need for all states to act in concert, arranged several meetings of the Chief Ministers. In the first two meetings, held on 16th October and 3rd December 1996, the Chief Ministers discussed and arrived at a Common Minimum National Action Plan on Power.

The Action Plan stated that "cross-subsidisation between categories of consumers may be allowed"; however, no sector would "pay less than 50% of the average cost of supply (cost of generation plus transmission and distribution). Tariffs for the agricultural sector were to be no less than 50 paise [less than USD 0.01] per kwh and to be increased to 50% of the average cost in no more than three years" (GoI, 1996). Consequently, as part of the reform strategy, independent Electricity Regulatory Commissions (ERCs) were established to make techno-economic decisions (including tariff-setting and licensing), independently from the political process. However, none of the states raised their agricultural electricity tariffs, not even to 50 paisa per kWh.

On 3rd March 2001, the Chief Ministers along with the electricity sector ministers met again to arrive at a resolution, which stated that: full metering of all consumers should be completed by December 2001; subsidies could be given only to the extent of the state government's capacity to pay the subsidies explicitly through budget provisions; it would be necessary to move away from the regime of providing free power; and the past decision to impose a minimum agricultural tariff of 50 paisa per kWh would be implemented immediately. These policy resolutions are yet to be implemented. Some states, like Tamil Nadu and Andhra Pradesh, which initiated metering initiatives and progressive tariff increases, repealed these after some time, although few states have introduced free power for farmers since the 2001 resolution.

At the same time, some states have undertaken initiatives to improve pumping efficiency with an objective to improve overall efficiency in the electricity supply. D'Sa (2010) provides an interesting compilation of experiences with implementing irrigation efficiency measures. Looking carefully at them, we find that these initiatives, largely supported by the international development organisations, have emphasised technological upgrades for improving the efficiency of pumps and hence overall energy efficiency.

There were primarily four technologies or instruments promoted under these initiatives: (1) the adoption of BIS (Bureau of Indian Standards)-rated mono-block pumps in place of locally made inefficient three-phase pumps; (2) replacement of the foot valves; (3) replacement of the suction and delivery pipes (from GI to RPVC); and (4) installation of shunt capacitors. Though all of these initiatives reported improved energy efficiency, it is not clear whether the reported energy efficiency was based on estimates or metering (D'Sa, 2010). Moreover, these initiatives were limited to pilot projects covering a few hundred pumps in some villages; they were never scaled up to the state level. That raises a further question as to why these initiatives, even when successful at producing the desired results for energy efficiency, were not scaled up to the state and national level.

Suggested reforms in the agricultural electricity supply followed three different approaches for improving efficiency: first, raising the tariff to recover the cost of supply; second, installing meters so that the farmers could be charged based on their consumption; and third, technological upgrades to improve pumping and energy efficiency. During this period, the primary concerns were to increase economic inefficiencies and to implement the reform initiatives. While there was political consensus on the need for reforms and rather widespread agreement on the suggested approaches, implementation did not take off.

The lack of implementation can be explained by various social, political and economic barriers. The rationalisation of agricultural electricity tariffs was politically infeasible and raised social objections, as discussed in the previous section. States that tried to initiate this type of reform had to repeal it, owing to popular and political demand. Where implemented, particularly in states with less groundwater dependence, the outcome has been negative, as seen in the case of West Bengal.

Metering of the agricultural electricity supply has been equally difficult to implement. While farmers were opposed to metering in anticipation of tariff hikes, the utilities were not prepared to take on the transaction costs involved in metering and billing farmers. The utilities often claim that metering and billing low-paying agricultural consumers is not cost-effective.[63] Finally, technological upgrading faced financial barriers. Neither the state nor the utilities were capable of investing the huge amount of capital required. The farmers, who have been used to a free (or highly subsidised) electricity supply as an entitlement expected the new technologies or instruments to also be free of cost. As observed, most of the initiatives for technological upgrades have been funded by international development organisations. Yet, in some cases, the farmers have shared a small portion of the cost with utilities (D'Sa, 2010).

Analysing the viability of policy combinations based on a survey of stakeholders, Singh (2009) claims that a combination of all three approaches offers better and more longer-term effectiveness. While the rationalisation of tariffs is financially most viable, he concludes that technological upgrading is easy to implement and politically most acceptable (Singh, 2009). It seems the underlying assumption is that a combination of the three approaches will lead to improvement in the quality of supply and thus an increase in farmers' income. However, improvement in the quality of supply to farmers is not very straightforward and requires a change in energy behaviour on the part of the farmers, and better response and activity from the utilities. As argued earlier, implementing these policies without upfront quality improvements may put a real additional burden on the farmers. Moreover, we find that these approaches to efficiency in agricultural electricity consumption are narrow in scope. There is a need to move towards an embedded perspective that bundles policies and incentives for better returns to all the stakeholders. To gain further insights, in the following sections we analyse the experiences and outcomes of the current initiatives being pursued in three Indian states.

## 4.2 Andhra Pradesh: improving pumping efficiency

Andhra Pradesh is one of the most groundwater-dependent states in India, with 146.8% of its ultimate groundwater potential (in terms of electrical pumps) developed, and an agricultural sector accounting for 31.19% of total electricity consumption (www.cea.nic.in). That makes energy and water-use efficiency in groundwater irrigation a critical need for the state. It may then come as a surprise that Andhra Pradesh is one of the few states that have been recently pursuing a free-power policy. As an energy analyst pointed out, "energy efficiency [in agriculture] was never a concern for the state government. Except for a brief period of reforms, because of entrenched political motives the successive governments [irrespective of ruling parties and political leaders] have always emphasised the provision of energy to the maximum number of irrigation pumps. They have successfully accomplished this through continued subventions to electric utilities via budgetary allocations."[64]

63 Moreover, the utilities have an additional incentive to avoid monitoring and accounting for agricultural electricity consumption. They have been recovering the cost of agricultural electricity supply through cross-subsidisation and state subvention. It is believed that they cover up their inefficiencies (*i.e.* losses) under the agricultural category as this is not accounted for. Monitoring and accounting agricultural electricity consumption at the outset would mean reduced cross-subsidisation and state subvention, pushing the utilities into further financial crisis.

64 Interview with a retired senior officer of APSEB and energy specialist, October 21, 2010, Hyderabad.

However, given increasing concerns about the overconsumption of electricity in agriculture and the increasing subsidies, local governments have taken initiatives to improve efficiency in agricultural electricity use. These were largely limited to pilot projects on pump improvements and adjustments covering a few hundred pumps (for details on these initiatives see D'Sa [2010]). Though they claimed to have produced positive outcomes, these initiatives could not purport to have any impact on the larger electricity supply system, as they were limited to a very small number of pumps. Moreover, these initiatives were never scaled up to the state level for a higher cumulative outcome. Consequently, the problem became worse over time with the increasing number of pumps being run on electricity.

In 2000, under a pro-reform state government, the Andhra Pradesh Electricity Regulatory Commission issued an order for a steep hike in electricity tariffs for all consumers, including the farmers. Though the tariff hike for all categories of consumer averaged 20%, the farmers were the worst hit. Those in drought-prone areas were given the option of using meters and thereby paying Rs. 0.35 per kWh, or paying a flat rate of Rs. 200 per horse power (hp) up to 3 hp, Rs. 350 per hp for pumps with 3 hp to 5 hp, Rs. 450 per hp for pumps with 5 hp to 10 hp, and Rs. 550 for pumps with more than 10 hp capacity. Farmers in other areas were charged a flat tariff of Rs. 250, Rs. 400, Rs. 500, and Rs. 600, respectively, whereas the prevailing tariffs were Rs. 100, Rs. 200, Rs. 300 and Rs. 400, respectively (Lakshmipathi, 2000). There was serious opposition to the tariff hike across the state among all categories of consumer, which forced the government to partially roll back the tariff hike. Moreover, the ruling Telgu Desam Party (TDP) was thrown out of power in the 2004 State Assembly elections. The political failure of TDP is blamed on its pro-reform stance and tampering with agricultural electricity subsidies.

The newly elected Congress Party, keeping true to its election promises, offered a free-power supply to farmers. On 14th May 2004, on his first day in office, the new Chief Minister signed his first official order announcing the supply of free electricity to farmers. Later the government also waived about Rs. 12 billion in outstanding electricity bills for the farmers (Financial Express, 2005). The policy at the outset offered unconditional, zero-cost electricity to all farmers for a duration of nine hours every day. Afterwards, the government made some changes in the free-power policy to better target the subsidies and improve efficiency in agricultural electricity use. In 2005, the Chief Minister raised the question whether it is proper "for an income-tax paying farmer to be given free electricity?" (Financial Express, 2005). Subsequently, the government prepared a modified agricultural electricity policy that put conditions on free power. First, it distinguished between various agricultural consumers based on type of ownership: (corporate farmers and income-tax payers); access to surface water (wet land/dry land); size of land holdings; and the number of agricultural electricity connections.

To be eligible for free power, the policy mandates that a farmer must have no more than three electricity connections on dry land, and no more than 2.5 acres of landholdings on wet land. The revised electricity policy also denied a free-power supply to corporate and income-tax paying farmers. Second, the new power policy emphasised energy conservation through demand-side management. It made mandatory provisions for four DSM measures to be implemented in a time-bound manner: 1) installation of shunt capacitors; 2) replacement of crude metal foot valves with frictionless foot valves; 3) replacement of suction and delivery pipes from GI to RPVC; and 4) installation of ISI-marked pumps. As can be seen, these measures were drawn from past experiments with technology upgrades for energy efficiency, which claimed to have produced positive results in pilot projects. The farmers were required to undertake the first two measures by March 2006 and the last two measures by March 2008. While these were mandatory for farmers accessing the free power supply, others were offered an incentivised tariff of Rs. 0.20 per kWh (instead of Rs. 0.50) upon implementing all four measures.[65]

[65] As the policy document could not be accessed, all information provided in this paragraph is collected through various interviews with the staffs of APTRANCO, APERC and some farmer representatives and cross-verified by news reports.

It was claimed that the first three measures are easy and cheap to undertake and can lead to 30% to 40% energy savings.[66], [67] However, these policy measures were hardly ever implemented in the field. Why were the measures not implemented, even when they were mandatory under the agricultural electricity policy and had demonstrated (through earlier pilot projects) positive results for energy efficiency? We have identified several explanations based on interviews with various stakeholders. First, since a free-power policy had already been in place, there was little incentive for farmers to undertake these measures. Moreover, the farmers always fear new technology, which they suspect may lead to tracking of their consumption and thus higher tariffs in the future. Neither the government nor the utilities put enough effort into educating the farmers about these measures, and how they could improve the quality of the electricity supply.[68]

Second, the utilities were supposed to monitor implementation of these measures. But, as the state government paid for agricultural electricity, they had little motivation and no incentive to bear the cost of monitoring the implementation. Yet, they could have benefited substantially from the successful implementation of these measures by selling the energy saved to high-paying consumers. Third, the government emphasised penalties for defaulters, but there were no regulatory mandates for penalising neither the farmers nor the utilities for non-implementation of these measures. Fourth, the lack of local technical expertise was yet another barrier to implementation. Some of the farmers tried to install shunt capacitors, the easiest and cheapest of the measures. However, due to lack of knowledge, the local electricians installed the capacitors at wrong place, leading to pump burnout in many cases. That resulted in farmers' perception that these measures were damaging for their pumps.

Consequently, farmers opposed these measures.[69] The utilities could have addressed the issue by providing a helping hand with the implementation and training the local electricians. Fifth, the replacement of pumps is always expensive, and unaffordable, for many farmers.[70] Neither the state nor the utilities offered to share the cost of pump replacement. So the measures had little momentum. Finally, due to a lack of monitoring, many of the high-income farmers, who were denied free power under the new policy, are still getting free power.[71] These farmers, often with higher political clout, have defended the status quo of free-power policy.

## 4.3 Gujarat: rationing electricity supply to agriculture

Gujarat is one of the states where groundwater is used intensively. This is evident in the fact that: 126.6% of the state's ultimate groundwater potential (in terms of electrical pumps) has been developed; the agriculture sector accounts for 24.75% of total electricity consumption (www.cea.nic.in); of the 15.81 BCM in groundwater available annually, 76% is withdrawn every year; and 61% of the administrative blocks are over-exploited, critically or semi-critically as per the norms of the Central Groundwater Board (www.cgbw.gov.in). In many ways, the state of Gujarat epitomises the groundwater crisis in India. Though the damaging agricultural electricity subsidies were started later in this state, with the 1988 introduction of a flat-rate tariff, they have grown over the years. Until the recent reforms, Gujarat had one of the highest electricity subsidies in India (Briscoe, 2005). As a consequence of the subsidies and the resulting losses sustained by the utilities, there was rapid deterioration in the quality of the electricity supply, not only for the farmers but also for all other rural consumers in the state. Moreover, a major concern for the state is depletion of the groundwater table due to over-extraction that is induced by the flat-rate tariff.

66 Replacing GI pipes by RPVC pipes at the suction and delivery end can save 20% in electricity, replacing foot valves can save another 10%-12% and replacement of pumps can save 20%-25% in electricity, while installing shunt capacitors can reduce line losses (Chandramouli, 2000).

67 Interview with a senior engineer at APTRANSCO, October 22, 2010, Hyderabad.

68 Interview with an NGO member, October 23, 2010, Secunderabad.

69 Interview with a farmers' leader, October 25, 2010, Hyderabad.

70 In Andhra Pradesh, even the small farmers own multiple pumps and some of these do not discharge water at all. It is a real burden and financially infeasible to replace all the pumps

71 Interview with a farmers' leader, October 25, 2010, Hyderabad.

In response to this situation, in 2003 the Government of Gujarat introduced a scheme called *Jyotigram* (Lighted Village), with the objective of rationing the rural electricity supply. The scheme was launched initially in eight districts within Gujarat on a pilot basis, but by the following year, it was extended to the entire state. By 2006, over 90% of the villages in Gujarat were covered by this scheme. Under the scheme, the feeders supplying agricultural consumers were bifurcated from those supplying residential and commercial consumers, at the sub-station level. These feeders were metered to improve the accuracy of energy accounting and to identify the sources of any significantly greater-than-expected demand. At an investment of Rs. 12 billion, a parallel rural transmission network was laid out across the state (Shah *et al.*, 2008; Shah and Verma, 2008; Mukherji *et al.*, 2010). Implementation of the scheme resulted in two significant changes: a) villages are provided with 24-hour electricity supply for domestic use and for schools, hospitals, market places and village industries; b) farmers are provided with a good-quality electricity supply for eight hours daily.[72]

The main purpose of this scheme was to improve electricity supply to rural consumers. Two early studies conducted by the Institute of Rural Management (IRMA) and CEPT University report on how the *Jyotigram* scheme has improved the electricity supply to rural areas, improved the quality of rural life and contributed to bridging the rural-urban divide.[73] Both these studies, however, do not analyse the impacts of this scheme on the water-energy nexus in Gujarat and how the farmers have been affected by the rationing of rural electricity. A later study conducted by the International Water Management Institute (IWMI) confirms the positive outcomes of *Jyotigram* for the quality of rural life. In addition, the study provides a detailed analysis of the agrarian impacts of the scheme (See Shah *et al.*, 2008; Shah and Verma, 2008; Mukherji *et al.*, 2010).

The study identifies five positive changes that the scheme has brought about. First, by providing electricity with greater continuity and fewer interruptions, even though for a limited eight-hour period daily, the scheme has benefited the farmers. As discussed earlier, constant tripping in the conventional supply system made it impossible to keep an irrigation schedule, wasted water and electricity, and increased the wear and tear on pumps. Second, low and fluctuating voltage, in part due to rampant use of capacitors[74], was a major problem in the conventional supply system. By separating out the agricultural supply lines, the scheme has made it inappropriate and almost impossible to use capacitors, and thus it has improved voltage stability and brought order and discipline to agricultural electricity use.

Third, in conventional supply systems, the reliability of agricultural electricity supply is a major problem as the farmers do not have precise knowledge of when electricity will be supplied and withdrawn. The scheme addresses this problem by ensuring a fixed schedule for agricultural electricity supply. Farmers get their ration of eight hours of electricity on a fixed schedule that rotates between night and day and is pre-announced to everyone, making the irrigation schedule easier for farmers to understand. Fourth, though the farmers are aware that the unrestrained pumping of groundwater will certainly lead to disaster, they could never forge collective self-regulation. By rationing the electricity supply, the scheme has put a cap on collective groundwater extraction, in a uniform and just manner. Fifth, with completion of the scheme's implementation in 2006, the state has lifted the virtual restriction on new agricultural connections. The state has been offering new connections in a planned manner depending on the availability of groundwater and electricity (Shah and Verma, 2008).

All these changes have certainly benefited farmers by making it possible for them to maintain an irrigation schedule, save on pump maintenance costs, use labour more efficiently and conserve water. This does not mean farmers are unreservedly happy with the scheme and its outcomes. The outcomes, for the farmers' part, include negative perceptions, welfare costs and thus opposition.

72 All the villages get agricultural electricity supplied during the day or night on a weekly rotation schedule. The schedule for agricultural electricity supply is preannounced to farmers leading to a reliable supply.

73 Interviews with researchers involved in the studies conducted by IRMA and CEPT University, September 7-8, 2010, Anand and Ahmadabad.

74 Technically, capacitors are used as a gateway to improve the power factor, but farmers often use them to steal electricity from single-phase supply intended for residential consumers. Here, a capacitor (locally known as *tota*) is used to convert single or two-phase supply to three-phase supply when three-phase supply is down for load-shedding. This leads to significantly low voltage not only for the tail-end pump owners but also for residential consumers.

While most of the farmers value the improvements in the quality of supply, some find it mere sugar-coating for a bitter pill, *i.e.* a rationed electricity supply. The latter group includes pump owners in the water-abundant areas of central and southern Gujarat, who had been operating their pumps for 18-20 hours a day using capacitors. The extra hours of pumping were for extracting water for sale to small and marginal farmers and sharecroppers, which provided extra profit to the pump owners at zero investment. Now they are forced to do with just eight hours of pumping, which is sometimes not sufficient to irrigate their own land.

On the other hand, the water buyers, *viz.* sharecroppers, landless labourers, small and marginal farmers, are worse-off under this scheme (Shah and Verma, 2008). Vibrant water markets have been central to Gujarat's groundwater irrigation economy (Shah, 1993; Dubash, 2002). Due to the rationing of the electricity supply, the groundwater markets have shrunk and access to irrigation water for buyers has declined. At the same time, irrigation water prices have increased in the range of 40% to 60%, pushing many out of irrigated farming and thus a reasonable income. The landless labourers cultivating leased lands have been affected by the reduced availability of irrigation water, as well as reduced opportunities for farm work as the total area being irrigated has decreased (Shah and Verma, 2008). Consequently, there is an emerging perception among the farmers that the *Jyotigram* scheme has not benefited them. As a farmer representative asserted, "government is trying to pursue rural development at the cost of agricultural development. They make tall claims that village life has improved after *Jyotigram*. How can village life improve when village income drops? We do not need 24-hour electricity in our houses, when our pumps do not run on our lands."[75]

The *Jyotigram* scheme has significantly improved the electricity supply system in Gujarat. It has benefited the utilities by reducing losses, thefts and increasing revenue realisation from the agriculture sector.[76] Consequently, the electric utility that used to post heavy losses a few years back started making a profit immediately after implementation of the scheme (Pandit, 2006). The residential and commercial consumers in rural area have benefited from improved, 24-hour electricity supply. The state has benefited from a reduced subsidy burden. Farmers have benefited from the better quality of the supply. Contrary to the belief that rationed electricity supply would restrict agriculture, the agricultural output of Gujarat has gone up. As Shah *et al.* (2009) claim, the *Jyotigram* scheme is a key driver: "A reform that has had by far the most far-reaching impact on Gujarat's agriculture is Jyotigram Yojana.

Rationing of the farm power supply post-Jyotigram brought about a certain order and discipline in the extraction of groundwater, but the improved quality and reliability of farm power supply also made it possible for farmers to make ambitious plans to grow cotton and wheat on a large scale" (Shah *et al.*, 2009: 48 & 54). Though there is opposition among the farmers, it is limited to small groups in some areas that seem to have been negatively affected by rationing. From a groundwater perspective, the rationing of electricity has put a cap on the collective extraction of groundwater and contributed to groundwater conservation. Certainly, there is room for improvement, particularly by adapting the electricity allowance (which is 8 hours daily across the state now) to local needs, the nature of the aquifers and the farming seasons.

75 Interview with a farmer, September 10, 2010.

76 Though the agricultural electricity tariff has not been hiked, revenue realisation (in proportion to consumption) has increased as agricultural consumption has declined due to the rationed supply. Moreover, the scheme has also mandated that all new agricultural connections must be metered and charged a tariff based on their consumption.

## 4.4 Maharashtra: agricultural demand-side management programme

Although Maharashtra is one of the most developed states in India, a large portion of its population is dependent on agriculture for its livelihood. Due to uneven rainfall across the state and poor development of surface irrigation[77], most of the farmers depend on groundwater as a reliable source of irrigation; out of total irrigated land in Maharashtra, 71% is irrigated by groundwater. Over the years, groundwater irrigation in the state has intensified, resulting in the development of 142.5% of groundwater potential (in terms of electrical pumps), and 18.66% of total electricity is consumed by the agricultural sector (www.cea.nic.in). Consequently, the widespread and progressive depletion of groundwater tables in Maharashtra has become a cause of major concern over the past two decades; in many locations this has occurred more or less annually. Groundwater table depletion has already had serious impacts (including a possible correlation with increasing levels of farmer suicide) and, in consequence, has received a lot of media publicity and political attention. As in other states, much of this debate has focused on two aspects of what is a more complex problem: a) the provision of highly-subsidised electricity for groundwater irrigation; and b) the failure to preserve watersheds and encourage groundwater replenishment (Foster *et al.*, 2007).

Although the state has raised concerns time and again about increasing agricultural electricity consumption and depletion of the groundwater table, the state has not done much to address these issues. The early initiatives included pilot projects for pump improvements, that covered only 1750-2000 pumps, and the financing of drip irrigation for some farmers (D'Sa, 2010). Confronted with building political pressure and a growing agrarian crisis[78], however, the state has followed the path of other states in providing progressive electricity subsidies to the agriculture sector. Though the state has taken some initiatives to regulate groundwater use, implementation has been slow and thus the outcomes have been insignificant (Phansalkar and Kher, 2006).

With rising concern at the national level for climate mitigation, energy efficiency in groundwater irrigation has regained prominence in recent years. As part of its initiatives to promote energy efficiency, BEE has designed and is implementing an Agricultural Demand-Side Management (Ag DSM) Programme across the Indian states. The objective of the programme is "to create an appropriate framework for market based interventions in the agricultural water-pump segment by facilitating a conducive policy environment for promoting Public Private Partnerships (PPPs) to implement the projects" (BEE, 2009: 9).

Under this programme, an ESCO would invest in energy efficiency measures aimed at rural pumpset feeders, for which supply quality enhancements (such as High-Voltage Direct Supply [HVDS]) would have already been carried out. The intervention would lead to less energy being consumed by the feeders, and hence could result in lower subsidies being paid by the state government. Part of the subsidy savings would then be repaid annually to the ESCO to compensate it for the investment in the pumpset upgrades. To ring fence the payment security mechanism, large financial institutions can be brought in to provide loans for the project as well as an adequate payment security mechanism for investors. Utilities will play the important role of monitoring and verification. The detailed steps involved in the implementation of the Ag DSM programme are provided in Box 2.

[77] The Maharashtra Water and Irrigation Commission constituted by the Government of Maharashtra in 1995 estimated that out of the state's total cultivable land area of 22.54 million hectares, the area that could be brought under surface irrigation is 8.5 million hectares. However, at an aggregate investment of Rs 269 trillion since 1950 (at current prices), the area brought under surface irrigation in Maharashtra is only 3.86 million hectares.
Even this achievement is an exaggeration. Only 1.23 million hectares, or around a third of the potential created, is actually irrigated by canals; another 0.44 million hectares was irrigated by wells in the command areas of irrigation projects (DHMJ Drought Forum, 2007).

[78] The agrarian crisis is evident in the growing number of farmer suicides in Maharashtra, particularly in drought-prone areas.

Box 2: Steps involved in the implementation of the Ag DSM programme

- Identification of Districts and Sub-Divisions of State for Engagement: The objective of this task is to rank districts and sub-divisions of a state based on a framework and shortlist/identify the most preferred districts for initial engagement and DPR preparation.
- Identification and Selection of Feeders for DPR Preparation: The objective of this task is to identify eligible feeders for DPR preparation based on size, HVDS, adequate number of pumpsets, measureable baseline (feeder and pumpset level metering), and availability of baseline data.
- Planning for preparation of DPR.
- Engagement of consultants for DPR preparation.
- Organisation of workshops and seminars for awareness generation and capacity building for farmers and utility employees in areas where DPR is being developed.
- Risk-mitigation measures for ring fencing of risks in Ag DSM projects.
- Developing a model for implementation of the project.
- Engagement of ESCO for implementation of DPR.

*Source: BEE (2009).*

As part of the national Ag DSM scheme, the first pilot project was launched in Maharashtra. This first project covers 2,221 agricultural pumps[79] connected via four feeders (Bramhapuri, Nandeshwar, Borale and Bhose) in the Mangalwedha sub-division of Solapur circle. The Ag DSM project has three components: first, replacement of existing pumps with BEE-rated, five-star energy efficient pumps; second, replacement of foot valves; and third, replacement of the suction and delivery pipes. The scheme requires a separate HVDS for agricultural supply to be in place before pump replacements. In that case, the Ag DSM programme is not very different from measures proposed and undertaken earlier to improve efficiency in groundwater irrigation.

However, the Ag DSM programme has tried to remove some of the barriers to implementation. The major barrier to pump replacement is the huge financial cost required, which neither the farmers nor the utilities are in a position to incur. The Ag DSM programme removes this barrier by engaging ESCOs and financial institutions, who will invest in the projects and get repaid by sharing in the energy savings. Lack of technical expertise and regular maintenance has been a hurdle for pump technology upgrades. The engagement of certified ESCOs is expected to address this gap. Monitoring and verification is entrusted to the utilities, which are going to share the energy savings with the ESCOs. BEE has taken on the role of the regulatory and guiding agency, which coordinates among the stakeholders and sets the norms and rules.

The programme was launched in Solapur on 1st February 2009. As part of the first step, two consultancy companies were hired to prepare a financially viable, detailed project report. Based on an exhaustive and detailed energy audit of 1,670 pumps, a DPR was presented that determined the project techno-economically viable. The report found the overall weighted-average operating efficiency of existing pumps to be 28% as compared to 48.9% for the new pumps. It estimated the energy savings potential at 39.1% when the three measures are implemented. Doing a cost-benefit analysis, the DPR claimed that the simple payback period would be three years. It also suggested different models of investment based on cost and benefit sharing (Mitcon and PWC, 2009).

79 Though an energy audit was conducted and DPR was prepared for 2,221 pumps initially, the project now covers 3,530 pumps, including provision for some new connections.

The initial contract for replacing the pumps was awarded to Kirloskar Brothers, a leading global pump manufacturer. Later, the company withdrew from the project for undisclosed reasons.[80] In August 2010, the contract was then awarded to CRI Pumps, which committed to replacing 3,530 pumps in the following six months. The company has undertaken the project for a five-year term and has committed to cumulative energy savings of 36% over this period, which would be monitored by a third-party agency appointed by BEE with the approval of the Maharashtra State Electricity Distribution Company Ltd. The estimated cost of the project is Rs 70 million, which will be invested by the company (Business Line, 2010). Yet, by April 2010 the company had still to install the pumps; only two pumps had been installed for testing purposes. This situation raises doubts about the successful implementation of the project. However, the utility and the BEE are optimistic about the success of this programme. As for the farmers, they are excited not only about the new pumps they will get for free but also by the promise that the quality of electricity will increase without tariff hikes, and that the new pumps will retrieve more water.[81]

## 4.5 Conclusion

During the past two decades, Indian states have made several efforts to improve efficiency in the electricity supply for groundwater irrigation. These efforts, driven by neo-liberal policies, have primarily aimed to improve the technical and economic efficiency of the agricultural electricity *supply* rather than improving the efficiency of electricity *use*. Moreover, these initiatives have been limited to a few small-scale pilot projects so far and are not capable of producing larger impacts, although they all claim to have produced positive outcomes.

In this Section, we have analysed three different initiatives pursued during the past decade. The Andhra Pradesh experience suggests that having a mandatory policy is not enough. Though the state government has established mandatory technology specifications for upgrading the pumps used to access a free power supply, lack of an enabling environment, proper monitoring and the right incentives did not result in proper implementation. On the other hand, Gujarat's efforts to ration the agricultural electricity supply have achieved modest success by putting a cap on electricity use and collective groundwater extraction. Although this has generated negative perceptions and welfare costs on the part of some farmers, in general it has benefited many farmers, utilities and the state government. Certainly, it has potential to be scaled up to the national level. Yet, the Gujarat model offers just part of the potential solution to the complex energy-water problem and does not necessarily improve energy efficiency, rather, it puts a cap on energy use.

The national Ag DSM programme, currently being implemented in Maharashtra, builds on past experience. Here, the aim is to improve efficiency in agricultural electricity use more so than improving economic efficiency. Economic efficiency, it is assumed, can be achieved through a spillover effect as efficiency in electricity use improves. The Ag DSM programme combines the Andhra Pradesh model with the Gujarat model. A Separate HVDS (High-Voltage Direct Supply) for agricultural electricity is a perquisite for the programme. This involves the replacement of inefficient pumps as well as foot valves and pipes. It attempts to remove barriers to implementation by building a coalition of both state and non-state agencies in the process. The programme distributes the costs, benefits and risks among the partners of this coalition, while protecting the interests of farmers.

However, the Ag DSM programme, as yet is limited to a few pilot projects. While one project is being executed in Maharashtra, four other states (Gujarat, Rajasthan, Haryana, and Punjab) are on their way and have prepared bankable DPRs. Delay in implementation of the first pilot

80 It is claimed that the Kirloskar Brothers were not confident about the energy efficiency potential of their pumpsets. They did not want to invest in a project "that cannot save enough energy to repay for the investment". Interviews with a local utility staffer in Mangalwedha (November, 2010) and project engineer in BEE (April 4, 2011).

81 Interview with several farmers, Mangalwedha, November 2010.

project raises doubts about the success of the programme at the national level in the near future. Given that pumps are to be replaced free of charge, the programme is vulnerable to being co-opted by the political process and politicians. Already, the fact that the first pilot project is being implemented in the constituency of a federal energy minister has raised many eyebrows.[82] Current farmer support to the programme is based on misleading promises (by local authorities) that the new pumps will retrieve more water. If these promise fail, the farmers may oppose scaling up of the programme. If the promises are proved right, this may further aggravate the energy-water problem.

Moreover, ESCOs' attitude towards the Ag DSM programmes is somewhat dubious. Most of the ESCOs are more interested in conducting energy audits and preparing DPRs for the Ag DSM programme than in implementation as this is an easier way to secure profits. There are only a couple of pump-manufacturing vendor ESCOs that are interested in the implementation process.[83] Yet, the Ag DSM programme holds promise for improved energy efficiency in groundwater irrigation. But again, the whole scheme takes a limited approach as it does not address the problem of depletion of the groundwater table. In the following section, we make a case for a wider and embedded approach to the energy-water problem.

82 Pointed out by many civil society members during interviews.

83 Based on interviews with several ESCOs in Delhi and Maharashtra.

# 5. Zooming out from a restricted to an embedded approach

## 5.1 Summary of arguments

We started this research paper with the finding that the climate-mitigation potential of India's agricultural sector is being paradoxically underestimated, given that the potential appears to be huge (Charnoz and Swain, 2012). While agriculture in India is most vulnerable to climate change impacts, agriculture itself is one of the major contributors to greenhouse gas emissions. As the second highest-consumer of electricity in India, the sector has huge potential for energy efficiency, particularly when it comes to groundwater irrigation. Prevailing agricultural electricity subsidies are blamed for the inefficient use of electricity in agriculture. In this context, our research was aimed at finding ways to improve energy efficiency in agriculture within a "free-power" environment.

We began with an analysis of the relationship between climate change and agriculture in Section 2. We concluded that the outcomes of climate change on Indian agriculture will largely depend on the level of availability of water for irrigation in the coming years. On the other hand, being the largest contributor to greenhouse gas emissions, the agricultural sector has high potential for mitigation. Energy and water efficiency offers a synergy between adaptation and mitigation in the agricultural sector. However, the mitigation opportunities in Indian agriculture have been underestimated. Though India is actively promoting energy efficiency measures, the agricultural sector has been neglected. While the sector has potential to offer the highest collective return through energy efficiency, the implementing agencies have paid little attention and have failed to realise those returns.

Then we analysed what has become the mainstream neo-liberal discourse, upheld by many Indian and international technocrats, regarding agricultural electricity subsidies. In this view, subsidies lie at the root of economic inefficiencies in electricity utilities, agricultural practices and the state economy. As a solution, this perspective recommends reforming the pricing structure. Such reforms not only have supporters at the domestic policy level but also at the multinational agencies. Though pricing based on actual consumption might improve the economic efficiency of utilities, it may also produce a wide array of negative social and political consequences. It may create a situation where equal access to water for irrigation is challenged, particularly for the small and marginal farmers who depend on the informal groundwater market and are unable to own pumps.

In Section 4, we presented a socio-political analysis of these subsidies. We concluded that agricultural electricity subsidies, as they were introduced, were part of a solutions package meant to address larger developmental problems like food security and rural poverty. To a certain extent, the policy has been successful in producing the desired results. However, over the years it has been politicised by various interest groups and increasingly turned into a problem, leading to various economic and environmental inefficiencies. Yet, it would be wrong to depict agricultural electricity subsidies as a mere waste of public money. Rather, they are a socio-political constraint that governments have to manoeuvre to work with in the short and medium run. Working up front against subsidies is likely to be counter-productive at many levels.

Finally, we analysed the current initiatives taken to improve energy efficiency in the agricultural sector within the free-power context. We concluded that the current approaches are narrow in scope and largely driven by the neo-liberal technocratic discourse we pointed out. To some extent, they may constitute part of a solutions package, but they are not enough to address the complex energy-water nexus. In fact, achieving greater electricity-use efficiency in agriculture is difficult without achieving greater water-use efficiency. In the following concluding paragraphs, we make a case for a broader and more embedded approach to electricity and water-use efficiency.

## 5.2 A too narrow approach to agricultural electricity subsidies

Agricultural electricity subsidies have been interpreted as a unilateral problem that leads to economic inefficiencies affecting farmers, utilities and state governments. Consequently, the solutions proposed are unilateral, focused on revising the price of electricity and/ or improving water-pumping efficiency. Throughout this paper, we have challenged this narrow approach to agricultural electricity subsidies. We have demonstrated that the raising of electricity prices for farmers does not address the problem; rather, this leads to several other problems bearing welfare costs. Doing away with these subsidies may aggravate rural poverty by reducing farmers' disposable income and exacerbate the problem of food security by reducing agricultural yields. As for improving water-pumping efficiency, this approach is claimed to have produced positive outcomes in a few pilot cases, but there is yet no clear evidence as well as technical assessments available.

Improving pumping efficiency without improving water-use efficiency could in fact lead to serious problems. Farmers are always demanding more water than what is currently accessible to them: once pumping efficiency is improved, they can extract more and more, which may in turn aggravate the depletion of groundwater tables. As these tables drop further down, the amount of electricity required to draw water would increase.

Electricity and water use in irrigation are very much intertwined. A true solution to the problem would need to address both these issues simultaneously.

Analysing agricultural electricity subsidies from an environmental, economic and socio-political viewpoint, we find this to be a multi-dimensional problem. The issue is firmly linked with the groundwater problem, rural poverty and food security.[84] Addressing one aspect would not provide a sustainable solution. There is a need for a much broader and embedded approach that considers all dimensions simultaneously. Though the government has identified several dimensions of the problem, these are still treated as independent problems rather than as a complex network. For example, the proposed solution for energy efficiency (improved water-pump efficiency) does not consider water-use efficiency. Similarly, the proposed solution for cheap electricity does not consider the rural poverty dimension.

Unequal emphasis and pursuance of these policies has led to improvements in one dimension often at the expense of another. In developing its strategy for supplying agricultural electricity, India needs to start weighing the externally and internally oriented strategies more directly against each other, instead of thinking of them as separate. This research has emphasised the need to bundle policies together so they can produce better outcomes. At the same time, there are multiple constituencies at stake that necessitate the bundling of interests. In the following section, we make a range of suggestions towards a wider approach to the problem.

84 Recently, the water, energy and food security nexus is recognized in global policy debate, and building synergies across these sectors is emphasised as a solution for a green economy (Hoff, 2011).

## 5.3 Recommendations

The larger the focus, the larger the benefits; the lesser the focus, the greater the risks. Here we emphasise the need to integrate electricity management with water and agricultural management based on the following recommendations.

a) *Improving Surface Irrigation.* Since 1950, India has made direct public investment in providing surface-irrigation infrastructure. After six decades of public development and public spending, around one-third of irrigated lands have access to surface water. Despite regular expansion and increased capital investments, the actual size of the surface-irrigated areas has been almost stagnant since the mid-1980s.[85] Those who are deprived of surface water are bound and motivated to extract groundwater for irrigation, resulting in much faster development and use of groundwater resources. Consequently, around two-third of India's irrigated lands are irrigated through groundwater, which has caused a rapid increase in electricity consumption by the agricultural sector. One obvious solution lies in the expansion of the surface irrigation system. With good monsoon rainfall and water sources like the Himalayan glaciers and a wide network of rivers, India has huge untapped potential. It is urgent to revitalise the existing network of canals in order to reduce dependence on groundwater. Though detailed studies are required for precise estimates, it seems likely that surface irrigation expansion can produce a much larger economic benefit for the farmers and the state while requiring a lower level of capital investment compared with investments in sourcing groundwater particularly when taking into account the cost of subsidies and Ag DSM.

b) *Groundwater Table Management.* Depletion of the groundwater tables is one of the major reasons for the rising demand for electricity used in groundwater irrigation. Yet, the state has not done enough to replenish groundwater resources. While India receives a good amount of rainfall that can revive these tables, much of it is wasted or discharged to the sea. There is a need for promoting innovative schemes to replenish groundwater tables. Individual farmers can do a lot in this direction by harvesting rain water, and the local governments need to promote awareness and initiate a range of actions. Though some states have taken initiatives to promote rainwater harvesting, these were not pursued with adequate vigour or well-presented to the farmers. On this front, combined efforts by the state and individual farmers are required. Groundwater replenishment would not only address the problem of depleted water tables, but would also reduce the demand for the electricity used to draw water.

c) *Improving Technologies for Lift Irrigation.* There is a strong need to promote alternative and more efficient technologies for crop irrigation. To date, the most popular method has been flood irrigation. Water is pumped to the field and is allowed to flow along the ground among the crops. This method is widespread as it is simple and cheap. The problem is that about one-half of the water used ends up not getting to the crops, which means lot of wasted water through evaporation and unwanted runoff. Alternative and more efficient methods of irrigation have developed that can reduce water demand. Drip irrigation, for instance, saves water by allowing water to drip slowly to the plant roots, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing and emitters. This method of irrigation is very water-efficient, but more suitable for horticulture. Sprinkler irrigation is another method similar to rainfall. Spray heads eject water into the air in widely dispersed droplets that permeate the entire soil surface. Though both technologies are commercially available in India, they have not received much popular attention due to their cost. Most of the farmers are not in a position to make the upfront investment required to install these systems. However, the state can play a facilitating role by marketing and subsidising these technologies to farmers. These methods of irrigation not only save water and thus electricity, but also save farmers' disposable income.

[85] In 1980, surface water and groundwater sources were irrigating about 15 million hectares each. After 30 years, coverage of surface irrigation has remained unchanged, while groundwater irrigation has more than doubled (Gulati, 2011).

d) *Modifying Agricultural Practices.* Some easy and inexpensive methods can reduce water and electricity demand by a great deal. Land levelling is one such traditional practice that can save lot of water and improve crop management. The unevenness of a field's surface has a major effect on yields. It results in uneven water coverage, which means that more water is needed to soak the soil. Land levelling not only improves water-use efficiency, but it also contributes to better yields by combating weeds and the uneven maturation of crops. Mulching is another agricultural practice that increases the moisture-retention of land, and thus reduces the need for water, reduces erosion, provides nutrients, suppresses weed growth and increases fertility. Instead of burning the organic residue, which is common practice in India, the farmer can use it as mulch. Though farmers are aware of these agricultural practices, they often do not implement them because of the perceived extra labour required or lack of awareness about the benefits. In actuality, there is an urgent need to reintroduce these practices into Indian agriculture.

e) *Promoting organic agriculture.* From a climate change perspective, organic agriculture offers a lot of potential. Applying these methods, agriculturists can minimise emissions and sequester significant quantities of atmospheric carbon dioxide, especially in soil. Additionally, organic agriculture offers alternatives to energy-intensive agricultural inputs, such as chemical fertilisers and pesticides. Global adoption of organic agriculture has the potential to sequester up to 72% of the current agricultural GHG emissions on an annual basis (Scialabba and Muller-Lindenlauf, 2010) and up to 32% of all current man-made GHG emissions (INFOAM, 2009). The state needs to promote further research on organic agriculture and can help farmers by spreading awareness of this practice.

Prevailing fertiliser subsidies are one of the reasons for high water use. Farmers have a perception that higher use of chemical fertilisers can produce better yields. Subsidised fertilisers encourage farmers to use them more and more. As we have discussed, higher use of chemical fertilisers requires higher use of water. Therefore, there is a need to reduce consumption of chemical fertilisers and promote use of organic fertilisers, which the farmers can produce at zero cost.

f) *Crop and Varietal Diversification.* Crop diversification is another rational and cost-effective method for improving water and energy-use efficiency in agriculture (Lin, 2011). Farmers can save a lot of water and electricity by planting less-water-intensive crops or choosing to grow less-water-intensive variants of the same crop. India already has developed less-water-intensive variants of wheat and rice. The state can facilitate this process by promoting research on new types of crops and marketing them to farmers. This approach contributes not only to climate mitigation by promoting conservation of water and energy but also has potential to improve the resiliency of agriculture to climate change impacts.

g) *Realigning Food Procurement Policy.* The state can facilitate crop and varietal diversification by realigning food procurement policy. At present, water-intensive crops are ensured a support price and thus have a higher market value. Given that backdrop, farmers have little incentive to go for less-water-intensive crops, which cannot fetch them as good a price. The state needs to realign its food procurement policy by ensuring higher price incentives for less-water-intensive crops.

h) *Redesigning Subsidy Policy.* The current unmetered and across-the-board agricultural electricity subsidies are damaging as they benefit the high-consuming farmers more and encourage unrestricted consumption. Redesigning these subsidies on the basis of more direct transfers to targeted beneficiaries could greatly enhance electricity and water-use efficiency. For instance, stronger price incentives (low tariffs) should be provided to low-consuming farmers, while lower price incentives (high tariffs) should be provided to high-consuming farmers. Therefore, there is a need to devise tools for the direct transfer of subsidies to needy farmers. In any case, this would require metering of the electricity supplied to agricultural consumers.

i) *Improving Pump Efficiency.* Finally, improving pump efficiency is useful in improving the overall energy efficiency of agriculture. Indian states have already started working on this. But the current Ag DSM programme needs to better-align a range of interests toward faster implementation. It particularly needs to ensure farmers' active participation so they have a real stake in the process and share in the costs and benefits, something that would require innovative arrangements. The active engagement of electricity regulatory commissions in issuing regulatory mandates for timely implementation is also necessary.

Many of these suggested initiatives require the state to play a greater role, while seeking contributions from individual farmers. The state again needs to engage in capacity building and awareness campaigns to promote greater community participation. We again re-emphasise the need to take a broader and more integrated approach to promoting efficiency in agricultural electricity use. What the Indian State has been doing is certainly commendable, but it remains far too narrow in its approach. Solely focusing on improving pump efficiency, for instance, cannot be deemed a perfect solution as it may also come with a range of negative impacts, like even-faster depletion of water tables and decreasing incentive to manage water demand. That is why we call upon India to focus first on optimising water demand in agriculture before improving the energy efficiency of the equipment. The support of the international community, we believe, should be entirely rethought in this light.

Over the past five years, foreign aid to India has been quickly increasing and was recently close to 3 billion USD a year. The volume has rebounded from two decades of particularly low aid and now approximates the levels last seen in the early 1980s. Yet, the share of ODA going to agriculture has declined from 12% in 2005 to only 2% in 2009 (OECD, online data, 2011). This trend is not appropriate. Much to the contrary, increased focus should be granted to agriculture in light of its major energy efficiency potential.

Current initiatives by international donors to support energy efficiency in Indian agriculture have been largely focusing on the technical side of things such as the replacement of agricultural pumps. Yet, rather than favour the biases in India's energy policies (towards renewable energy rather than energy efficiency; or towards industrial and commercial consumption, rather than agricultural), the international community should try to tilt the domestic agenda towards neglected avenues: energy efficiency in agriculture; irrigation and water management; improving agricultural practices; fostering technology transfers (through a new wave of demonstration projects); improving coordination between ministries and domestic agendas (such as the Ministry of Agricultural and the Ministry of Power); raising awareness about appropriate practices (through NGOs, schools, universities, media), as well as promoting local dynamic leadership (through better identification of grassroots organisations and individuals).

In doing so, donors should mobilise the full extent of their financial, research and technical assistance tools - to trigger dialogue on policy design rather than merely supporting this or that project. Tools include grants, as well as market-based and soft loans, to states, local authorities, private companies, banks or microfinance organisations. Financial guaranties could also support local authorities in raising capital at lower interest rates for agricultural programmes, while direct equity could support ESCOs addressing the issue of agricultural efficiency. Technical assistance and research could also be better directed to support policy design.

# List of acronyms

| | |
|---|---|
| Ag DSM | Agricultural Demand-Side Management |
| FAO | Food and Agriculture Organization |
| GDP | Gross Domestic Product |
| GHG | Green House Gas |
| GWh | Gigawatt/Hour |
| IPCC | Intergovernmental Panel on Climate Change |
| KWh | Kilo Watt/Hour |
| SDP | State Domestic Product |
| SEB | State Electricity Board |
| SERC | State Electricity Regulatory Commission |
| TDP | Telugu Desam Party |
| ToD | Time of Day |
| T&D | Transmission and Distribution |
| LULUCF | Land Use, Land-Use Change and Forestry |

# Appendix

### Table A.1: Estimated number of rural households, and total and indebted farming households

| State | Estimated number of rural households ('00) | Estimated number of farming households ('00) | Estimated number of indebted farming households ('00) | Percentage of farming households indebted |
|---|---|---|---|---|
| Andhra Pradesh | 142 512 | 60 339 | 49 493 | 82.0 |
| Gujarat | 63 015 | 37 845 | 19 644 | 51.9 |
| Maharashtra | 118 177 | 65 817 | 36 098 | 54.8 |
| West Bengal | 121 667 | 69 226 | 34 696 | 50.1 |
| All India | 1 478 988 | 893 504 | 434 242 | 48.6 |

*Source: NSO (2005).*

### Table A.2: Share of public sector outlays and expenditure under agriculture and allied activities

*(Rs. 10 Million/Crore)*

| Five-year plan/annual plan | Agricultural and allied activities | | Total plan outlay | | Percentage share of agriculture and allied activities to total | |
|---|---|---|---|---|---|---|
| | Plan Outlays | Actual Expenditure | Plan Outlays | Actual Expenditure | Plan Outlays | Actual Expenditure |
| **Ninth Plan (1997-2002)** | **37 546** | **37 239** | **859 200** | **941 041** | **4.9** | **4.0** |
| Annual Plan (1997-98) | 6 974 | 5 929 | 155 905 | 129 757 | 4.5 | 4.6 |
| Annual Plan (1998-99) | 8 687 | 7 698 | 185 907 | 151 581 | 4.7 | 5.1 |
| Annual Plan (1999-2000) | 8 796 | 7 365 | 192 263 | 160 608 | 4.6 | 4.6 |
| Annual Plan (2000-01) | 8 281 | 7 577 | 203 359 | 164 479 | 4.1 | 4.6 |
| Annual Plan (2001-02) | 9 097 | 8 248 | 228 893 | 186 315 | 4.0 | 4.4 |
| **Tenth Plan (2002-07)** | **5 8933** | **60 702** | **1 525 639** | **1 618 460** | **3.9** | **3.8** |
| Annual Plan (2002-03) | 9 977 | 7 655 | 247 897 | 210 203 | 4.0 | 3.8 |
| Annual Plan (2003-04) | 9 940 | 8 776 | 256 042 | 224 827 | 3.9 | 3.9 |
| Annual Plan (2004-05) | 1 1109 | 10 963 | 287 843 | 263 665 | 3.9 | 4.2 |
| Annual Plan (2005-06) | 1 3840 | 12 554 | 361 239 | 247 177 | 3.8 | 5.1 |
| Annual Plan (2006-07) | 1 6163 | 16 573 | 441 285 | 309 912 | 3.7 | 5.3 |
| **Eleventh Plan (2007-12)** | **13 6381** | **NA** | **3 644 718** | **NA** | **3.7** | **NA** |
| Annual Plan (2007-08) | 1 9370 | 18 770 | 559 314 | 361 255 | 3.5 | 5.2 |
| Annual Plan (2008-09) | 2 7274 | 23 405 | 867 828 | 676 529 | 3.1 | 3.5 |
| Annual Plan (2009-10) | 2 6291 | 10 123* | 752 650** | 425 590* | 2.4 | 3.5 |

** Centre expenditure only as figures for states are not available yet.*
*** Total of centre and states except Maharashtra & Uttarakhand.*

*Source: DES (2010).*

### Table A.3: Net state domestic product (NSDP) from agriculture, 2007-08 (at current prices)

*(Rs. Millions)*

| State | NSDP | NSDP from agriculture | Agricultural contribution as % of NSDP |
|---|---|---|---|
| Andhra Pradesh | 2 920 980 | 694 590 | 23.78 |
| Gujarat | 2 576 940 | 465 990 | 18.08 |
| Maharashtra | 5 049 506 | 724 291 | 14.34 |
| West Bengal | 2 778 688 | 551 816 | 19.86 |

*Source: RBI (2010).*

### Table A.4: Status of pumpset electrification

| State | Estimated ultimate groundwater potential in terms of electrical pumpsets | Pumpsets electrified Number | Pumpsets electrified Percentage (%) |
|---|---|---|---|
| Andhra Pradesh | 198 1000 | 2 769 275 | 139.8 |
| Gujarat | 779 800 | 921 521 | 118.2 |
| Maharashtra | 2 449 800 | 3 169 115 | 129.4 |
| West Bengal | 650 000 | 116 343 | 17.9 |
| All India | 19 594 000 | 16 760 455 | 85.5 |

*Source: DES (2010).*

### Table A.5: Consumption of electricity for agricultural purposes

| Year | Consumption for agricultural purposes (GWh) | Total consumption (GWh) | % of agricultural consumption to total consumption |
|---|---|---|---|
| 1982-83 | 17 817 | 95 589 | 18.64 |
| 1983-84 | 18 234 | 102 344 | 17.82 |
| 1984-85 | 20 960 | 114 068 | 18.38 |
| 1985-86 | 23 422 | 122 999 | 19.04 |
| 1986-87 | 29 444 | 135 952 | 21.66 |
| 1987-88 | 35 267 | 145 613 | 24.22 |
| 1988-89 | 38 878 | 160 196 | 24.27 |
| 1989-90 | 44 056 | 175 419 | 25.11 |
| 1990-91 | 50 321 | 190 357 | 26.44 |
| 1991-92 | 58 557 | 207 645 | 28.20 |
| 1992-93 | 63 328 | 220 674 | 28.70 |
| 1993-94 | 70 699 | 238 569 | 29.63 |
| 1994-95 | 79 301 | 259 630 | 30.54 |
| 1995-96 | 85 732 | 277 029 | 30.95 |
| 1996-97 | 84 019 | 280 206 | 29.98 |
| 1997-98 | 91 242 | 296 749 | 30.75 |
| 1998-99 | 97 195 | 309 734 | 31.38 |
| 1999-00 | 90 934 | 312 841 | 29.07 |
| 2000-01 | 84 729 | 316 600 | 26.76 |
| 2001-02 | 81 673 | 322 459 | 25.33 |
| 2002-03 | 84 486 | 339 598 | 24.88 |
| 2003-04 | 87 089 | 360 937 | 24.13 |
| 2004-05 | 88 555 | 386 134 | 22.93 |
| 2005-06 | 90 292 | 411 887 | 21.92 |
| 2006-07 | 99 023 | 455 748 | 21.73 |
| 2007-08 | 104 182 | 501 977 | 20.75 |

*Source: DES (2010).*

### Table A.6: Per state consumption of electricity for agriculture purposes in 2007-08

| Year | Consumption for agricultural purposes (GWh) | Total consumption (GWh) | % of consumption for agricultural purpose |
|---|---|---|---|
| Gujarat | 10 946.44 | 44 236.33 | 24.75 |
| Maharashtra | 12 675.64 | 67 930.96 | 18.66 |
| Andhra Pradesh | 15 241.05 | 48 861.10 | 31.19 |
| West Bengal | 1 110.07 | 26 247.97 | 4.23 |
| All India | 104 181.69 | 501 977.11 | 20.75 |

*Source: DES (2010).*

### Table A.7: Farmer suicides (nationally)

| Year | All suicides | Farmer suicides | Farmer suicides as % of all suicides |
|---|---|---|---|
| 1997 | 95 829 | 13 622 | 14.21 |
| 1998 | 104 713 | 16 015 | 15.29 |
| 1999 | 110 587 | 16 082 | 14.54 |
| 2000 | 108 593 | 16 603 | 15.29 |
| 2001 | 108 506 | 16 415 | 15.13 |
| 2002 | 110 417 | 17 971 | 16.28 |
| 2003 | 110 581 | 17 164 | 15.52 |
| 2004 | 113 697 | 18 241 | 16.04 |
| 2005 | 113 914 | 17 131 | 15.04 |
| 2006 | 118 112 | 17 060 | 14.44 |
| 2007 | 122 637 | 16 632 | 13.56 |
| 2008 | 125 017 | 16 196 | 12.96 |
| 2009 | 127 151 | 17 368 | 13.66 |

*Source: NCRB (2010); Sainath (2010).*

### Table A.8: Farmer suicides at the state level

| Year | All suicides | Farmer suicides | Farmer suicides as % of all suicides |
|---|---|---|---|
| Andhra Pradesh | 14 500 | 2 414 | 16.65 |
| Gujarat | 6 156 | 588 | 9.55 |
| Maharashtra | 14 300 | 2 872 | 20.08 |
| West Bengal | 14 648 | 1 054 | 7.20 |
| All India | 127 151 | 17 368 | 13.66 |

*Source: NCRB (2010).*

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