

Irrigation Institutions in a Dynamic Economy: What Is China Doing Differently from India?

Author(s): Tushaar Shah, Mark Giordano and Jinxia Wang

Source: *Economic and Political Weekly*, Vol. 39, No. 31 (Jul. 31 - Aug. 6, 2004), pp. 3452-3461

Published by: Economic and Political Weekly

Stable URL: <http://www.jstor.org/stable/4415340>

Accessed: 11-03-2018 03:23 UTC

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <http://about.jstor.org/terms>



JSTOR

Economic and Political Weekly is collaborating with JSTOR to digitize, preserve and extend access to *Economic and Political Weekly*

Irrigation Institutions in a Dynamic Economy

What Is China Doing Differently from India?

India's water sector is crying for institutional and policy reforms. Its public irrigation systems are performing far below par. As a direct consequence, farmers are turning to groundwater for their irrigation needs. Booming groundwater irrigation has become the mainstay of Indian farming but it has also all but wrecked the country's power economy because of perverse policies of pricing of electricity for agriculture.

Yet, there is no firm strategy of dealing with these and other challenges.

Other south Asian countries are in much the same boat.

Based on two spells of fieldwork in six provinces of north China, this article shows that, facing much the same problems as its south Asian neighbours, China is responding differently to its water problems. This is by no means a suggestion that the approaches China is trying out would work in India – or even in China itself. However, by including China's experience in its discussions, Indian policy-makers will clearly have a wider repertoire of institutional alternatives with which to experiment.

TUSHAAR SHAH, MARK GIORDANO, JINXIA WANG

I Background

As water development concerns increasingly make way for water resource management strategies, discussions on water institutions in India and her south Asian neighbours are focusing on three key issues: (a) how to improve the performance and financial viability of public irrigation systems; (b) how to make groundwater use sustainable in economic and environmental terms; and (c) how to make a systematic transition from the water resource development mode to an Integrated Water Resources Management (IWRM) mode.

India is struggling on all three fronts. Its public irrigation systems are falling far short of their design potential for performance; they do not receive the investment they need for maintenance and upkeep; but above all, they are increasingly becoming a drag on state exchequer. Indian discussion on public irrigation systems is enamored by participatory irrigation management (PIM) and irrigation management transfer (IMT) as an 'institutional fix' for all these problems. However, despite two decades of experimentation, available evidence provides no indication that PIM works or will solve the problems public irrigation systems face. Similarly, India is stymied by its unregulated groundwater economy that functions as a colossal anarchy. Technocrats advocate strong regulatory frameworks; sociologists argue for community based resource management; western experts argue for hi-tech approaches tested in the western US and Australia's Murray-Darling. In reality, policy action is paralysed by a political economy in which half of the country's population depends for livelihood on groundwater draft that is rapidly becoming unsustainable. Worse, thanks to perverse subsidies under its flat system of electricity pricing, India's booming groundwater irrigation economy has wrecked its energy economy.

The key challenges to rationalising electricity pricing and supply to pumps are the huge transaction costs of collecting charges based on metered use and the fact that so many livelihoods have come to depend upon tube well irrigation [Shah, Scott, Kishore and Sharma 2004]. Much the same reasons defy the transition to IWRM: how to price water to reflect its scarcity value when water is such a volatile political issue? How to make an effective regulatory framework stick? How to unify fragmented water institutions? [Shah, Makin and Sakthivadivel 2001].

While India can provide its own answers to these questions, experiences from elsewhere may help guide its choices. However, as suggested above, looking to countries with far different social realities may not be the most helpful approach. Instead, examining the experience of nations which share at least some of India's fundamental conditions may be the more fruitful. Of those conditions, the most important may be (1) developing country status, (2) having a perceived need for water sector reform, and (3) large numbers of diffuse water users. India's neighbour to the north, China, has all three conditions. To gain an understanding of how the Chinese water experience might provide lessons for India, we combined literature review with two field visits in the Chinese provinces of Hebei, Henan, Shaanxi, Liaoning and Jiangsu during 2002 and 2003 which included visits to around 25 villages and discussions with officials of some 20 water bureaus at township, county, prefecture and provincial levels. The paper

This and the following 10 papers were presented in the Third Partners' Meet of the IWMI-Tata Water Policy Research Programme held at the Institute of Rural Management, Anand on February 17-19, 2004. We are grateful to Tushaar Shah for compiling this collection. -Ed

outlines a variety of ways in which China has acted differently from India, indeed all of south Asia, even as it struggles with the same set of issues that countries like India face. South Asian discussion and action on irrigation management reforms, ground-water management and IWRM seems stuck. The idea behind this paper is not to make a virtue out of the different route that China is following but to stimulate some 'out of box' thinking within India on possible ways out of its water woes.

II 'Bounded Service Providers' as Managers in Small Irrigation Projects

One issue that most developing countries have not resolved satisfactorily is the management of irrigation systems, small and large. For long, governments have maintained large irrigation bureaucracies. However, bureaucratic management has been seen as a resounding failure almost everywhere; moreover, resource-strapped governments increasingly find irrigation bureaucracies a huge financial burden they are impatient to shed. During 1980s and 1990s, the idea gained ground that instead of through remote bureaucracies, irrigation schemes are best managed by organised and empowered farmer communities [Vermillion 1996 and 1999]. As a result, PIM and irrigation management transfer IMT emerged as the 'ideal' institutional model. And many eager governments jumped on this new bandwagon with alacrity, especially when offered a cheap loan from an international donor.

However, after over 20 years of experience with IMT and PIM, old questions still remain unanswered. Does farmer management ensure better quality of irrigation service to farmers? Does it mean lower cost of O and M? Does it result in improved productivity of irrigation water at the system as well as farm level? And better spatial and inter-personal equity in the allocation of water? Does PIM result in greater investment in maintenance and repair? And ease the financial burden on the state? To none of these has PIM or IMT offered an enduring answer. In the Philippines, initial years of the National Irrigation Authority (NIA)'s pioneering effort threw up positive results; but the performance of PIM has now slipped [Panella 1999]. Where farmer management has improved cost recovery, it has done so by shrinking the command area served. In many African countries, PIM has done better where command areas are populated by white commercial farmers with large holdings; but has left black smallholder communities worse off [Shah, van Koppen, Merrey, Lange, Samad 2002]. In Sri Lanka and Nepal, there are some success stories; but these need constant propping up. The latest experiment of large-scale PIM in Andhra Pradesh in India, which has been projected globally as a model, has already run out of steam even as several other Indian states have copied Andhra Pradesh's PIM Act [Reddy 1999].

One would have expected that after decades of Maoist experiments with variations of collective management in rural economy, Communist China would take to ideas of community irrigation management with passion and zest. And everywhere we went, we found remnants of collective management. However, except where World Bank loans support PIM projects, China has not fallen for the communitarian model of irrigation organisation. Instead, one witnessed everywhere variants of a model best described as 'bounded service provider', a private economic agent incentivised to perform a role assigned to him/her within a boundary established and defended by the village committee; hence our use of the phrase 'bounded service provider'.

This model is found most commonly with irrigation tube wells. Before the sweeping agrarian reforms initiated by the Deng

administration after 1978, collectives throughout China were responsible for making and maintaining tube wells as well as pumps and distribution systems. With the onset of the household responsibility system (now defunct) and later reforms, a variety of institutional arrangements have now come into play in the Chinese countryside. Where water tables are high and tube wells and their operation inexpensive – as in parts of Henan province – village committees still own and maintain bore holes; but farmers bring their own or shared pumps; and the irrigation organisation is quite akin to what we find in a south Asian village.

In deep tube well areas of Hebei, Shaanxi and Shandong provinces, village irrigation organisation undergoes marked change. Shallow and middle deep tube wells dominate the ground-water irrigation here as well. But we also find areas here with deep tube wells serving larger commands of 600-1,000 mu (approximately 40-70 ha), whose construction costs are beyond the reach of most individual farmers.¹ In these areas, it is still common for deep tube wells to be established, funded, and owned by the village development committee often by using accumulated savings, borrowing or imposing a new tax on farm land. Increasingly, however, village committees invite private investments, usually from farmers, to establish and operate tubewells as irrigation entrepreneurs [Lohmar et al 2002].

Thus the emerging Chinese management model for small-holder irrigation systems is strikingly different from what we find in south Asia. Earlier, in the Maoist era, irrigation tube wells were directly managed by the village collective through salaried operators, much like public tube wells are still managed by government corporations in many Indian states. However, increasingly, O and M of these is commonly contracted out to a 'service providing entrepreneur' on a kind of franchise model. A variety of contracting arrangements seem to be in vogue; but variations were observed in five areas: (a) identification of 'service providers'; (b) management fee; (c) responsibility of the contractor; (d) role of the village committee; and (e) impact.

Typically, 'service providers' are found from the more entrepreneurial amongst the village's farmers, men or women. Only in one of the villages we visited did the irrigation system manager come from outside the village. In a few villages, a five-year 'management contract' was auctioned to the highest bidder. But a common procedure to identify and appoint the 'service provider' was informal negotiation by the village committee (VC) and/or the township water bureau (TWB) with prospective candidates. In some Shaanxi villages, where the TWB had built costly drip or sprinkler irrigation systems, we found the village leaders themselves, all men, had secured management contracts. We also came across women managers of tube wells, one of whom took on the task not because it was remunerative but rather because she had been pressured by VC relatives to ensure continued operation. Where the management contract was auctioned, the village committees levied an annual fee on the contractors; however, this did not appear to be common and in these cases, the village committee still assumed the responsibility for maintenance and repair, and the manager was responsible only for water distribution and fee collection.

The period of the management contract varies from five to 30 years. The contractor's responsibility typically includes: (a) operation and maintenance of the system; (b) orderly distribution of water to farmers; (c) collection of irrigation fees; and (d) the payment of electricity fees to the village electrician or township electricity bureau. However, the irrigation fee is invariably determined by the village committee and/or the township

water bureau; and this feature makes this arrangement different from outright privatisation. There were too many variations in the way VCs determined irrigation fees to permit generalisation; but fees are fixed in terms of hours of pumping or kWh of electricity used.² In new drip or sprinkler irrigation systems in Shaanxi, irrigation fees appeared high and the management contract lucrative. However, in some villages, we also found that pressure from farmers forced the VCs to keep irrigation fees low; and at least in one village, we found the contractor had terminated his contract and the village committee found a new contractor who also happened to be the village electrician.

Our surmise is that the lucrativeness of the irrigation franchise varied with contractor's contribution to the capital cost. In systems built, owned and operated by private farmers, the VC had little or no say in determining the irrigation fee. In some of the new drip and sprinkler systems, where contractors shared the capital costs, the VC had the power to fix the irrigation fee, but it allowed liberal margins and gave long-term contracts. We came across two such situations in Shaanxi; in one, the contractor shared less than 10 per cent of the capital cost and received a five-year contract; but in the other, the contractor contributed 25 per cent of the capital cost of a sprinkler irrigation system for which he obtained a 30-year management contract. Management contracts seemed to be the least lucrative on schemes wholly built and owned by VCs.

III Entrepreneurial Managers in Large Irrigation Systems

When it comes to large irrigation systems, the picture is somewhat different and more diffuse. There are World Bank assisted PIM programmes like we have in Andhra Pradesh; but little is known about how well these have done. Jiangsu has one such project to organise water user associations (WUAs); however, discussions with the provincial water bureau officials suggested that the project has not brought about much change. A key problem Jiangsu wanted addressed by PIM was the control of excessive use (around 15,000 m³/ha for rice) by farmers of expensive Yangtze water transferred from the south of the province to north. In the Jiangsu PIM project, the Bank funds were used to install meters at each WUA so that farmers could save in water fees if they reduced water use. Maintaining the meter, distributing water and collecting the water fee and turning it over to the local water bureau was all that the WUA did. The maintenance of canals and other infrastructure is still the responsibility of the local government.

Elsewhere, canal O and M, water distribution, and water fee collection in large irrigation systems are increasingly being taken away from village committees (or collectives) which had dominated irrigation management. This role is increasingly contracted out by the village leadership to private franchisees or WUAs of varied hue, often with strong financial incentives to save water and promote its efficient use. In a study of 51 villages from four irrigation districts in Ningxia and Henan, Wang et al (2002) found that between 1995 and 2001, the proportion of villages where collective management of irrigation systems fell from 100 to 27 per cent; that amongst the villages that moved away from collective management, contracting to individual managers was twice as popular as forming WUAs; and that many WUAs were effective guise for management by the village leader himself.³

Canal irrigation fees in many Chinese systems are levied in two parts: a basic water fee based on area irrigated and a

volumetric water fee based on volume of water use. A part of the basic water fee collected is the contractor's fixed reward. However, the volumetric water fee offers the contractor opportunity to increase his income by saving water. Before each cropping season, Irrigation district officials determine a target water entitlement for each village based on historical use patterns and other criteria, and value these entitlement on a volumetric fee. The total cost is apportioned to the farm land in the village, and the contractor is authorised to collect the volumetric charge as an enhanced basic water fee from the farmers. However, he is required to pay to the water bureau only the volumetric rate on actual water use. By saving water, thus, the contractor can enhance his earnings. The Wang et al paper (2003) showed that in the incentivised villages, water managers behaved significantly differently from the rest of the villages. In general they found that: (a) in villages with collectively managed systems, water use/ha was higher; (b) water use/ha was 40 per cent lower in villages with incentivised management; (c) shift to private contractor reduces water use/ha but more so when the contractor is incentivised; (d) water-saving by incentivised managers reduces wheat yields by 10 per cent, but maize and rice yields were not affected in any significant manner; and (e) in any case, these farmers either sustained their income levels or improved them despite low yields.

The China study by Wang et al, also found that while management reforms had gathered pace in Ningxia, they stagnated in Henan. Their explanation was the drive for reform at the provincial level: in Ningxia, the Provincial Water Bureau pushed contracting energetically; in Henan, no such initiative was forthcoming. A study of reform of public tube well management in Gujarat, India by Mukherji and Kishore (2003) concluded similarly: here too, management reforms succeeded because they were energetically supported and pushed by the top-levels of the irrigation department. Moreover, there is indicative evidence that incentivised irrigation managers have begun to worry about farmers turning to groundwater irrigation in the face of poor quality of surface irrigation service. In a Henan, Lohmar et al (2002) noted: "In these villages, it is interesting to see how the increasing use of groundwater has led to competition in the delivery of the village's water, forcing the surface system to improve its water delivery services".

All in all, the direction in which institutional reforms in irrigation management are heading in China is different from south Asia where reforms are still shrouded in obscure communitarian logic. In PIM/IMT projects in India, focus of government, NGOs and donors is on organising the communities, forming WUAs, capacity building, empowerment, and creating the right 'process'. There is little engagement with the nuts-and-bolts issues of managerial rewards and incentives, clarifying roles and responsibilities and, above all, getting results in terms of improved services, better fee collection, and more crop per drop. By focusing on creating 'bounded service providers', China's reforms seem focused on results. Nowhere in the course of our field visits did we hear farmers or officials waxing eloquent about empowerment and capacity building. Instead, the institutional design discussion was centrally about shaping incentives, authority, checks and balances, and contract design and enforcement. Thus, the features of the 'Bounded Water Service Provider' model we frequently encounter for small, self-contained irrigation schemes in rural China are best described as follows: (a) by insisting that the manager makes a substantial cash investment, it is ensured that he brings a serious intent of running a profitable water business for a long haul; (b) the seemingly

high gross margin allowed makes it worthwhile for him to do proper O and M; (c) since the VC/TWB have some role to play in the issue water withdrawal permits by the county water bureau, they can, to some extent, ensure the manager's monopoly; (d) but at the same time, by insisting that the manager cannot raise the water price without the approval of the TWB, there is a built-in check on the exercise of monopoly power; and (e) since the village community has often no other alternative, a well-run, even if somewhat expensive, irrigation system would lift the entire economy to a higher plain of welfare.

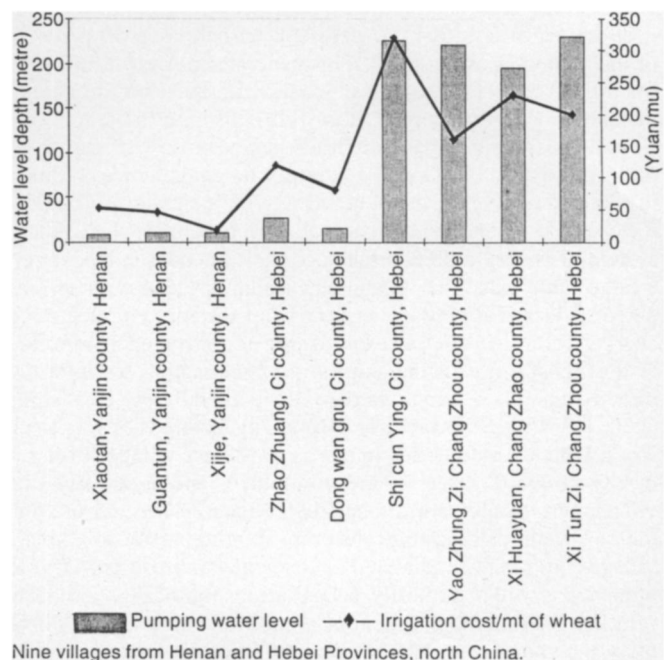
IV Energy-Irrigation Nexus

A major cause of widespread groundwater depletion in India is perverse incentives created by energy subsidies [Shah, Scott, Kishore and Sharma 2004]. These mean that the cost of groundwater use that farmers incur does not rise directly with growing scarcity of groundwater because of perverse energy subsidies. For instance, the cost of a cubic meter of groundwater purchased by a small farmer is around Rs 4-5 in eastern Uttar Pradesh or north Bihar in India where it is abundantly available;⁴ but it is less than Rs 2 in north Gujarat where it is mined from 800 feet or more. In Bangladesh, where groundwater is abundant and can be pumped from 10 feet below ground, irrigating a hectare of paddy with purchased groundwater costs a high Taka 6,000 (Approx Rs 4,800; US \$ 100) [Mainuddin 2002, pers comm] which drives many smallholders to manual irrigation; in contrast, in groundwater-stressed Tamil Nadu, where most groundwater presently being used is mined, irrigating a hectare of paddy with purchased groundwater costs less than Rs 1,500 because of electricity subsidies. This is not the case in China; as figure shows for nine villages of Henan and Hebei provinces we surveyed in 2002, irrigation cost as proportion of gross value of output rises in tandem with the depth from which groundwater is pumped.

The root of the problems is argued to be the transaction costs involved in collecting electricity charges from millions of farmers scattered over a huge country side. The logistical difficulty and economic costs of metering electricity used by tube wells has been found so high that most Indian states have done away with metering and instead charge a flat tariff based on horsepower rating of the pumps [Shah 1993; Kishore, Sharma and Scott 2002]. Pakistan too tried flat tariff for nearly a decade before reverting to metering in 2000. In India, there is growing opposition to flat tariff in part because it is believed to induce inefficient use of power and groundwater but in part also because flat tariff has been used by populist politicians to subsidise tube well irrigation. Electricity subsidy is thought to be the prime reason why many state electricity boards in India are on the verge of bankruptcy. Despite this state of affairs, some observers still argue that reintroduction of metering may not be a practical idea in the Indian context unless innovative technologies and/or institutional arrangements for collecting electricity charges can be used to reduce the transaction costs of metering and charge collection [Shah, Scott, Kishore and Sharma 2004; Godbole 2002]. All in all, groundwater as well as power sectors in India are stuck in an invidious energy-irrigation nexus that does not augur well for either.

Surprisingly, the electricity-irrigation nexus is not a subject of discussion in China at all. The Chinese electricity supply industry operates on two principles (a) of total cost-recovery in generation, transmission and distribution at each level with some minor cross-subsidisation across user groups and areas; and (b) each user pays

Figure: Irrigation Cost and Pumping Depth of Water Level in Tube Wells



in proportion to his metered use. Unlike in much of south Asia, rural electricity throughout China was charged at a higher rate than urban; and agriculture paid more than domestic and industrial use until a few years ago [Wang et al 2004]. Until 1997, the responsibility for O and M of the village electricity infrastructure and user charge recovery lay with the village committee. The standard arrangement in use was for the village committee and the township electricity bureau to appoint and train one or more local farmers as part time village electrician with dual responsibility, of maintaining the power supply infrastructure in the village as well as collecting user charges for a transformer assigned to him/her based on metered individual consumption from all categories of users. The sum of power use recorded in the meters attached to all irrigation pumps has to tally with the power supply recorded at the transformer for any given period. The electrician is required to pay the township electricity bureau for power use recorded at the transformer level.

This arrangement did not always work easily. Where power supply infrastructure was old and worn out, line losses below the transformer made this difficult. To allow for normal line losses, 10 per cent allowance is given by the township electricity bureau to the electrician. However, even this must have made it difficult for the latter to tally the two; as a result, an Electricity Network Reform Programme was undertaken by the national government to modernise and rehabilitate rural power infrastructure.⁵ Where this was done, line losses fell sharply;⁶ and among the villages we visited, none had a problem tallying power consumption recorded at the transformer level with the sum of consumption recorded by individual users, especially with the line-loss allowance of 10 per cent.

It is interesting that the village electrician in Henan and Hebei is able to deliver on fairly modest reward of Y 200-250/month plus incentive bonus of around Y 200/month [Zhang 2004] which is equivalent to the value of wheat produced on 1 mu (or one-fifteenth of the value of output on a hectare of land). For this rather modest wage, China's village electrician undertakes to

make good to the township electricity station full amount on line and commercial losses in excess of 10 per cent of the power consumption recorded on the transformers; if he can manage to keep losses to less than 10 per cent, he can keep 40 per cent of the value of power saved. This generates powerful incentive for him to reduce line losses. In the way the Chinese collect metered electricity charges, it is well nigh impossible to make financial losses since these are firmly passed on downstream from one level to the next. Take for example, the malpractice common in south Asia of end-users tampering with meters or bribing the meter-reader to under-report actual consumption. In the Chinese system, it is very unlikely that such mal-practices can occur on a large scale since the village electrician is faced with serious personal loss if he fails to collect from the farmers electricity charges for at least 90 per cent of power consumed as reported at the transformer meter. And since malpractice by a farmer directly hits other farmers in the village, there likely exist some peer control over such practices. In making metered power pricing work, China's unique advantage is its strong village level authority structure. The village committee, and especially, the village party leader, are respected and feared. These ensure that the electrician is able to do her job. In comparison to China's village committees, India's village panchayats are utterly devoid of power as well as authority as institutions for local governance.

In India, similar experiment is being tried out in Orissa where private companies in charge of distribution first experimented with Village Vidyut Sangha's (Electricity Cooperatives) but are now veering around to private entrepreneurs as electricity retailers. However, we do not have evidence on how well this arrangement is working. Even as India is taking small steps in the direction of private electricity retailing,⁷ China is turning full circle. In its third phase of modernising the electricity sector, electricity plants, transmission and distribution infrastructure are all now turned over to county electricity bureaus which have the responsibility of O and M of the infrastructure, of electricity delivery to households and other users, and of collecting user charges. Thus China is moving to a system similar to India's where state electricity boards (SEBs) directly serve hundreds of thousands of customers and collect user charges through their own field force. Expectedly, China will begin to face much the same problems in user fee recovery that Indian SEBs are trying hard to wriggle out of.

In many Chinese provinces, County Electricity Companies are therefore trying new ways of reducing transaction costs of collecting user fees for rural customers, especially irrigators. One of these is promoting pre-paid electricity cards or the IC card technology. The IC card system combines computer management, interactive card and single-chip auto control technologies. Its key benefit is that users need to pay electricity fee in advance to get their cards 'recharged'; moreover, IC cards can also be used for auto-irrigation and to record irrigation time. When the money stored in the card is used up, irrigation pump is switched off automatically. In recent years, the IC card system for the irrigation tube wells has been introduced in many water short provinces, such as Shandong, Hebei, Jilin, Heilongjiang, Liaoning, Inner Mongolia, Henan, Shaanxi, Jiangsu and Gansu.

A study commissioned by the IWMI-Tata Programme to understand how the IC card system is working in Liaoning found that the main driver of the technology is the difficulty that township electricity companies and/or village committees faced in collecting electricity dues from farmers [Wang et al 2004]. The study also found that Chinese farmers are as resistant to the IC card system as south Asian farmers are to metering; and this

resistance is not reduced by the fact that the County Electricity Companies and Village Committees invest Y 800/tube well plus Y 2000/village on a computer/reading machine. Farmer resistance is understandable. According to Wang et al (2003), agricultural electricity bureau of Xinchengzi Region in Liaoning province could not collect electricity fees of about 2 to 4 million yuan/year from farmers before the IC cards were introduced; now, farmers have lost this hidden subsidy.

The IC card system keeps the county electricity company happy, because it eliminates all hidden subsidy. It keeps village committees happy because they are spared the hassle of collecting user fee from reluctant farmers. We would however expect farmers to be unhappy because of the new discipline to which they have to submit under the IC card system; but the Wang et al (2004) study concludes the majority of farmers interviewed to be happy because IC card system is 'fair', it reduces inter-farmer conflict on irrigation, and above all it drastically reduces the use of electricity and water, and thereby irrigation cost. As one farmer mentioned, "I save water, because now I see how much it costs".

V

Direct Regulation and Water Demand Management

Throughout south Asia, like in the north China plains (NCP), pockets where groundwater draft is exceeding long-term recharge are increasing by the day. Indian response to the challenge of sustainable groundwater management is however still muted. Political leaders still view groundwater as a resource that needs intensive development. Groundwater professionals realise the need for applying brakes in growing pockets of resource over-exploitation and keep exhorting the need for strong legislation and regulatory frameworks. Many policy researchers, including the IWMI-Tata researchers, however, believe the case for direct regulation hopeless in south Asian settings, not because it is unnecessary or undesirable but on the grounds of administrative feasibility and costs. They argue that direct regulation of groundwater withdrawal would be well nigh impossible to enforce on 20 odd million pump owners, a number that is growing at a rate of 0.8-1 million/year [Shah 2003], scattered across a vast countryside. The Indian experience with direct regulation so far has justified this pessimism [Shah 2004; Moench, Burke and Moench 2002; Phansalkar 2002].

However, under comparable conditions, China's experience with direct management, even if not entirely positive, has at least shown some positive signs. Different provinces in the NCP have tried different combinations of instruments for direct demand management including: (a) tube well permits; (b) withdrawal permits; (c) differential and penal pricing; (d) direct regulation and sealing of wells; (e) creating alternative water supply; and (f) promotion of water saving technologies. The experience has been mixed; in general, these strategies have worked better on industries than on farmers, and in richer eastern provinces than in poorer western ones.

Table 1: Issues in Agricultural Water-Energy Nexus: China versus India

	China	India
Energy fees proportional to use	Yes	No
Cost recovery in energy provision	Yes	No
Operator incentive for water efficiency and fee collection	Yes	No
Strong energy management oversight from village authorities	Yes	No
<i>Water-Energy Nexus is considered an unresolved issue</i>	No	Yes

Tube well permits do not control total groundwater draft but do act as a check on tube well numbers especially in over-exploited areas. Withdrawal permits are the most important direct management intervention and entail the registration of each user, allocation of quota to him/her, levy of a water resource fee, and the monitoring actual use vis-à-vis allocation much like a system that Mexico is experimenting without much success [Shah, Scott, and Buecheler 2004]. Water bureaus in some groundwater stressed regions at different administrative levels began experimenting with withdrawal permits as far back as in 1970s but without broader legislative support. However, real impetus came only with a 1993 regulation on 'Implementation Method of Water Withdrawal Permit System', under which any organisation or individual who draws water from a river, lake or groundwater over certain levels must apply for a water withdrawal permit from the water resource bureaus (WRBs) at various government levels. The legal and policy support gained further strength more recently with the Water Law of 2002 which requires that old as well as new tube wells get withdrawal permits by paying an annual withdrawal fee [Wang and Huang 2002]. Doing this is a Herculean task; and major successes are claimed. Wang and Huang (2002) for example cite a 1995 Report on Implementation Situation of Water Withdrawal Permit System by the ministry of water resources which asserts that 95 per cent of users had applied for withdrawal permits by July 1995. According to many observers, this is unlikely to be true even in 2002. In our discussion with Xingtai Water Bureau officials, of the 80,000 tube wells in use in the Hebei prefecture, only 30,000 permits had been issued so far. The same was the case in Liaoning, Henan, Shaanxi and Jiangsu.

Another problem in the utility of withdrawal permits is the collection of withdrawal fees from farmers. In the 1993 Regulation farmers were specifically exempted from the fee for a period of five years by the central government to alleviate their burden; and the exemption continues to date. Every once in a while, one comes across an interesting experiment at regulation such as the use of IC cards installed on each tube well such that it automatically shuts off once its allocated quota is pumped out, as we saw in Shaanxi. However, the general picture is that tube well as well as withdrawal permits have not brought any significant regulation of groundwater demand for irrigation. Wang and Huang (2002) suggested that water bureaus in Hebei were to begin collecting water fees from farmers irrigating with groundwater in 2000; however, in course of our fieldwork in Hebei in mid-2002 and again in 2003, we found no sign of farmers paying any water withdrawal fee in Hebei. Moreover, since most tube wells are owned and operated by village committees, permits are issued to them at a rate of 1 per village rather than per tube well. Similar was our experience in Liaoning which instituted Withdrawal Permits way back in 1978 and imposed a Water Resource Fee in 1987. Both these were enforced on industrial users and water companies even before the 1988 National Water Law gave a legal basis in support of such regulation; however, it is yet to touch agricultural use of groundwater.

Shaanxi has passed a slew of new water regulations in a quick succession: Water Pollution Control Regulation (1998); Flooding Control Regulation (1999); River Canal Management Regulation (2000); Urban Water Source Protection Regulation (2001); Water Saving Management Regulation (2003). These regulations are acquiring teeth because more and more water use is getting mediated; and institutions – water companies, irrigation districts, VCs – respond to regulations more quickly and readily than individual users. Through out north China, then, direct regulation

is pursued vigorously with those segments of users who are easy to identify and regulate. For example, of the total of 23,800 permits issued by water bureaus in Shaanxi, over 10,000 are to industrial users, irrigation districts and water supply companies supplying domestic and industrial customers. Where irrigation tube wells are operated by VCs, tube well permits are issued to them; but where they are individually owned, the picture is hazy and uncertain. With the segment of large users in the formal 'organised' sector, water budgeting too is done on an annual basis with a further set of deterrents as in the province of Jiangsu. Here, at the start of each year, water indents are called for from bulk water users by the provincial water bureau. The total demand is compared with supply and quotas are assigned. These are monitored at the end of the year; and users exceeding the quotas are penalised with a lower quota in subsequent year. Like Jiangsu, Shaanxi too distinguishes between water resource fee and water service fee but at woefully low rates of Y 0.03-0.06/m³ for surface water, Y 0.08/m³ for groundwater and Y 0.20/m³ for spring water used by industry. Only industry is subjected to a water resource fee. Come 2005 and, we were told by WRB officials, the fee is being raised 10 times.

The experience of Shaanxi as well as Liaoning and Jiangsu suggests that the emergence of mediating agencies and bulk users makes direct regulation easier; it is easier to enforce withdrawal permits and levy resource fee on 'managed water' than self-produced water; and that pricing also works more easily with institutional users and 'managed' water. In Liaoning, for example, levying differential water resource fees for groundwater at Y 0.55/m³ in saline intrusion areas as compared to 0.3 Y/m³ in normal regions has begun to reduce groundwater extraction in saline intrusion areas. Some industries have improved water use efficiency; others have closed down. And the bureau has used resources generated to bring surface water to increase groundwater recharge in coastal aquifers with some success.

VI Indirect Approaches to Demand Management

Groundwater demand for irrigation in some parts of rural north China is facing downward pressure because of unrelated wider trends which have no bearing on programmes and strategies evolved by water administration. A major factor has been the global decline in rice prices which in recent years have drastically reduced profitability of rice cultivation. In Liaoning province, as a result, farmers have begun shifting whole sale from irrigated rice to rain fed maize. Especially in rice areas, falling rice price have combined with rising costs of energy in pumping groundwater from deep tube wells to form a pincer that is driving tube well irrigated rice out of the market. According to Liaoning Provincial Water Bureau officials we met, this pincer – besides controls on industrial use of groundwater – has helped raise average depth to the water table from 34 m to 18 m in the province.

This became clear to us in our visit to Youtai village, near the city of Shenyang in Liaoning. This village like others in the region has only 1 crop of rainfed maize in a year, planted in May and harvested in October. After that the climate is too cold for farming. Rainfed maize and irrigated rice are the alternatives from which farmers choose. And rain fed maize is becoming increasingly popular. Maize yields at 800 kg/mu are higher than irrigated rice at 600 kg/mu. The prevailing farm gate price of both are similar at Y 1.1/kg. But rice is far more input intensive – especially in fertiliser, water and labour. Wage rates are Y 30/day. A hectare (=15 mu) of rice requires 400-500 hours of pump irrigation. As

a result, input costs of irrigated rice may be as high as Y 500-600/mu. Not surprising that of the 5,096 mu of farm land in this village, only 1,000 mu are under rice; 3 years ago, the proportions were the opposite of this.

In Hebei, Bt cotton is increasingly replacing maize-wheat combination that has prevailed during recent years in many areas; and the Chinese government is proactively encouraging this shift, only partly because Bt cotton uses far less water compared to the maize-wheat combination. For one, land planted with Bt cotton remains fallow the rest of the year in many areas. Then, Bt cotton needs only one, at most two irrigations; whereas wheat needs at least 4-6 irrigations although maize is mostly rainfed. Above all, cotton is not only amenable to drip irrigation but has a strong positive yield response. As a result, we found large areas of Bt cotton farmers in Hebei and Shandong taking to drip irrigation to save pumping costs and raise crop yield. There is also massive adoption of plastic mulch as a device to reduce evaporation of water and moisture preservation in Hebei and Shandong provinces. Farmers we met claimed large electricity cost savings and significant yield gains. That there are significant yield gains from mulching seems also indicated by the fact that farmers spend Y 25-30/mu to lay mulch, and that local shops stock polythene mulching material is indication that demand is mainstreamed. Near Feixiang on the border of Shandong province, we found extensive use of plastic mulching in even rain fed Bt cotton. The woman farmer we interviewed planted Bt cotton only if there is rain. But for the past 2-3 years, she has begun using plastic mulch at a cost of Y 20-25/mu which helps to greatly improve the root zone moisture regime and improve crop yields.

Bt cotton seems extremely profitable with gross income at Y 1,300-1,500/mu and input costs at Y 300/mu. This makes it attractive to farmers. And because it saves groundwater, intervening around it has become popular with VCs and WRBs in groundwater stressed areas. In Dagao village in Nangong county (Xingtai prefecture, Hebei), the key problem is salinity in shallow aquifers and water tables falling @ 1 m/year. Several micro-irrigation projects are established here. In one such that we visited, of the 3,500 mu of irrigated area, 1,000 were under Bt cotton, and over 50 per cent of Bt cotton mu were under drip irrigation installed by the VC from its own funds. Some 80 old shallow tube wells (5 KV), privately owned, are now in use only for supplementary irrigation. In 1995, 9 new Deep TWs (30 KV) were installed by the VC at a cost of Y 1,20,000 (Y 70,000 for Deep TWs and Y 50,000 for buried pipes) each commanding 300 mu. Farmers asserted great advantage of drip irrigation. Earlier, irrigating all the 500 mu took the VC 1 month; now it is done in 1 week. Water use has fallen from 50m³/mu to 20 m³/mu. Electricity cost of pumping is down from Y 25/mu to Y 7/mu. And cotton yield has increased, according to farmers interviewed, from 150 kg/mu to 225 kg/mu. Enthused by the results, the VC is planning to cover all 3,500 mu under drip irrigation, which essentially is 'strip irrigation' since no micro-tubes are used. Before the drip system was installed, it took 1.5 hours to irrigate a distant mu; now, 1 hour's pumping irrigates 4 mu.

Table 2: Water Pricing in Jiangsu

User Category	Water Resource Fee (Y/m ³)	Water Supply Cost (Y/m ³)
Groundwater pumpers	2	0
Domestic customers	0.03	0.04
Industrial Irrigation	0.03	Supply cost + 5-10 per cent margin
	0	Y 5-12/mu for rice
		Y 0.6-3/mu wheat

Promoting the shift from wheat-maize combine to Bt cotton, promoting drip irrigation and mulching in Bt cotton aided by high and rising costs of electricity – all these are emerging as indirect instruments of controlling groundwater demand in north China plains.

VII Arresting Urban Groundwater Depletion

Like elsewhere in Asia, Chinese cities are facing unprecedented groundwater stress. The strategy many Chinese provinces find effective to control urban groundwater depletion is three-pronged: (a) import surface water from distant sources and use it to crowd out urban tube wells; (b) as alternate sources become available, seal urban tube wells in a campaign mode; (c) begin to enforce withdrawal permits strictly once alternative water becomes available; and (d) use a penal water resource fee on groundwater to reflect the scarcity value of groundwater and promote substitution of surface water for groundwater.

Much evidence in Chinese cities suggests that depletion of urban aquifers is best countered not by demand management, which certainly plays a role, but by crowding out urban tube wells through water imports. Shaanxi as well as Jiangsu offer good examples of how such a strategy works. Until 1990, urban tube wells supplied 8,00,000 m³/day to urban population resulting in serious depletion of Shaanxi's urban aquifers. Now, surface water imports supply 1.2 million m³/day. All urban tube wells are closed and, according the officials of Shaanxi Water Resource Bureau, water tables are now rising @ 1-1.5 m/year. All new urban water supply projects are based on surface water imports. Xian, the capital city, gets its water from a reservoir 40 km away.

Jiangsu, next only to Shanghai and Guangdong in industrial progress and per caput income, has experienced intensive groundwater use in the industrial and domestic sectors in large part because its use carried no or very low fees. As a result, in many urban areas, groundwater tables had fallen to 40 m or more; and tube wells were typically 80 or more meters deep. To ease the pressure on groundwater, the province implemented a south-to-north water transfer project of its own within the province using lifted Yangtze water. This water is priced according to a different formula; since the water has to be lifted to a considerable height at five different places, there is a significant fixed as well as variable water supply cost. To reflect this, the water price too has a flat (basic price) and variable component (volumetric, based on metered use).

Having created a new supply source, the province began enforcing water permits and put into place a two-part pricing formula providing for a water *resource* fee and a water *supply* fee (Table 2). In this new formula, groundwater is priced way above even lifted Yangtze water at Y 2/ m³; as a result, industries as well as water companies have begun substituting surface water for groundwater. All non-irrigation tube wells are metered. Each groundwater user (non-irrigation) is issued a withdrawal permit, accompanied by a card which records the complete tube well profile as well as pattern of pumping and use of groundwater. A total of 4,830 tube wells have been so covered by the formal regulatory system in three cities of the province. Along side, the WRB has also launched an intensive water saving programme; some 1,000 industries are involved in experimenting innovative water saving technologies.

As a result of this extensive direct regulation, since 1995, the province has made a big impact on reducing urban groundwater depletion. From 2001, Jiangsu Provincial WRB has begun a

campaign to close urban and industrial tube wells; 3,100 tube wells have already been closed; and the WRB target is to close all tube wells by 2005. Not surprising then that groundwater depletion has not only been arrested but water tables in many urban areas have begun rising by up to 6 m/year. Jiangsu's experience suggests that where alternatives are available and dependence on groundwater is low, proactive demand management not only becomes feasible but quite easy.

VIII

Size and Penetration of Water Bureaucracy

One reason why China has aggressively pursued direct management in water resources sector is its huge, 6-layered water bureaucracy presided at the top by the ministry of water resources. The real operating agencies are however parts of the hierarchy of water bureaus at provincial, prefecture, county and township levels which generally constitute the operational arms of water administration within the various provinces. India is notorious for its bloated bureaucracy; but the Chinese employ far more bureaucrats in managing water resources. Hebei is a case in point. Xingtai prefecture, one of Hebei's 11, alone has a total of 20,000 employees in water resource bureaus and other water organisations in the prefecture. In Liaoning province, some 40,000 government staff are employed in water bureaus at different levels, excluding an equal number at village level. Gujarat is bigger than Liaoning, but has just around 11,000 public officials employed by water related departments; most of these are engineers hired for construction of projects; very few public officials are devoted directly to water resources and service management at the district level and below; and this size too is shrinking.

In China, water bureaus are substantial outfits even at the county level (equivalent to 2-3 taluks/blocks/tehsils in south Asia). In Ci county in Hebei province, which has 19 townships and 390 villages under it, the county water bureau staff is only 60 and a typical township water bureau employs 20-30 officials; however the entire hierarchy of water bureaus in Ci county employs some 560 people. Hebei province, for instance, has nine city level water bureaus and 200 water bureaus of counties like Ci which manage water resources in 4,000 small townships and villages. Thus, when all levels are taken together, the water bureau structure in a province may employ several tens of thousand officials; and these do not include village and some of the township level water officials who are paid wholly from local taxes and water fees. Whereas the provincial water bureau is fully supported by the state budget, the county water bureau has to raise a portion of its own budget and the township water bureau and village water administration is wholly self-financed. Thus, Ci county in Hebei has an annual budget of Y 30 million; of this, in 2002, Y 10 million was contributed by the national government under drought mitigation programme but the balance of Y 20 million had to be raised from farmers' taxes and local incomes. Kendy et al (2002) note, in their study of groundwater institutions and policies in Luancheng county near Beijing that "fee revenues are sufficient to fund the County Water Affairs Bureau, but not to finance water conservation countywide".

Having a large bureaucracy with deep penetration and presence at local and meso levels has its pros as well as cons. The Chinese bureaucracy has been a subject of much criticism. However, the powerful role it can play in the governance of scarce natural resources such as water is often underestimated. In India, the Supreme Court announced two far-reaching environmental decisions during the past decade: first, it enjoined the forest

department to halt illegal felling of trees in reserved forest areas forthwith; and the forest department effectively implemented the Supreme Court's injunction throughout Indian countryside because it has a large field force with significant presence at the local levels. In 1996, the same Supreme Court designated the Central Groundwater Board of India as the nation's Groundwater Authority and mandated it to control groundwater over-draft forthwith. Six years later, the Central Groundwater Authority has remained totally ineffective to implement the Supreme Court mandate mainly because it has no field force worth the name.

India has got so disillusioned with its bureaucracy that all its energy is focused on shrinking it rather than vitalising it.⁸ Irrigation departments of most Indian states have recruited professional engineers only for constructing irrigation systems; now that the construction phase is over, these have failed to transform their professional workforce for resource management and service provision roles. As a result, irrigation bureaucracy is increasingly being viewed as a drag on the public exchequer; and many states have not recruited professional staff in irrigation departments for the past 12-15 years; and according to one analysis, Gujarat's irrigation department will shrink from a total strength of 11,000 engineers to less than 500 by 2010 because those who superannuate are not replaced. At the same time, we find that the government's presence in water management role at district, taluka and village level is either very thin or absent. China's focus on transforming bureaucrats into entrepreneurs is of relevance to India because the role of the state will have to grow – not shrink – as the stress on water resources grows further. For, leave alone direct regulation, even indirect instruments of water management require a bureaucracy to implement.

IX

Institutional Reform

Compared to south Asia's fragmented water administrations, China's water affairs bureaus represent an effective first step towards integrating and unifying water management tasks at local levels. Until a decade ago, water management in a typical county in China was fragmented as in a south Asian local administrative territory (such as a tehsil or a district). Before then, water supply and sanitation and infrastructure construction was managed by the urban construction bureau; water companies were controlled by urban management department. Groundwater was under the ministry of geology and mines. And water saving technologies were the responsibility of the ministry of agriculture while power plants and electricity transmission and distribution infrastructure in many provinces were owned and managed by water bureaus.

A serious – and avoidable – water crisis in Shenzhen in 1991 led its municipal administration to create a water affairs bureau which integrated all tasks and functions concerned with water source development and construction, flood control and drainage infrastructure, urban water supply and sanitation, water saving programmes – all under one umbrella. The water affairs bureau model caught on like wildfire; and by May 1999, 160 counties had reorganised water resource bureaus into water affairs bureaus. In May 2000, Shanghai brought in even more functions under a new Shanghai Water Affairs Bureau [Wang and Huang 2002]. From the groundwater perspective, another major 1998 reform was to remove groundwater management from the ministry of geology and mines to the ministry of water resources, a more logical home.

We heard the echo of this bottom-up institutional reform backed by top level legislative action (2002 Water Law) wherever

we went. In Shaanxi, converting erstwhile water resource bureaus into water affairs bureaus has been done in a campaign mode. Until recently, urban water supply was managed by urban construction bureaus. Now there is a growing movement to shift this to water affairs bureau. Of the 100 County WRBs in Shaanxi, seven have already transformed into WABs. In Liaoning, too, 11 counties and four cities have already converted to water affairs bureaus since 1997. All 11 counties in Xingtai prefecture in Hebei province have converted into water affairs bureau's which manage water companies; only Xingtai city's water supply is managed by a company owned by urban construction bureau.

In Jiangsu, we found transition to the water affairs bureau structure was progressing at different pace in different parts of the province. Suzhou city, for instance, has a WAB that integrates all key water management roles: water supply, issue and enforcement of withdrawal permits, collecting pollution fees, water resource fees, all under one roof. Elsewhere in the province, the restructuring is still in progress. Despite this uneven pace of reform, Chinese researchers believe that unified water resources management under the overall leadership of the much-restructured MoWR is gradually becoming a reality in China [Wang and Huang 2002].

Increasingly, water affairs bureaus are strongly encouraged to adopt a business rather than regulatory-bureaucratic approach and generate resources locally by selling services. True, this may be easier said than done, especially since revenue yielding water infrastructural assets are often still held by provincial bureaus or the national government. Hebei, for example, has two large reservoirs which might yield substantial income from water sale to industries and municipalities; however, these are under the direct control of the national government. In Ci County Water Bureau in Hebei, the new drive towards local resource generation is already beginning to change the culture of the bureau. The River Basin Management office made Y 2 million last year by selling irrigation to farmers @ Y 10/ 1000 m³ of Zhuang River water to irrigate 60,000 mu. Ci county water affairs bureau also has a separate company to manage urban and industrial water supply from groundwater. Industries either get water from the company or obtain a licence and make their own tube wells by paying the water resource fee. These are closely monitored and closed if the resource position is inadequate.

Conclusion

In this article, we have suggested that China is refreshingly unorthodox in exploring unique solutions to its context which, in several respects, is more similar to south Asia's than of the industrialised west where south Asia tends to look for solutions. It is by no means our contention that approaches China is trying are necessarily appropriate for other countries or even that they will solve China's problems. We are also not suggesting that China's performance on Integrated Water Resources Management is about to meet international standards. In fact, a UN Expert Committee studying Huaihe basin wrote in 2000 that, "Water use and abuse in the Huaihe basin is effectively anarchic with very limited enforcement and compliance" [UN 2000]. However, we do suggest that south Asian discussions on water reforms need to incorporate a wider body of experience; as such, Chinese explorations appear one appropriate candidate. From examining the Chinese experience, three sets of conclusions can be drawn with direct relevance to south Asia.

First, China has already given up on traditional communitarian model of organisation for managing its small scale groundwater

based irrigation systems as well as large irrigation projects. Instead of participatory management by water users' associations – except on World Bank funded PIM projects – China has experimented with a variety of models of 'irrigation service providers' who are incentivised for better service delivery, improved water use efficiency and better performance in water fee collection. It is not clear yet how well this arrangement is performing; in the case of small scale systems, it is certainly promoting financial sustainability; in large systems, indications are that incentivised service providers promote efficient water use, besides improving fee collection.

Second, north China's agrarian economy is as precariously dependent upon high energy use in pumping groundwater as south Asia's is. However, the huge transaction costs of metering a large number of scattered tubewells has forced south Asia to adopt flat electricity pricing which is more prone to subsidisation, while China, in a similar situation, has struggled to make metered electricity supply and full cost recovery work in agricultural power supply. This has not been easy; but significant gains seem to have been achieved by incentivising village electricians to operate as commission agents of the township electricity bureau. More recently, many Chinese provinces have been experimenting with EC pre-paid electricity cards for agricultural electricity supply. Many Indian states – where subsidised flat electricity tariff is wrecking groundwater as well as power industries – are struggling to reintroduce metering. China's experience can provide useful guidance in this direction.

Third, north China has made quite some progress in getting some modicum of control over runaway groundwater over draft by using a combination of direct as well as indirect instruments of demand management such as promotion of water saving approaches and technologies, implementation of withdrawal permits, pricing of water resource as well as services, enforcement of water withdrawal quotas, crowding out urban tube wells by surface water imports and such like. Doubtless, these measures have been more effective in urban areas than in agriculture, and in economically more dynamic eastern provinces compared to agricultural western provinces. However, after years of regulatory activism there is growing confidence amongst Chinese water professionals that they can achieve their own version of IWRM which, at the ground level, means (a) bringing all water management roles under water resource bureau structures; (b) broadening water resource bureau roles by rechristening them as water affairs bureaus; (c) instituting a system of water withdrawal permits; (d) imposing and levying a water resource fee in addition to water service charges; (e) countering urban groundwater depletion through import of surface water from distant projects; and (f) by reorienting its massive water bureaucracy from water development to resource management mode rather than by shrinking it. [37]

Address for correspondence:
iwmi-tata@cgiar.org

Notes

[The authors gratefully acknowledge comments on an earlier draft by FAO's Jacob Burke, IWMI's Hugh Turrall and USDA's Brian Lohmar.]

- 1 Going to the depth of 350 metres or so, motor-pumps generally of 28 kW and 1,000-1,500 metres of buried pipeline network – all of which comprises a tubewell assembly may entail an investment of Y 250-300 thousand (US \$ 30-38,000) apiece.
- 2 However, in some new drip and sprinkler irrigation systems established with support from National Water Saving Programme, water meters are

- installed on the main distribution line as well as on each plot; and contractors levy fee per m³ of water supplied.
- 3 "In most cases (70 per cent of WUAs), the governing board was the village leadership itself. In minority share of cases, village leaders appointed a chair or manager to carry out the day-to-day duties of the WUAs. In many of the WUAs that had village appointed leaders, however, the manager actually had close ties to the village leadership, more than half being a leader in an earlier time period. In other words, at least in terms of the composition of the management team, most WUAs differ little from collective management" [Wang et al 2003]. In a study of PIM in Zhanghe and Dongfeng Irrigation Districts of Hubei province, Zhang and Dinghuan (2003) concluded that in 70 per cent of the WUAs, water fee collection is still done by VCs; that 81.3 per cent of WUAs have village leaders as chairmen and that 84 per cent of the households were not involved in electing the WUA chairman.
 - 4 Water purchased from 5 hp diesel pump with an hourly discharge of 12,000 litres costs Rs 50 in most parts of eastern India.
 - 5 Although the network reform programme is a national government programme, the government contributes only a part of the resources, the balance being contributed by the village committees. Just to give an example, Guantun village in Yanjin county of Henan got a grant of Y 60,000 under this project for power infrastructure rehabilitation. To match this, the village contributed Y 60,000, too; of this 60 per cent came from the funds from the village collective; and the remaining 40 per cent were raised as farmer contributions by charging Y 80/person. All the power lines and other infrastructure was rehabilitated during recent years under this national programme. New meters were purchased by the township in bulk and installed in users' homes on a cost recovery basis. A system of monitoring meters was installed too.
 - 6 The village electrician's reward system encourages him to exert pressures to achieve greater efficiency by cutting line losses. In Dong Wang Nnu village in Ci county, in Hebei province, the village committee's single large transformer which served both domestic and agricultural connections caused heavy line losses at 22-25 per cent. Once the Network Reform Programme began, the electrician pressurised the VC to sell the old transformer to the County Electricity Bureau and raise Y 10,000 (partly by collecting a levy of Y 25/family and partly by a contribution from the village development fund) to get two new transformers, one for domestic connections and the other for pumps. Since then, power losses have fallen to the permissible 12 per cent here.
 - 7 A recent study of privatisation of electricity retailing in rural Orissa commissioned by the IWMI-Tata programme, it seems things are moving fast. Village vidyut sanghas energetically promoted in over 5,000 of villages seem to have proved unequal to the task of billing and collecting electricity charges. To retrieve the situation, three private franchisees were appointed on terms comparable to the Chinese village electricians. However, unlike the Chinese village electrician, each of these large franchisees undertake billing, metering and collection for hundreds of villages through their employees and agents [Mishra 2004]. As in China, here too, results are encouraging; bill collection has improved rapidly; consumer complaints are addressed swiftly; a new line of communication has opened up between the utility and its consumers. The lessons are important; however, before making a final conclusion, Orissa approach needs to be tried in states where electricity use in agriculture is high, which it is not in Orissa.
 - 8 To be sure, as part of its transition from a planned to a market economy, China too is restructuring government to streamline and reduce its staff. However, indications are that many restructured agencies will be under pressure to generate resources through service provision, and 'increase efficiency and effectiveness by focusing on the core tasks' [UN 2000].
- (2002): 'Investment, Conflicts and Incentives: The Role of Institutions and Policies in China's Agricultural Water Management on the North China Plain', Agriculture Information Bulletin No 782, Economic Research Service, USDA.
- Mainuddin, M (2002): pers comm.
- (2002): Groundwater Irrigation in Bangladesh: 'Tool for Poverty Alleviation' or 'Cause of Mass Poisoning'? Proceedings of the *Symposium on Intensive Use of Groundwater: Challenges and Opportunities*, December 10-14, Valencia, Spain.
- Mishra, Sudhakar (2004): 'Alternative Institutions for Electricity Retailing: Assessment of Orissa Experiments'. Anand, IWMI-Tata Water Policy Programme (unpublished report).
- Moench, M, J Burke and Y Moench (2002): *Rethinking the approach to groundwater and food security*. Food and Agriculture Organisation of the United Nations, Rome, 2003, (Water Reports 24).
- Mukherji, A and A Kishore (2003): *Tubewell Transfer in Gujarat: A Study of the GWRDC Approach*, Colombo, Sri Lanka. IWMI Research Report No 69.
- Panella, Thomas (1999): 'Irrigation Development and Management Reform in the Philippines: Stakeholder Interests and Implementation', presented at the International Researchers' Conference on Irrigation Management Reform, held at Hyderabad, India, December 11-14.
- Reddy, D Narasimha (1999): 'Designer Participation: Politics of Irrigation Management Reforms in Andhra Pradesh, India', presented at the International Researchers' Conference on Irrigation Management Reform, held at Hyderabad, India, December 11-14.
- Shah, T (1993): 'Groundwater Markets and Irrigation Development. Political Economy and Practical Policy' Oxford University Press, New Delhi.
- (2003): 'Groundwater Management: Synthesis of IWMI Research 1999-2003', International Water Management Institute (Draft), Anand, India.
- (2004): 'Community Management (Comman) of Groundwater Resources: An Appropriate Response to Groundwater Overdraft in India'? Comment on Comman Project Report.
- Shah, T, B V Koppen, D Merrey, M D Lange, M Samad (2002): 'Institutional Alternatives in African Smallholder Irrigation: Lessons from International Experience with Irrigation Management Transfer', Colombo, Sri Lanka, IWMI, V.24 p (IWMI research report 60).
- Shah, T, I Makin and R Sakthivadivel (2001): 'Limits to Leapfrogging: Issues in Transposing Successful River Basin Management Institutions in the Developing World' in Charles L Abernethy (eds), *Intersectoral Management of River Basins*, International Water Management Institute.
- Shah, T, C Scott, and S Buechler (2004): 'A Decade of Water Sector Reforms in Mexico: Lessons for India's New Water Policy', *Economic and Political Weekly* (Forthcoming).
- Shah, T, C Scott, A Kishore and A Sharma (2004): *Energy-Irrigation Nexus in South Asia: Improving Groundwater Conservation and Power Sector Viability*, IWMI Research Report No 70, Colombo, Sri Lanka.
- United Nations (2000): 'Perspectives on Integrated Basin Management for a Policy Study on the Huaihe River Basin, China', The United Nations, New York.
- Vermillion, Douglas (eds) (1996): 'The Privatisation and Self-Management of Irrigation: Final Report, International Irrigation Management Institute', Colombo, Sri Lanka.
- Vermillion, Douglas (1999): 'Property Rights and Collective Action in the Devolution of Irrigation System Management', paper for the Workshop on Devolution of Natural Resource Management, Puerto Azul, Philippines, June 21-25.
- Wang J, and J Huang (2002): 'Tubewell Management and Technical Efficiency (in Chinese)', *Journal of Water Resources Advances*, Vol 2.
- Wang, J, Z Xu, J Huang, S Rozelle, I Hussain and E Biltonen E (2002): *Water Management Reform, Water Use and Income in the Yellow River Basin*.
- Wang, J, Z Xu, J Huang and S Rozelle (2003): 'Incentives in Water Management Reform: Assessing the Effect on Water Use, Production and Poverty in the Yellow River Basin', Chinese Council for Agricultural Policy (draft paper), Beijing.
- Wang, J, L Zhang and S Cai (2004): 'Assessing the Use of Pre-paid Electricity Cards for the Irrigation Tubewells in Liaoning Province, China', IWMI-Tata Water Policy Programme, Anand and Chinese Centre for Agricultural Policy, Beijing.
- Zhang, Lubio (2004): 'The Economics of Electricity Supply to Tubewell Irrigation in North China', IWMI-Tata Water Policy Programme (draft report), Anand, India.
- Zhang L and H U Dinghuan (2003): 'Sustaining Water User Associations: Problems and Policies', Unpublished report for Public Policy Programme of the Ford Foundation, Beijing.

References

- Godbole, Madhav (2002): 'Electricity Regulatory Commissions: The Jury Is Still Out', *Economic and Political Weekly*, Vol XXXVII, No 23, June 8-14, pp 2195-2201.
- Kendy, E, T Steenhuis and C Liu (2002): 'Policies Drain the North China Plain: Hydrologic Impacts of Institutional Changes Affecting Luancheng Country, Hebei Province, 1949-2000', Department of Biological and Environmental Engineering, Riley Robb Hall, Cornell University, Ithaca NY, 14853, USA (Draft).
- Kishore, A, A Sharma and C Scott (2002): *Power Supply to Agriculture: Reassessing the Options*, IWMI-Tata Water Policy Research Highlight No 7.
- Lohmar, Brian, Jinxia Wang, Scott Rozelle, Jikun Huang and David Dawe