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The Impact of Erratic Electricity supply on Irrigated Agriculture

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CONTENTS

Abstract

Unscheduled power cuts reduced summer paddy yields in Aurepalle and Dokur in 1990 and 1992. Power cuts are the inevitable result of flat rate pricing schedules for agricultural electricity, but they are only a major problem when they are unscheduled and unpredictable. Unpredictability raises production costs and reduces crop yields. Farmers indicate that they are willing to pay more for better quality power delivery. The Andhra Pradesh State Electricity Board has limited options due to political pressure. If it cannot adopt pro rata pricing it must tighten existing rations; otherwise unscheduled cuts will become increasingly common.

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Introduction

On 10 April 1990 much of Telangana region of Andhra Pradesh was crippled by a bandh in protest of the reduced allotment of electricity to farmers from 24 to 13 hours. Farmers complained that the power cut reduced the area they could irrigate and raised production costs by requiring that work be organized around electricity availability.

The target of the bandh was the scheduled reduction of power, but unscheduled cuts were also reported with regularity during the summer season in 1990 and again in 1992. Unscheduled cuts were particularly harmful to rabi paddy, which requires daily irrigation. Power cuts had a strong impact in parts of Mahbubnagar district of central Andhra Pradesh. In Aurepalle village, for example, about 40% of the rabi paddy crop failed in 1990 due to erratic electricity supply.

This paper describes the problem of poor quality electricity delivery in rural South India. It then presents the results of surveys in two Andhra Pradesh villages affected by power cuts, reviewing farmers' experiences in the 1990 rabi season, the short term costs of power cuts, and farmers' planned response to the problem. It also summarizes the Andhra Pradesh State Electricity Board's view of the situation.

The Electricity Drought

Electricity demand is growing faster than generating capacity in Andhra Pradesh. Power cuts occur each year with growing regularity as the summer progresses and hydroelectric generating capacity declines. Prior to 1990, however, lift irrigation enjoyed an exemption from power cuts (Andhra Pradesh State Electricity Board (APSEB), 1989; conversations with APSEB officials).

The low, flat electricity fee paid by well owners encourages profligate use of water and power. Farmers pay an annual flat fee of Rs. 100 per horsepower per pumpset hookup, which implies marginal cost of electricity consumption equal to zero. (Pumpsets over 5 hp pay a higher flat fee, but vast the majority of pumps are less than 5 hp.) As an input will be used until its marginal cost equals its marginal product, flat electricity charges make electricity use economical up to the point when more electricity use does not lead to more production. Electricity use is not constrained by price, but as a scarce good it must be rationed somehow. Quantity rationing is inevitable under low, flat rate pricing.

Predictability and Frequency of Power Cuts

Rationed electricity has two pertinent characteristics: predictability and duration. Scheduled power cuts are predictable, so agricultural operations can be organized around them. If power cuts are unpredictable, labor costs rise due to the need to monitor electricity and turn on the pumps in a timely manner. Production costs rise, but crop damage can be avoided as long as the duration of supply (once the power comes on) is sufficient to irrigate. However, if the duration of supply is so short that attempts to irrigate are continually thwarted, yields will fall.

The Study Villages

Farmers in two Mahbubnagar district villages, Aurepalle and Dokur, were surveyed to examine the incidence and impact of unscheduled power cuts during the 1989-90 rabi season.

Aurepalle and Dokur villages are located about 70 km and 110 km south and southwest of Hyderabad, respectively. Both villages are in the shallow to medium deep red soil region, with 600-700 mm average annual rainfall. Around 20% of the farmers in each village have access to irrigation wells and planted paddy in the 1990 rabi season.

Unscheduled power cuts began in Dokur in February and in Aurepalle in March. In Dokur, the cuts were mainly confined to the first half of February and may have been caused by a faulty transformer. Power was very sporadic, with frequent cuts that hampered irrigation. The paddy crop suffered, but farmers indicated that the poor harvest (67% of expected production among those surveyed) resulted as much from lack of water in their wells as from lack of electricity.

In Aurepalle, on the other hand, farmers maintained that there was sufficient water in the wells but that frequent, unpredictable power cuts prevented irrigation. Interruptions in the current occurred throughout each day from the first week in March until the crop was harvested in mid- to late April. Power cuts took place as many as 20 times per day with unpredictable duration. Labor costs rose as the farmer or his servant had to monitor the current throughout the course of the irrigation, which was usually an entire day. Furthermore, as soon as the water was pumped into the field channels, the power would fail and the farmer would have to start over again. In between attempts to irrigate much water was lost to seepage into the non-retentive, shallow red soil of most of Aurepalle's field channels (Dvorak, 1988). As a result electricity consumption rose per unit of water brought to the field; farmers report that pumps ran for up to ten hours each day instead of their normal village average of five hours.

Farmers surveyed in Aurepalle lost 40% of their expected paddy harvest. In Dokur the situation was less severe, but paddy crop losses still amounted to a third of expected harvest. The overall cost of the unscheduled cuts included yield losses, higher labor costs (due to the need to monitor power), and increased electricity consumption. The cost of higher power consumption was not incurred by farmers because of flat rate pricing, but as a waste of a scarce good it represents an economic cost to society.

Farmers' Response

Frequent cuts and short duration of power supply cannot be overcome simply by hiring labor to monitor the labor supply. When the duration of supply is so short that irrigation is impossible, other power sources must be used. The most likely alternative is diesel; for open wells draft animal power could also be used.

Farmers indicated that they are not enthusiastic to substitute diesel fuel for electrical power because diesel is too expensive. Only one farmer among those surveyed had bought a diesel pump in response to the erratic electricity supply.

Farmers in Kolar district of Karnataka, outside of the survey area, have developed a mechanism to cope with both the unpredictability and frequency of power cuts. Where the topography allows it, many farmers have built small catchment tanks on the highest part of their land. When the power is on they pump water into the tank, and then irrigate by gravity when it is full. (This is the same concept as rooftop tanks built by urban water users faced with water rationing.) The costs of gaining additional water in this way include the area removed from

cultivation to build the tank (about 60-100 square meters) and the seepage of water along the more extensive conveyance system (source: field visit to Kolar District with S.T. Somashekhara Reddy).

Farmers' Attitudes About Pricing

Flat rate electricity pricing was introduced in the mid-1980s ostensibly to benefit small farmers as well as reduce administrative costs. But the benefits from flat rates are not accrued without costs: farmers pay less for poor quality, unreliable power. Quantity rationing results directly from excess demand for power caused by the low, flat tariff.

70% of well owners interviewed in Aurepalle and 100% of those in Dokur said that they would prefer to pay higher flexible rates and have assured access to electrical power than to pay the low flat rate with an uncertain electricity supply. Only some of the largest farmers preferred the flat rates, because they would have to pay the most under pro rata pricing. They would prefer to switch to a less water-intensive crop than pay more to irrigate a paddy crop.

Willingness to Pay

Farmers in Dokur and Aurepalle were asked how much they would be willing to pay to irrigate an acre of paddy. Their answers varied quite widely, ranging from Rs 100 to Rs 300. The average in Aurepalle was Rs 170 and the average in Dokur was Rs 154.

Changed Cropping Pattern

When farmers were questioned in 1990 about their plans for the 1991 rabi season, virtually all said they would reduce the area planted under paddy in favor of a less water-intensive crop. Given the uncertain availability of electricity, a crop such as paddy requiring daily irrigation becomes risky. Groundnut, the most common alternative, is only irrigated every 10-15 days, so the high costs of irrigation are incurred less frequently.

Power supply was erratic in Aurepalle and Dokur again in 1992. Aurepalle farmers were resurveyed following the 1992 rabi season. Most of them had reduced the area under paddy and so did not suffer as badly from the erratic power supply as they had in 1990. However, they indicated that they cannot eliminate paddy entirely from their cropping pattern because it is essential to their diet and because some land is not suitable for other crops.

Andhra Pradesh State Electricity Board's View

APSEB officials interviewed by the author see little hope for improving the situation. "APSEB considers the supply of power of the right quality and quantity to all its existing consumers and to extend its service to others who seek power supply as its sole mission" (APSEB, 1989). However, it faces very tight constraints given the high and growing demand for power and political obstacles to raising power charges.

APSEB's activities are not subsidized, but its price schedules are determined by the central and state governments. (APSEB officials say that it has the legal right to set its own price but does not challenge the government's directives.) In order to carry out the seemingly impossible task of providing plentiful, underpriced power, APSEB has a multi-tiered price system that taxes industry and subsidizes agriculture. It is one of only two Indian states that does not run a deficit (APNSEB, 1992).

Supplying electricity to agriculture currently costs APSEB Rs 200 crores per year, with only Rs 20 crores recovered in fees paid by farmers. The huge gap is filled by charging high electricity fees for industrial and other users (Table 1). APSEB officials feel that it would not be possible to cover the costs of providing power to the agricultural sector by raising the price paid by farmers. Only a minor price increase would be politically possible, and it would not make a sizeable difference in total revenue.

However, raising prices would increase revenue per unit supplied and also reduce the total demand and hence the total outlay for supplying agricultural power. APSEB does not have reliable estimates of the price elasticity of demand for electricity, so it is not clear what impact various price scenarios would have on APSEB's costs and returns. But evidence shows that farmers do respond to prices: the utilization of each pump increased significantly after the introduction of flat rate pricing in 1981-82 (Table 2).

APSEB officials realize that flat charges encourage power consumption, but they indicate that for political reasons a general return to pro rata pricing is most unlikely. On the other hand, if farmers understand the relationship between power tariffs and power availability, pro rata tariffs might not be so unpopular. Publicity efforts in this regard would be useful.

Some APSEB officials are not convinced that pro rata pricing would improve the quality of power delivery. Power cuts are so pervasive in the summer because hydroelectric generating capacity falls to practically zero. This represents the loss of over half of the state's total potential generating capacity. These officials say that since it would be impossible to charge farmers enough to raise the money to build additional thermal power plants, nothing can be done about summer power cuts.

But something must be done. Agriculture's share of total electricity consumption is rising steadily (Figure 1), while growth in generating capacity is insufficient to meet demand (Figure 2). APSEB has had to buy electricity from the central sector since 1983-84 by an amount roughly equivalent to the increase in electricity consumption by the agricultural sector. Future growth in generating capacity will have to come from new thermal and gas plants as virtually all of the state's hydroelectric potential has been tapped already (conversation with APSEB officials). Thermal energy generation is not attractive because by using petroleum it drains foreign exchange.

Some APSEB officials believe that a combination of higher user charges and incentives to conserve might generate enough revenue to pay for thermal generating potential sufficient to meet demand, but they are pessimistic with regard to the likelihood of such action. In this case only stricter rationing will control consumption to manageable levels.

Conclusion

Power cuts are unavoidable under the current pricing system. In most cases they are scheduled, so farmers can organize irrigation accordingly. In some cases they are unscheduled, but when the power does come it stays on long enough to irrigate the crop. In this case farmers pay higher labor costs but can avoid crop damage. Finally, in some cases power cuts are unscheduled and frequent, and the power does not stay on long enough to irrigate the crop. In this case the short term consequence is loss of the crop, and the long term response must be either to switch to diesel, stop planting in the rabi season, or irrigate with electric pumps but run the risk of crop failure.

Some APSEB officials acknowledge that frequent, unscheduled cuts take place in some villages such as Aurepalle. They indicate that minor errors in the energy input-output calculations are to blame and describe such problems as small in the context of statewide electricity supply and demand. However, for the affected farmers the problem is not small. Furthermore, the dynamics

of electricity supply and demand suggest that such errors are likely to become more frequent. In fact they are already sufficiently frequent that in late 1992 farmers demonstrated in Bangalore against unpredictable supply (M.G. Chandrakanth, personal communication).

Farmers want cheap, continuous and stable power. They cannot have all three. Predictable supply can only be achieved with either pro rata pricing or more severe rationing. Under flat rate pricing power cuts are inevitable, but it is not inevitable that they should be unpredictable or that the duration of supply should be so short as to prevent irrigation.

References

Dvorak, Karen, 1988, "Indigenous Soil Classification in Semi-Arid Tropical India, ICRISAT Economics Group Progress Report No. 84.

Power Development in Andhra Pradesh (Statistics), 1988-89; 1991-92, Andhra Pradesh State Electricity Board, Hyderabad.

Shah, Tushaar, 1989, "Efficiency and Equity Impacts of Groundwater Markets: A Review of Issues, Evidence and Policies," IRMA Research Paper No. 8, Anand.

Table 1
Andhra Pradesh Power Tariff by Consumer Category, 1992

Domestic	62.8
Commercial	131.8
Agricultural/Irrigation	4.5
Industry:	
Low Tension	95.3
High Tension1	17.5
Power Intensive	118.4
Railway traction	128.6
Outside the State	8.0
Overall average Rate	70.0
Overall average cost of operation	70.2

Source: APSEB, 1991-92

Table 2

Effect of Flat Rate on Hours of Operation of Electric Pumps

	Average Power Consumption per Electric Pumpset			
	Before the Switch to Flat Rate		After the Switch to Flat Rate	
State	Year	kwh/pumpset	Year	kwh/pumpset
Andhra Pradesh	1981-82	2232	1982-83	3294
Uttar Pradesh	1973-74	2065	1979-80	6724
Maharashtra	1975-76	2191	1979-80	3142

Source: Shah, 1989

FIGURE 1

SHARE OF TOTAL ELECTRICITY CONSUMPTION

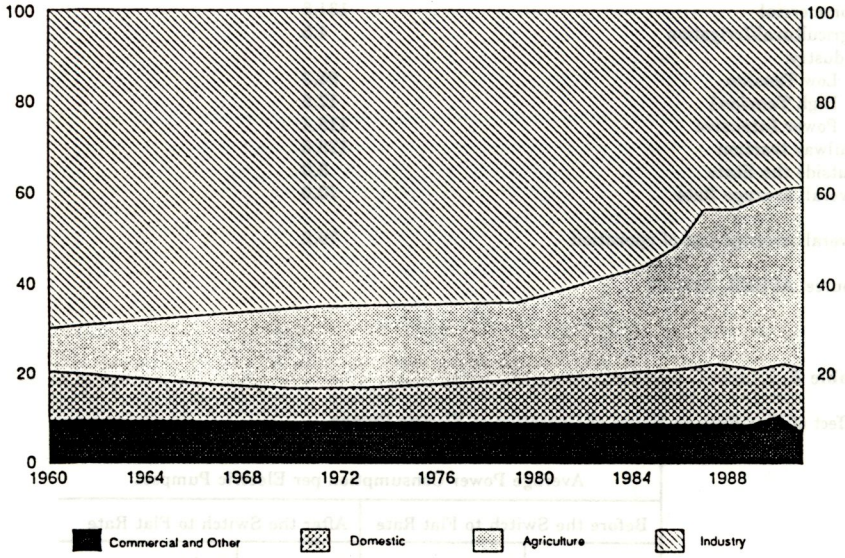
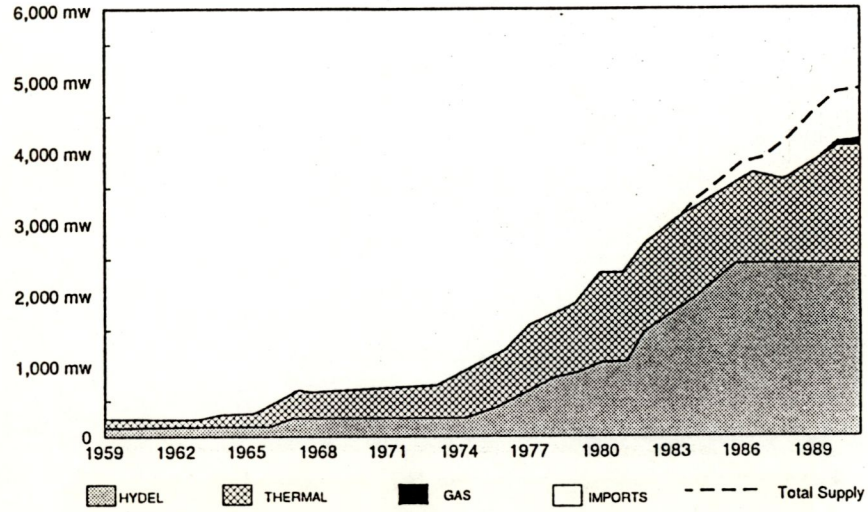


FIGURE 2

ANDHRA PRADESH STATE ELECTRICITY SUPPLY



NOTE: THERMAL + HYDEL + GAS = INSTALLED CAPACITY