ELSEVIER

Energy Policy 33 (2005) 39–51

ENERGY POLICY

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Impact of electricity prices and volumetric water allocation on energy and groundwater demand management: analysis from Western India

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Abstract

In recent years, power tariff policy has been increasingly advocated as a mean to influence groundwater use and withdrawal decisions of farmers in view of the failure of existing direct and indirect regulations on groundwater withdrawal in India. Many researchers argue that pro rata electricity tariff, with built in positive marginal cost of pumping could bring about efficient use of the resource, though some argue that the levels of tariff in which demand becomes elastic to pricing are too high to be viable from political and socio-economic points of view.

The paper presents a theoretical model to analyze farmers' response to changes in power tariff and water allocation regimes vis à vis energy and groundwater use. It validates the model by analyzing water productivity in groundwater irrigation under different electricity pricing structures and water allocation regimes. Water productivity was estimated using primary data of gross crop inputs, cost of all inputs, and volumetric water inputs. The analysis shows that unit pricing of electricity influences groundwater use efficiency and productivity positively. It also shows that the levels of pricing at which demand for electricity and groundwater becomes elastic to tariff are socio-economically viable. Further, water productivity impacts of pricing would be highest when water is volumetrically allocated with rationing. Therefore, an effective power tariff policy followed by enforcement of volumetric water allocation could address the issue of efficiency, sustainability and equity in groundwater use in India.

Keywords: Overall gross water productivity; Overall net water productivity; Overall net water productivity exclusive of irrigation cost

1. Introduction

Several regions of India face groundwater crisis. In many parts of peninsular India, which is underlain by hard rocks, excessive withdrawal of groundwater for irrigation made possible through proliferation and energisation of wells has led to depletion of the resource base, frequent failure of wells and sharp reduction in irrigation potential of wells. In alluvial areas of western India, uncontrolled abstraction through tube wells energised by high capacity pumps led to permanent depletion of shallow aquifers and alarming drops in water levels. Today, agricultural pumping accounts for 31.4 per cent of the total power consumption in India (CMIE, 2002), which observed a steady increase during the past decade mainly owing to the rising cost of abstraction of groundwater.

The poor financial working of many State Electricity Boards is attributed to highly subsidised power made available to the farm sector, which accounts for a major chunk of the electricity consumption in the respective states, and power thefts. While some states provide 100 per cent subsidised electricity in the farm sector, some states do not meter agricultural power consumption and charge electricity on the basis of connected load. Deteriorating financial condition severely limit the ability of State Electricity Boards to supply good quality power to the farm sector. In contrast to this, groundwater resources are abundant in eastern India; but its development for irrigation is precariously low. Many researchers have argued that groundwater irrigation could trigger agricultural growth and help alleviate poverty in this resource abundant region (for instance see Shah, 2000). However, this region faces major shortcomings in catering to the rural energy demands.

Great deal of consensus exists among researchers over the fact that rural-electrification and power-subsidies in

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doi:10.1016/S0301-4215(03)00196-4

the farm sector have triggered exponential growth in groundwater irrigation in India (Moench, 1995; Shah, 1993; Palmer-Jones, 1995). Many have argued that the current mode of pricing power consumption in the farm sector, which does not reflect the actual unit consumption, creates incentive for wasteful use of both power and groundwater (Kumar and Singh, 2001; Palmer-Jones, 1995; Saleth, 1997). Sustainable approaches to manage groundwater resources that are grounded on a sound footing of good hydro and social sciences are, however, not forthcoming.

The groundwater management debate in India has so far focused on many direct and indirect management options: artificial recharge of groundwater in areas facing problems of overdraft; direct regulation of groundwater abstraction through state legislation; indirect regulations through well financing and other leverages; local management of groundwater by user groups; establishment of private/cooperative property rights in groundwater. Some of them have already been tried in different parts of the country. Legal interventions to check and control overdraft were never successful due to their social and political ramifications.[1]

The National Bank for Agriculture and Rural Development (NABARD) has been using "control of institutional financing for well development" in over-exploited areas; but was by and large ineffective in checking overdraft due to large-scale private financing of well development. In Gujarat, the State Electricity Board deny new agricultural power connections in over-exploited areas, and in critically developed areas when well spacing regulations are violated; but this measure has been ineffective due to the use of old power connections for newly drilled wells (Gass et al., 1996). There have not been many attempts to foster local, community-based initiatives to manage groundwater. So far as water rights reform is concerned, there have been no breakthroughs in the discussions on the institutional processes to institute them.

Artificial recharge of groundwater has been tried in many parts of India to arrest depletion, some of which are also community based; but met with very little success. The reasons are many: First, the areas facing depletion problems are falling in arid and semi arid regions where availability of endogenous surface water is extremely limited. Second, unfavourable physical conditions for recharging like poor groundwater storage potential exist in some areas. An important example is the groundwater recharge movement in Saurashtra peninsula of Gujarat, which was primarily driven by religious and spiritual organizations and voluntary movements. Though this decentralized movement of water harvesting claims to have made significant achievements in terms of number of wells and ponds recharged (Shah, 1997; Kumar, 2000b), analysis and available evidences suggest that their impact on depletion and overall water situation could be negligible (Kumar, 2000b). Third: the cost of recharging through artificial recharge structures in terms of the cost per unit volume of water is often prohibitively high.

In sum, the existing direct and indirect regulations and direct management interventions have been ineffective in arresting depletion. In the recent years, power tariff policy has been increasingly advocated as an instrument to influence groundwater use and withdrawal decisions of farmers (Shah, 1993; Saleth, 1997).

The past decade has seen wide debates on the potential linkage between electricity pricing and groundwater use for irrigation; especially the implication of electricity prices for access equity, efficiency and sustainability in groundwater use (see for instance Moench, 1995). These debates are characterized by differing and often diametrically opposite views on the potential impact of power tariff changes on access equity, efficiency of groundwater use and sustainability of the resource (based on Shah, 1993; Palmer-Jones, 1995; Saleth, 1997; Kumar and Singh, 2001; IRMA/UNICEF, 2001; de Fraiture and Perry, 2002).

Many researchers argue that pro rata electricity tariff, with built in positive marginal cost of pumping could bring about efficient use of the resource (Shah, 1993; Moench, 1995; Saleth, 1997; Kumar and Singh, 2001), though some argue that the levels of tariff in which demand becomes elastic to pricing are too high to be viable from political and socio-economic points of view (de Fraiture and Perry, 2002). Narayanamoorthy (1997) argues that influence of power tariff on the consumption of electricity and water would be too less on the ground that it constitutes a meagre portion of the total cost of cultivation.

Not much of consensus exist at the fundamental level about appropriate tariff structures, which generate efficiency in resource use, equity in access to groundwater and sustainability of resource use. After Saleth (1997), power tariff policy alone cannot be an effective tool for achieving efficiency, equity and sustainability in groundwater use (Saleth, 1997). Unfortunately, these debates are based on theoretical reasoning and some practical considerations.

Saleth (1997) argues that even an imperfect system of groundwater rights will have more sustainable benefits than a most perfectly designed power tariff structure. Many researchers in the recent past have suggested

[1] Though groundwater legislation had been passed by Gujarat way back in 1992, it could never be enforced. Maharashtra groundwater legislation applies to only protection of public drinking water sources and has been only partially effective. The Central Ground Water Authority had enacted groundwater legislation in Delhi and neighbouring areas, but has been only successful in regulating industrial pumping. Many other Indian states, including Tamil Nadu and Madhya Pradesh are in various staging of formulating legislations to regulate groundwater.