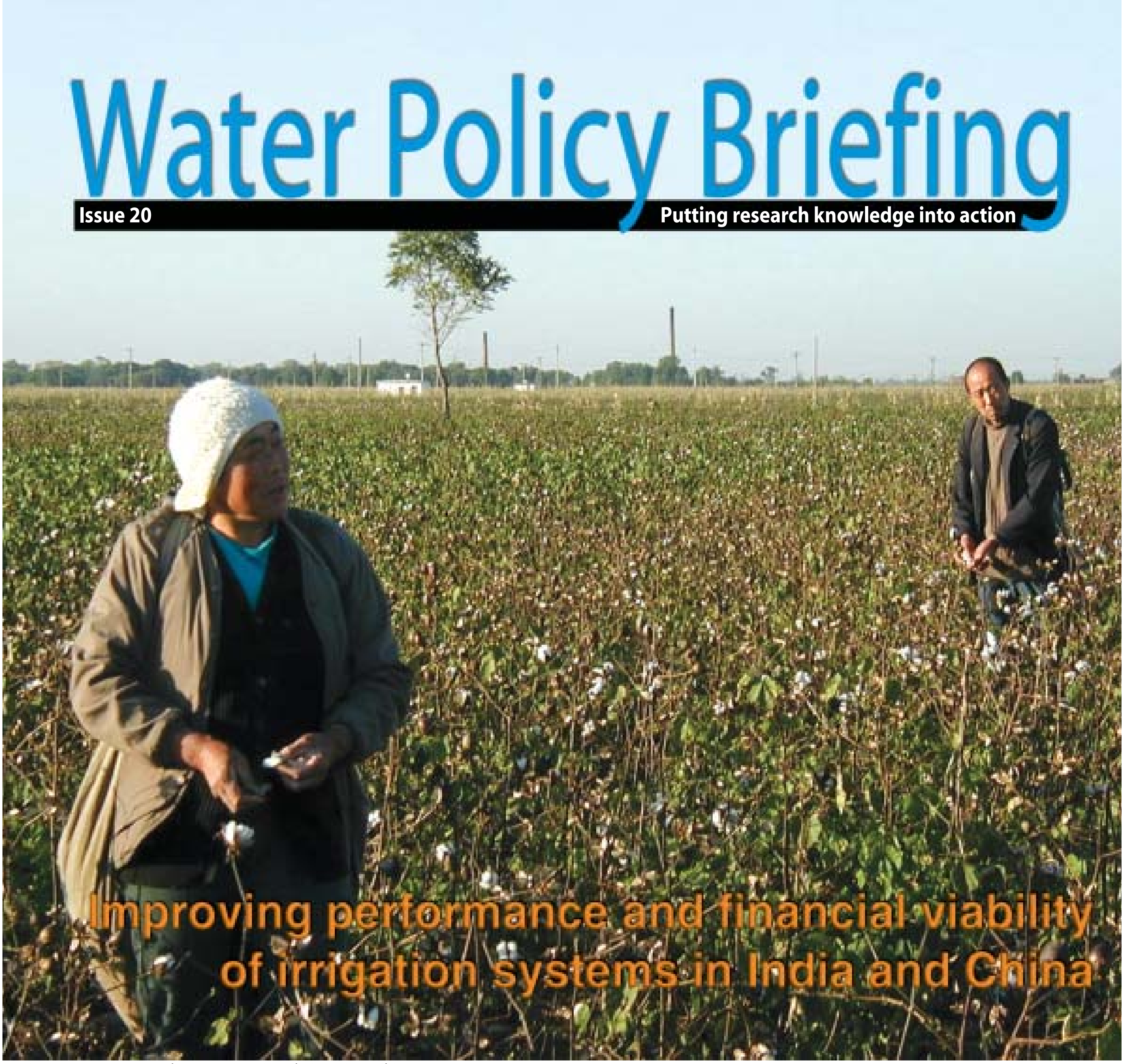
Water Policy Briefing

Issue 20

Putting research knowledge into action



Improving performance and financial viability of irrigation systems in India and China

Bt Cotton supports groundwater savings in Hebei Province, China

Photo Credit: Tushaar Shah

The two giant Asian neighbours—India and China—have been facing much the same problems but experimenting with different strategies when it comes to addressing their water issues and the management of their public and private irrigation infrastructure. China's experimentation with alternative institutional arrangements has the potential to offer options to India's equally complex surface and groundwater irrigation economies.

International Water Management Institute

Improving performance and financial viability of irrigation systems in India and China

China and India face similar challenges in managing their irrigation economies. Both are developing nations with large agricultural populations, high population densities and a high proportion of agriculture under irrigation. Both are facing challenges in financing existing irrigation systems in the face of broader economic reforms. And in both countries, groundwater provides a particular challenge since it is a major source of irrigation, but with accelerating declines in both quantity and quality.

Problems in financing surface irrigation systems, worries about continued groundwater table declines along with cost implications for both farmers and the energy industry, and a range of other issues have raised serious concerns over the future sustainability of irrigated systems and food security. As a result, there is now near unanimous agreement in both countries on the need to formulate practical strategies to manage the future of their irrigation economies.

India and China are trying different paths when responding to their water problems and the management of public and private irrigation infrastructure. Yet, China's experience with alternative institutional arrangements could provide useful direction to India's equally complex surface and groundwater irrigation systems.

Moving from water development to IWRM— the challenge of irrigation management in India

The central management of irrigation by bureaucracies has been a failure in many countries. For example, in India, public irrigation systems have fallen far short of their planned potential: they irrigate smaller areas than they were designed to; deteriorate year by year because they receive significantly less investment than is needed for their maintenance; and they have become a drag on state finances. Many resource-strapped governments are more than eager to shed themselves of responsibility for the management of public irrigation projects. Yet, the shift in thinking from bureaucratic to farmer management of irrigation systems has been a particularly difficult challenge.

Farmer communities in irrigation management schemes

Discussions on finding solutions to this problem have tended to focus on Participatory Irrigation Management (PIM) and Irrigation Management Transfer (IMT) processes. While there are small islands of excellence, there is no evidence that PIM will provide a solution on a large enough scale. In fact, studies of PIM and IMT models in Asia and Africa have shown that they have not provided the desired solutions. After over 20 years experience with PIM and IMT, old questions still remain unanswered: Does farmer management ensure a better quality of irrigation service? Does it mean more efficient water distribution between head and tail reaches? Does it result in improved productivity of irrigation water at the system level? And does it ease the financial burden on the State?

Energy-irrigation nexus

In India, power subsidies to the agriculture sector, used largely to pump groundwater, have hurt the country's energy economy. The subsidizing of electricity rates is believed to be the prime reason; so many state electricity boards are on the verge of bankruptcy.

Key challenges to rationalizing electricity pricing are the huge transactions costs of collecting charges based on metered use, and the politically sensitive issue of large numbers of livelihoods being dependent on groundwater. Most Indian states have done away with metering and adopted a flat tariff based on the horsepower rating of pumps. Thus, farmers do not experience the scarcity value of groundwater resource, nor the true cost to the society of providing them the energy required to pump it. Energy subsidies create perverse incentives in groundwater irrigation. For example in Uttar Pradesh or North Bihar where groundwater is abundantly available, the cost of a cubic metre of groundwater is around Rs. 4-5. In contrast, it

This Water Policy Briefing is based on research presented in *Irrigation Institutions in a Dynamic Economy: What is China Doing Differently from India?* by Tushaar Shah, Mark Giordano and Jinxia Wang, *Economic and Political Weekly* Vol.39(31): 3452-3461, 2004; *Governing the Groundwater Economy: Comparative Analysis of National Institutions and Policies in South Asia, China and Mexico* by Tushaar Shah, *Water Perspectives*, 1:2-27, 2003; *Incentives in Water Management Reform: Assessing the Effect on Water Use, Productivity and Poverty in the Yellow River Basin* by Jinxia Wang, Zhigang Xu, Jikun Huang and Scott Rozelle, *Environment and Development Economics* (2005, 10: 769-799); and *Incentives to managers or participation of farmers in China's irrigation systems: which matters most for water savings, farmer income and poverty?* by Jinxia Wang, Zhigang Xu, Jikun Huang and Scott Rozelle, to be published in *Agricultural Economics* in 2006.

is less than Rs. 2 in Gujarat where it is mined from 500 feet or more. In Tamil Nadu, where groundwater resources are scarce, the cost is minimal to the farmer due to free electricity.

Regulation and management

Groundwater has become the mainstay of Indian agriculture as a result of the inability of public irrigation systems to cater to irrigation needs. India is yet to find a practical solution to the problem of groundwater draft exceeding long-term recharge, exacerbated by the view of existing policy that groundwater in many regions is a resource that requires further development and utilization. Due to its localized nature, the growth of groundwater use via wells and tube wells tends to get noticed in an area only after it begins to result in a major decline in groundwater tables. The groundwater economy is untrammeled by any regulatory authority or mediating agency—permitting no role for even the village-level governance structure of gram panchayats (village councils).

Although groundwater experts continue to exhort the need to have strong legislation and regulation to prevent over-usage, many researchers believe that direct regulation is impossible due to the cost and difficulty of enforcing regulations on the approximately 20 million pump owners in India who are scattered over a vast area, with as many as 0.8-1 million new users added annually. Neither India nor any of its South Asian neighbours has in place a system of registering water users, nor do they have strong legal frameworks regarding groundwater and irrigation.

Policy Responses

Although India has had little success with the PIM/IMT model, the focus of government, NGOs and donors continues to be on concepts and methods such as organizing communities, forming Water User Associations (WUA), capacity building, empowerment, and creating the right processes. Reforms have had little engagement with nuts and bolts issues of managerial rewards and incentives, clarifying roles and responsibilities, bureaucratic accountability, and above all, in getting results in terms of improved services, better fee collection, and 'more crop per drop'.

The potential of China's "Bounded Service Provider" model

By focusing on creating an incentive-based model like the "Bounded Service Providers", China's reforms seem focused on results, ensuring that managers bring a serious intent of running a profitable water business for the long haul. A study of 25 villages in the Chinese provinces of Hebei, Henan, Shaanxi, Liaoning and Jiangsu during two field visits in 2002 and 2003 and more recent follow up showed that North China has achieved a significant measure of success with variants of a model best described as a "Bounded Service Provider" which is operated by farmers turned irrigation entrepreneurs.

This model involves a local entrepreneur, bureaucrat or economic entity being provided incentives to perform a role assigned to him or her within a boundary established by a village committee. This is not to say that the "Bounded Service Provider" system is the only one in use in China. In fact, China experimented with many different types of irrigation management systems, including PIM, over the last several decades, in tune with the changing policies of its government. Before sweeping economic reforms of the Deng administration in 1978, collectives throughout China were responsible for making and maintaining tube wells, pumps and distribution systems. Since then, a variety of systems have come into play.

For example, in parts of Henan province, where water tables are high and the operation of tube wells inexpensive, the system is similar to that in India, with village committees still owning bore holes but farmers bringing their own pumps. But in areas of Hebei, Shaanxi and Shandong provinces, where deep tube wells are required, marked changes have taken place in village irrigation management. With deep tube wells serving large areas of 40-70 hectares each, construction costs are beyond the means of average farmers. It is common for the tube wells to be built and owned by the village development committee, often by using accumulated savings, borrowings, or imposing new taxes. Increasingly, these village committees are inviting private investments, usually from farmers themselves, to build and operate tube wells.

Variations in the "Bounded Service Provider" system are found from village to village in aspects of the identification of the service provider, management fee, responsibility of the service provider, role of the village committee, and impact of the system.

Identification of the service provider

In almost all cases, bounded service providers are found from among the most entrepreneurial men and women of the village farmers. In a few villages, the management contract was auctioned to the highest bidder. But in most instances, the procedure involved informal negotiation between prospective candidates and the village committee and/or the township water bureau. Some of the service providers were women, although the majority by far were men. Where township water bureaus had set up expensive drip or sprinkler irrigation systems, the management contracts had been secured by the village leaders themselves.

Determination of irrigation fees

In most cases, the village committee remained responsible for maintenance and repairs, while the manager was responsible for water distribution and fee collection. The irrigation fee is invariably determined by the village committee and/or the township water bureau, a distinctive feature from privatization. Fees are fixed in terms of hours of pumping or kWh of electricity used and range from lucrative where new drip or sprinkler systems were in use, to low in villages where there was significant pressure from farmers to keep fees low. Periods of management contracts range from 5 to 20 years. Fees are also dependant on the contribution of the provider to capital costs, i.e. the higher the share of costs by the provider, the less of a say the village committee would have, and/or the longer the term of the contract to the provider.

provinces in 2002 found that water use per hectare is lower in villages with incentivized management of large irrigation systems, by as much as 40 percent. The study also found that water saving by 'incentivized' managers did not significantly reduce yields of major agricultural products. Yields of maize and rice were largely unaffected, although wheat yields declined by 10 percent.

Providing greater incentives to contractors through fees

Contractors receive a part of the basic fee, but they are also able to increase their incomes through the saving of

Table 1. Comparing Features of Village Groundwater Economies in South Asia and North China

	South Asia	North China
Ownership of tube wells	Private	Collective, contracted
Ownership of pumps	Overwhelmingly private	Mostly private, mostly collective
Do all farmers own pumps?	No	No
Do tube well command areas overlap?	Yes, extensively	No, rarely
Do pump owners compete to increase water sales?	Yes, because of active markets in pump irrigation service with powerful productivity and equity impacts	No, because tube wells are sited to serve specific command areas
Are water prices fixed by the operation market?	Yes, entirely; there is no regulation whatever of the way fragmented, local pump irrigation markets function	No, it is guided by a village committee and village leader; usually, it is fixed on energy-cost plus basis
Is water selling viewed as a source of areas where farmers make heavy	Yes, especially in Eastern India, significant income?	No, except in deep tube well Nepala terai and Bangaldesh investments
Irrigation cost as a proportion of total value of output	20–25% for water buyers	10–15% for water buyers

Participation of entrepreneurial managers in China's large irrigation systems

In the large irrigation systems, entrepreneurial management is becoming more and more common in the operation and management of canals, water distribution and water fee collection, which had earlier been the responsibility of village committees or collectives. From 1995 to 2001, the proportion of villages with collective management fell from 100 percent to 27 percent in a sample of villages surveyed by Wang et al (2005).

Of these, twice as many employed private contractors as formed WUAs. In fact, many WUAs were found to be a method by which a village leader would take control of the management. A study in 51 villages in Ningxia and Henan

water in relation to the water entitlement that is determined for each village by district irrigation officials before each cropping season.

Thus contractors induced more efficient water use because of the manner of incentives they faced. They were charged for a given volume of water but farmers paid them based on the area irrigated. As a result, if contractors irrigated more area with the same water, they earned more. Moreover, incentivized irrigation managers have begun to worry about farmers turning to groundwater irrigation in the face of poor quality surface irrigation service; and increasing use of groundwater has led to competition in the delivery of the village water, forcing the surface system to improve its water delivery services.

Regulation and management of groundwater demand

Compared to many South Asian countries, China has been more proactive in groundwater regulation although its experience is by no means completely satisfactory. It has experimented with a combination of tube well permits, withdrawal permits, differential and penal pricing, direct regulation and sealing of wells, creating alternative water supplies, and promoting water saving technologies. This strategy has proven more effective with industry than agriculture, and in richer provinces than poorer ones.

Tube well permits

Tube well permits provide a mechanism to check unplanned growth in groundwater wells. However, this has not begun to work as yet as farmers can get permits easily. However, the system of permits does serve to provide data on the number of tube wells in an area, an important aspect in over-exploited areas.

Withdrawal permits

The most direct method of intervention—withdrawal permits—registers users, levies fees, allocates quotas, and monitors actual usage. First introduced by water bureaus as far back as the 1970s, it received legislative support by a 1993 regulation—"Implementation Method of Water Withdrawal Permit System"—which made mandatory the registration of any individual or entity that draws water from a lake, river or groundwater over certain levels.

The Water Law of 2002 further required all old and new tube wells to have Withdrawal Permits. However, implementation has been slow. In general, Withdrawal Permits have yet to achieve significant regulation of groundwater demand for irrigation. However, it is evident that institutions such as water companies, irrigation districts and village committees respond faster and more readily to regulation than individual users. For example, of 23,800 permits issued in Shaanxi, over 10,000 are to industrial users, irrigation districts, and water supply companies.

Indirect approaches to demand management

Groundwater demand for irrigation in some parts of rural China is facing downward pressure because of wider trends not related to programs and strategies implemented by water administrators. A major factor has been the global drop in the price of rice in recent years.

Table 2. Comparing Water Institutions and Policies in South Asia and China: Summary

	South Asia	China
Does the village government have a significant regulatory role?	No, except in Baluchistan	Yes
Are there significant taxes on agriculture? Are these collected?	No	Yes
Is there a system of registering and licensing groundwater structures? Is it enforced?	No	Yes, but not enforced strictly
What's the nature of the water bureaucracy?	Fragmented; thin presence	Less fragmented, but more presence
Water is an economic good: Does water command an economic price?	No, most users pay a tax	Yes, most users pay a water price.
Does the water administration have the capability to enforce broad-spectrum measures?	No	Yes, rice cultivation in NCP completed eliminated.
Are there institutional limits to "competitive deepening of tubewells"?	Only indirect; unenforced	Avoided easily, even with privatization
Adoption of water saving methods and technologies	Very limited	Extensive and growing
Macro economic safety valves:Is there scope for shift of population from farm to off-farm livelihoods?	No, except in small pockets	Yes, with the work permit system liberalized
Institutional reform: is the focus just on cost recovery, or productivity and environment sustainability?	Focus on cost recovery through IMT	Chinese water admin. in a 'franchise mode' rather than IMT

Rice versus maize

The global decline in rice prices, the rise in prices of electricity, and the need for greater amounts of fertilizer and labour in rice cultivation, have encouraged the growth of other crops, most notably maize. With the cultivation of maize being rain-fed, as compared to the irrigation-intensive rice, Liaoning Province officials report that groundwater use in agriculture has fallen and water tables have risen from an average depth of 34 metres to an average depth of 18 metres.

Bt Cotton versus maize-wheat

The cultivation of Bt (bacillus thuringiensis) cotton also helps to support the protection of groundwater resources, since it requires only one to two irrigations per crop as compared to four to six for maize. Cotton also responds very well in terms of increased yield to drip irrigation, which uses far less water. The increased use of plastic mulch serves to reduce evaporation and preserve moisture. All these factors result in significant savings for farmers in terms of electricity and water costs.

Groundwater irrigation and the energy economy – managing costs

In contrast to India, electricity use in groundwater irrigation is not a major issue in China. A survey of nine villages in Henan and Hebei provinces in 2002 showed that irrigation cost as a proportion of gross value of output, rises in tandem with the depth from which the groundwater is pumped. The Chinese power supply industry operates on the principles of total cost recovery—with each user paying according to metered usage. Unlike in South Asia, rural users were charged at a higher rate than urban ones, and until a few years ago, agriculture even paid higher rates than industrial users.

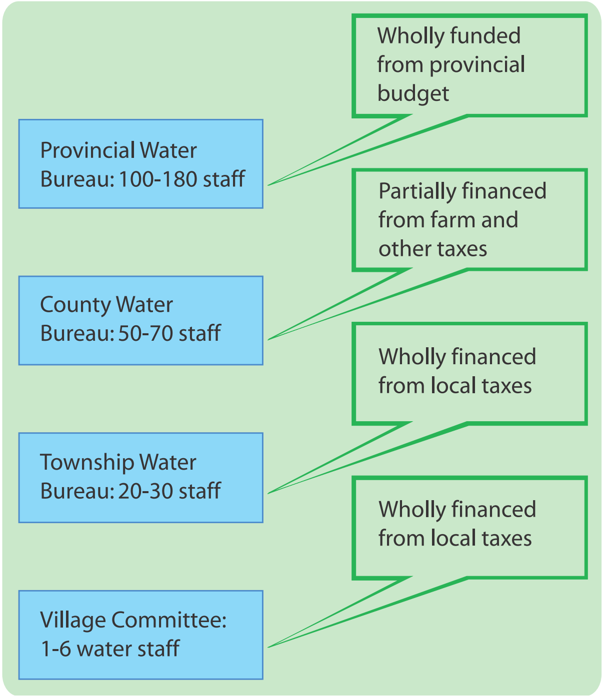
China's strong village-level authority structure makes metering practical and firmly discourages tampering by users. The passing of costs down to the users makes it impossible for power suppliers to incur losses. The standard arrangement is for the village committee and/or township electricity bureau to train one farmer as part-time electrician with dual responsibilities of maintaining the power supply infrastructure in the village and collecting user charges. Usage is based on meters, with one meter at the user's location and the other at the transformer. Issues dealing with non-tallying of the two meters have been largely solved by allowing a 10 percent loss due to leakage, and a modernization program by the Electricity Network Reform Program that resulted in losses falling sharply. And last but not least, the incentive given to village electricians to keep losses to less than 10 percent, is a powerful tool for them to reduce line losses.

Table 3. Issues in the 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
Water-Energy Nexus is considered an unresolved issue	No	Yes

Meanwhile, China is coming full circle, by turning over to county electricity bureaus, the responsibility of electricity plants, transmission and distribution infrastructure, and collection of dues from users. It is expected that China will begin to face many of the problems in user fee recovery that Indian State Electricity Boards (SEBs) are trying to overcome.

Figure 1. Structure of Chinese Water Administration and its Funding



China is already trying certain methods to overcome these hurdles. One that is proving successful is a pre-paid card or IC card system where users pay for electricity in advance on a rechargeable card. This system has been introduced in the water-short provinces. However, the IC card system has encountered resistance from farmers akin to the Indian farmers' resistance to metering. This resistance has not proved to be a major issue in China, mainly because the IC card system is perceived to be a fair one. Above all, it drastically reduces wastage of electricity and water since farmers can see from their IC cards how much it costs to pump groundwater.

Reversing Urban Groundwater Depletion

Chinese cities, like other cities in Asia, face unprecedented groundwater stress levels. The strategy adopted has been largely one of crowding out of urban tube wells through imports of water from other areas. In Shaanxi, all urban tube wells are now closed, resulting in water tables rising 1 to 1.5 metres annually.

Jiangsu Province adopted a system of importing Yangtze water from the south of the province to the north, priced at rates that reflect the need to raise the water levels at five locations in order to move it to users. However, this had to be followed up by increasing fees of water permits to levels higher than that of the raised water, encouraging users to switch to Yangtze waters. The Jiangsu Provincial Water Resource Board initiated a campaign to close all urban tube wells by 2005. As a result of this extensive direct regulation, the province has since 1995 made a big impact on reducing urban groundwater depletion, with levels rising up to six metres per year.

The way forward: looking at alternatives

South Asian discussions on water reforms need to incorporate a wider body of experience. As such, China's somewhat unorthodox approaches to solving the country's water resource problems could offer some useful pointers.

China could provide valuable lessons in the area of energy pricing and the groundwater economy as well as the introduction of incentives to improve the management of public irrigation systems. Additionally, China's more unified water affairs bureaus may offer an alternative to the comparatively disjointed administrative bodies responsible for water management in South Asia. China too had the experience of a sectoral approach to water management up until a decade ago, before which ministries as varied as agriculture, geology and mines and urban development ran various disparate water bureaus. China encouraged a service-oriented culture within its water affairs bureaus, which combined a business approach with incentivized service provider models.

Some key factors

China is experimenting with alternatives to the traditional communitarian model of organization for managing its small-scale groundwater based irrigation systems as well as large irrigation projects.

The country experimented with a variety of models of 'irrigation service providers' who are incentivized for better service delivery, improved water use efficiency and better performance in water fee collection. In the case of small scale systems, it is certainly promoting financial sustainability; in large systems, indications are that incentivized service providers promote efficient water use, besides improving fee collection.

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 subsidization, 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 IC pre-paid electricity cards for agricultural electricity supply. Many Indian states—where subsidized flat electricity tariff is wrecking groundwater as well as power economies—are struggling to reintroduce metering. China's experience can provide useful guidance in this direction.

North China has made considerable progress in getting some control over runaway groundwater overdraft 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, and crowding out urban tube wells by surface water imports. These measures have been more effective in urban areas than in agriculture, and in economically more dynamic eastern provinces than in the agricultural western provinces. However, after years of regulatory activism, there is growing confidence amongst the country's 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) reorienting its massive water bureaucracy from water development to resource management mode rather than by shrinking it.

Tube wells in Shenyang, Liaoning Province, China

Photo Credit: Tushaar Shah

Water Policy Briefing Series

The ***Water Policy Briefing*** Series translates peer-reviewed research findings into useful information for policymakers and planners. It is published several times yearly, with the goal of bringing new and practical approaches to water management and planning into the policy recommendation process. The series is put out by the International Water Management Institute (IWMI) in collaboration with national and international research organizations. It is free of charge to development professionals.

The Water Policy Briefings are also available online: **http://www.iwmi.cgiar.org/waterpolicybriefing/index.asp**
You can sign up to receive the publications by email or post. Comments and questions are welcome. Please send correspondence to:

The Editor, Water Policy Briefing
International Water Management Institute
P.O. Box 2075, Colombo, Sri Lanka
Telephone: 94 11 2787404 Fax: 94 11 2786854
Email: waterpolicybriefing@cgiar.org

About IWMI

IWMI is a non-profit scientific organization funded by the Consultative Group on International Agricultural Research (CGIAR). IWMI's research agenda is organized around four priority themes covering key issues relating to land, water, livelihoods, health and environment:

Theme 1: Basin Water Management: *understanding water productivity*
Theme 2: Land , Water and Livelihoods: *improving livelihoods for the rural poor*
Theme 3: Agriculture, Water and Cities: *making an asset out of wastewater*
Theme 4: Water Management and Environment: *balancing water for food and nature*

The Institute concentrates on water and related land management challenges faced by poor rural communities in Africa and Asia. The challenges are those that affect their nutrition, income and health, as well as the integrity of environmental services on which food and livelihood security depends. IWMI works through collaborative research with partners in the North and South, to develop tools and practices to help developing countries eradicate poverty and better manage their water and land resources. The immediate target groups of IWMI's research include the scientific community, policy makers, project implementers and individual farmers.

For further information see www.iwmi.org

IWMI
International
Water Management
Institute

Writers: Niresh Eliyathamby and Samyuktha Varma; Editor: Sharni Jayawardena; Design & Layout: Sumith Fernando