9 Breaking the gridlock in water reforms through water markets

Experience and issues for India

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Introduction

In recent decades India has witnessed rapid growth in demand for water, particularly in domestic and industrial sectors, due to population growth, urbanization, industrialization, and rising incomes. This growth in demand has not been matched by an increase in supply. The problem is compounded by pollution of water, which has reduced its suitability for various uses. Under these circumstances, it is more important than ever before to use water efficiently. It is also necessary to anticipate and address inter-sectoral conflicts over allocation and use of water.

The standard approach so far has been to advocate reform of water pricing across sectors to reflect the scarcity value of water and the cost of service provision. Nevertheless, major users of water particularly of irrigation water have resisted these reforms so far, resulting in inefficiency in water use, persistently low quality of water services and in some cases, loss of sustainability.

In this context, economic theory tells us that markets increase economic efficiency by allocating resources to their most valuable uses. In other words, if certain conditions are met, markets provide the correct incentives and lead to efficient resource use. Therefore, one way to change the incentives so that water users support the reallocation of water, and to achieving a more efficient allocation of water is through *water markets*. These allow water users to buy and sell water, thus changing the whole incentive structure and breaking the logjam of water pricing reforms – when water users can gain from reallocation they would be willing to sell water or pay a higher price for new supplies.

The aim of this chapter is to explore the reforms necessary for water markets to evolve in a manner capable of addressing India's emerging challenges. The following section elaborates on the concept of water markets and their rationale. We discuss the deficiencies of the current systems of water allocation and how water markets could be an improvement over them. In particular, we draw out the advantages of water markets over administered efficiency pricing (i.e. pricing marginal units of water at their

marginal cost). We then review experience of informal water markets in India, before discussing the emerging challenges in the context of the current management framework. After describing briefly how formal water markets could be an improvement over informal markets, we identify the legal and institutional measures required to establish formal markets and recent reform measures in this direction.

Water markets and their rationale

Usufructuary rights to water have evolved either explicitly through laws and regulations or implicitly through conventions. These water rights are generally based on one of three systems: first-come, first-served allocation (also known as *prior appropriation* rights), allocation based on proximity to flows (or *riparian* rights) and *public* allocation (Sampath 1992; Holden and Thobani 1996; Haddad 2000). Whereas queuing for water is the basic approach of the prior appropriation doctrine, the location of one's land determines water rights under the riparian doctrine. Under this approach whoever owns land along (above) the water has the right to ownership/reasonable use of the water. Finally, public allocation involves publicly administered distribution of water: "Under this system, public authorities decide how to allocate water using guidelines or laws establishing priorities and often specify the uses to which the water can be put" (Holden and Thobani 1996: 2).

Most developing countries follow variants of the last approach where essentially the rights are allocated free – though there may be a charge for water use (typically based on the amount of irrigated area), the water rights themselves are obtained without charge.[1] The track record, however, of administered systems of water allocation has not been impressive – water is typically underpriced and wastefully used and the delivery is high cost and unreliable (see Holden and Thobani 1996 for details).

While this is well known, the important point to note here is that none of these systems fulfill the conditions for well-defined property rights to water, which in turn are essential for water markets to exist. In this context, the question could well be asked "why not use administered efficiency-based pricing of water as an intermediate policy between managed quantity allocation and water markets?"

There are three reasons why water markets could be preferred to administered efficiency pricing (i.e. pricing marginal units of water at their marginal cost):[2]

1. Reduction in information costs – whereas it is theoretically possible to devise and implement a system of administered prices which would lead to efficient allocation of water, the information requirements are demanding and may require experimentation by trial and error.
2. Perhaps more important, if the value of prevailing usufructuary water

rights (formal or informal) has already been capitalized into the value of irrigated land, then imposition of administered pricing is (correctly) perceived by right holders as expropriation of those rights. In effect, this would result in a capital loss for irrigated farms. This could explain the strong resistance by these groups to establishing administered efficiency prices. Under the water market system, establishment of transferable water rights would formalize the existing situation (where irrigated land is more expensive), rather than being viewed as a usurpation of these rights. Thus, their implementation should be more feasible politically as compared to administratively imposed water pricing reforms.

3. The administrative solution presumes "far-seeing, incorruptible, influence-free" (Holden and Thobani 1996: 5) administrative bodies that are able to design and implement the "correct" prices. In practice, this may often not be the case: these bodies could be captured by interest groups or they may be short-sighted and unable to estimate future demand, or they may be unable to set and collect appropriate water charges. Advocates of administrative approaches, however, often ignore these problems.

For water markets to work, property rights to water must be private, exclusive and transferable (Bauer 1997). In this context, secure ownership provides an incentive to invest in greater productivity of the resource, while freedom to exchange provides the flexibility to reallocate the rights according to changing demand and other conditions. The role of the state should be minimal in this setting and should be restricted to protecting property rights, enforcing contracts, and reducing transaction costs and barriers to exchange. In fact, it can be argued that much of the current inefficiency in the water sector in India is due to excessive state regulation and subsidies which have distorted patterns of water use. As a corollary, then, freer markets would help in "getting the prices right," and in strengthening the incentives to conserve water as demand increases since any water saved could be sold.

Another important rationale for water markets is the *relationship between markets and liberty*. In contrast to non-market allocation which gives the state leverage in non-economic spheres as well, private property creates a space for individuals where the state cannot trespass. "Private property [the necessary precursor to markets] has thus been viewed . . . as a bulwark against the dictatorial authority of governments" (Cooter and Ulen 1996: 109).

In this context, by creating entitlements where none existed earlier, these markets can be a *tool for empowerment*. Holders of water rights would be sought after (irrespective of their socio-economic status), by those who would like to buy these rights.

Similarly, *environmentalists can also purchase water rights* in order to preserve a valued wetland or to increase a waterway's flow. Without a market

mechanism, environmental groups would have to depend on the state to achieve the same end (Haddad 2000). In fact, this has already happened in several states in western United States – the Oregon Water Trust, the Washington Water Trust, and Nevada's Great Basin Land and Water are three recent groups that have used water markets to acquire water rights and convert them into instream flows. The Oregon Water Trust for instance has been able to increase flows on more than 25 different streams and rivers flowing into the Columbia River (Landry 1998). In sum, the private space created by market mechanisms can be used to achieve socially valued ends.

Water markets in India

Before we review the Indian experience with water markets, it is important to distinguish between formal and informal markets. Under the former, water rights are clearly and universally assigned, with legal validity for freely negotiated sale of these rights. In case of informal markets, there is neither clear assignment of rights nor legal sanction to trade. Thus, in formal water markets enforcement of trades occurs by recourse to legal and institutional measures, whereas in the case of informal markets (which simply arise from spontaneous response of water users to changes in demand-supply situations), such recourse is not possible (Easter *et al.* 1998). Also, formal markets are often defined with respect to water rights, while informal markets operate for volume of water.

Extent of water markets in India

Water markets that exist in India are informal and are generally limited to localized water trading between adjacent farmers and the practice is quite common for groundwater. Although found in many parts of India, the occurrence of groundwater markets is not uniform. While water markets are widespread in Gujarat, Punjab, Uttar Pradesh, Tamil Nadu, Andhra Pradesh and West Bengal, they are most developed in Gujarat. The extent of area irrigated through water markets, which is often considered to be a surrogate for the magnitude of water trading, varies across regions as well as over time depending on a number of factors such as rainfall, groundwater supply, cropping patterns, and the cost and availability of electricity (Saleth 1994). In water-scarce pockets of Gujarat, Tamil Nadu, and Andhra Pradesh, a substantial area is irrigated through groundwater markets.

Several micro studies illustrate the degree of variation in use of water trading in India. In terms of area irrigated through groundwater markets, estimates vary from 80 percent for Northern Gujarat (Shah 1993) to 60 percent in Allahabad district in Uttar Pradesh (in a 16-village sample study; Shankar 1992) to 30 percent in the Vaigai basin, Tamil Nadu (Janakarajan 1994). Some studies report no water trading in their study area (Shah 1993; see also Shah 2009).

There is no systematic estimate at the national level of the magnitude of water trading. The area irrigated through water markets has been projected to be about 50 percent of the total gross irrigated area with private lift irrigation systems (Shah 1993). Other estimates, using a methodology based on pumpset rental data, put the figure at 6 million hectares or 15 percent of the total area under groundwater irrigation (Saleth 1999).[3] Assuming a net addition to output of US$230/ha/year (based on the difference between the average irrigated and rainfed yields as reported by Government of India 1999), Saleth estimated the total value of output due to water sales at US$1.38 billion per year (Saleth 1999).

Nature and characteristics of informal water markets in India

A review of the functioning of informal water markets in India can improve our understanding of the market and provide useful insights, which could form the basis for designing formal markets.

Localized and fragmented

As stated earlier, water markets in India are mainly limited to the irrigation sector – that is, one irrigator selling water to another irrigator. Water trading in India is localized, fragmented and is over short distances and periods. Unlike in Chile, western USA, and Australia, the institutions, legislation and regulatory framework do not exist in India for more formal transactions. In some rare cases, however, water purchases for non-irrigation uses have been reported. For example, brick manufacturers purchasing water have been reported by Shankar (1992).

Mainly driven by surplus supply

Most water sales do not involve any reduction in irrigation by sellers (Saleth 1999). Most of the sellers are large farmers owning deep wells and large capacity pumpsets and the buyers are usually small farmers without wells or pumpsets, though there are non-poor farmers who rely on groundwater markets due to farm fragmentation or inadequacy of water in own wells. By providing access to use of groundwater and irrigation assets to resource poor farmers, groundwater markets have promoted equity.

Monopoly power

The existing informal markets are small and unbalanced and are typically characterized by a weak bargaining position for buyers. Buyers often do not have a choice because of low density of wells, compounded by uneven topography and potential for seepage losses (Shah 1993), which gives sellers a degree of monopoly power. Further, there is evidence of buyers being

tied down to sellers from contiguous plots, as sellers can and do refuse conveyance of water through their plots to other possible suppliers (Janakarajan 1993, 1994). Monopoly power helps sellers not only in raising prices but also in compromising the quality of service they offer.

Influenced by social factors

Social factors and agrarian relations sometimes determine the development of water markets. For example, in Bihar it has been found that it was the water buyers' position in the social network, particularly their social proximity to sellers – rather than their ability to pay – that determines their access to water (Wood 1995). Moreover, there were several cases of price discrimination with prices being lowered for favored clients. In Paldi village in Gujarat, there is evidence of many water transactions being "bundled into existing landlord–tenant relations" (Dubash 2000). Thus, out of 20 wells sampled, 11 sold water – five separately and six to tenants.

Widely varying terms of payment

Terms of water payment vary widely and differ by crop and by season. Payments can be made through cash transaction or non-cash contracts. Cash payments are made on the basis of time, volume or area irrigated. Hourly price ranges between 3 rupees in West Godavari district of Andhra Pradesh to 45 rupees in Mehasana district of Gujarat (Shah 1993). Non-cash contracts, which typically take the form of sharecropping (i.e. seller collects a water rent in the form of a share of the buyer's output), are not uncommon.[4] They have been found to be incentive-compatible (Aggarwal 1999). These contracts work as "double-sided" incentive, providing the seller an incentive to ensure that water supply is timely and reliable and the buyer an incentive not to shirk in the application of labor. Sometimes the market displays a feudal character. In Tamil Nadu, there are cases where water buyers have to offer labor services such as operating the pump and irrigating the well-owners' fields for a paltry sum or none at all (Janakarajan 1993, 1994).

Groundwater overexploitation

There is some evidence of decline in groundwater table caused by competitive water withdrawal due to intense water marketing activities (Moench 1992). Under the current legal system, there is "open access" to groundwater (see below) and every landowner has an incentive to pump as much as possible, since what it is not pumped remains to be appropriated by someone else. This results in "the tragedy of commons where each user tries to maximize his/her own share winds up lowering everyone's share. When groundwater gets lowered it increases costs for all as they need to deepen their wells and require more powerful motors" (Planning

Commission 2007). Further, since farmers are faced with zero marginal cost for pumping (see below), over-exploitation cannot be avoided. Clearly, under the current system, it is natural to expect overexploitation of groundwater in water-scarce areas; the presence of groundwater markets only exacerbates it. In addition to reducing ecological sustainability, one important side effect of this phenomenon is that poor farmers who do not have the resources to deepen their wells are driven out of farming.

Ineffective and iniquitous regulation

Only a few states that are severely affected by groundwater extraction have opted for groundwater acts. These legislations rely typically on state imposed control mechanisms (permits for digging new wells over limited area and limited period of time, spacing and depth norms), with little emphasis on cooperative management. While there is no legal basis for trading, restrictions on withdrawal can potentially affect trading indirectly. These regulations however have been ineffective because of poor enforceability resulting from inadequate supervisory resources with states to deal with the large number of wells that are in operation.[5] Individual farmers can also render some of these regulations ineffective. For example, restrictions on the number of tube wells can be overcome by increasing the power of the pumpsets. The legislations are also iniquitous: while recognizing the rights of those who already own wells, they exclude others (Planning Commission 2007).

Irrigation–electricity nexus

Groundwater pricing is indirect and is determined mainly by the cost of electricity which accounts for the dominant part of marginal cost of pumping water. For electric pump sets, charges are levied on a flat basis per month in proportion to the horsepower of the pump set.[6] As marginal cost is zero, most farmers tend to use water inefficiently. Further, state power utilities find it difficult to raise flat tariff for years on end under pressure from Chief Ministers of states, who see pricing of power for agriculture as a "powerful instrument in populist vote bank politics" (Shah *et al.* 2007). Thus, "below cost, often free, and unmetered electricity supply for agriculture has contributed to an erosion of electricity distribution systems and also encouraged wasteful groundwater use" (Dubash 2007). To the extent water markets have encouraged excessive pumping, they have contributed to the deterioration in the financial health of the power sector.

Limited interface with formal sector

There are limited instances of the formal sectors of the economy (such as cities and industrial establishments) accessing groundwater market. This is

typically done through water tankers, which are usually operated by small units encompassing around ten people; the impetus for operators to enter into this activity is the prior possession of at least one factor of production: land, tankers or wells (Llorente and Zerah 2003). The water so distributed is not subject to any quality control. Municipalities hire water tankers from private firms to supply water to residents in emergency situations and also in newly constructed residential areas where waterpipe network is unsuitable and inadequate. Large industrial establishments also use this service. According to a survey conducted in Delhi in 1998, about 25 percent of industries and institutions surveyed were found to be dependent on private tankers on a fairly regular basis (Llorente and Zerah 2003). Even though private water tankers play a key role in supply to some users, they account for a small fraction of cities' total water supply. In a rare instance, the water utility for the metropolitan area of Chennai (Chennai Metropolitan Water Supply and Sewerage Board or Chennai Metro Water) had scaled up its reliance on groundwater purchases from farmers; the experience of Chennai Metro Water is discussed in Box 9.1.

Emerging challenges

To examine the context in which the role and nature of future water market will get determined, it is important to take note of the emerging challenges. Water scarcity is already a significant issue and is likely to get aggravated in future: "Indeed, by 2025, by many accounts, much of India is expected to be part of that one-third of the world which is expected to face absolute water scarcity" (Shah 2007). Signs of growing water scarcity are already visible. For example, the share of blocks (i.e. assessment units) of the country that are classified as over-exploited has increased from 5 percent in 1995 to 15 percent in 2004, making overexploitation of groundwater a matter of serious concern (Planning Commission 2007).[7]

Scarcity has also manifested itself in the form of growing conflicts, which have reached several levels: user groups, sectors, rural and urban areas, political parties, states, groups and individual farmers. These conflicts are likely to worsen and pose "a significant threat to economic growth, social stability, security and health of the ecosystem and the victims are likely to be the poorest of the poor as well as the very sources of water: rivers, wetlands and aquifers" (Gujja *et al.* 2006).

The second important challenge, moving forward, is the changing nature of water demand: "Industries and cities (which both require water and produce wastes) are growing rapidly. Rural life is changing, with more than half of the people in rural Punjab and Haryana no longer engaged in agriculture" (Briscoe and Malik 2007). According to official estimates, the demand for water from domestic and industrial sectors is projected to rise much faster in the coming decades than from the agricultural sector (see Table 9.1), implying that at the margin water will have

Box 9.1 Large-scale purchase of groundwater by Chennai Metro Water

Chennai Metro Water is a state-owned water utility in Chennai, a city in south India. Between 2001 and 2004, when drought conditions prevailed, Metro purchased water from farmers in the peri-urban areas using PVC pipes (through annual contracts) as well as water tankers (without contracts; on ad hoc basis). These were voluntary transactions and varied from 13 percent of Metro's supply during 2002 to 58 percent in 2004. Rates were fixed through negotiations at about 26 rupees per hour of supply (equivalent to about 1 rupee per kl as compared to reportedly 48 rupees per kl from desalination plant currently under construction in Chennai). Under the contract system, farmers pumped water into PVC pipes laid by Metro, which was collected and distributed by the Metro. In addition to conveyance; the cost of power used in pumping was also borne by the Metro. Under the tanker system, Metro paid about 5–6 rupees per kl and also bore the cost of transportation. The practice has been kept in abeyance since 2005, when rainfall and availability from other sources improved.

This was perhaps the only instance, where a formal segment of economy accessed groundwater from farmers on a large scale. The terms of these transactions were attractive not only for farmers, who managed to sell large quantities by reducing cropped area in dry seasons, but also for Metro, which could tide over a period of extreme scarcity.

The practice had a severe impact on the economy of the peri-urban areas that supplied water to Metro, however. The prospect of high income through water sales prompted several farmers to resort to over-pumping leading to water tables falling to extremely low levels, affecting all farmers including the sellers. Further, the change in land-use pattern led to falling agricultural employment and serious livelihood problems (Janakarajan *et al.* 2007). Many landless laborers and small farmers migrated to cities in search of employment, putting additional pressure on cities' strained infrastructure.

An important lesson from the Chennai experience is that although groundwater from peri-urban areas is an attractive proposition (for both urban local bodies and prospective sellers) and large scale transfers are feasible, the consequences for such transfers on the peri-urban areas can be severe, unless there is a sound framework to manage extraction in a sustainable manner.

Source: partially based on discussion with Chennai Metro Water officials

to be increasingly reallocated toward domestic and industrial sectors and away from agriculture.

Table 9.1 Projection of demand for water (km^3)

	1997–8		*2010*		*2050*	
	Amount	*Share (%)*	*Amount*	*Share (%)*	*Amount*	*Share (%)*
Irrigation	524	83	550	78	718	67
Domestic	30	5	43	6	101	9
Industries and power	39	6	56	8	148	14
Others	36	6	54	8	111	10
Total	629	100	702	100	1,077	100

Notes: Amounts for 2010 and 2050 are averages of "high" and "low" scenarios for the respective years. "Others" includes inland navigation, environment and evaporation loss
Source: Government of India (1999)

Both of these issues call for significant changes in water resource allocation and improvement in water use efficiency, particularly in the irrigation sector which accounts for a dominant share in total water use. Will these be possible within the management framework currently being pursued? In surface irrigation, which accounts for about 60 percent of total irrigation use, water user contributions represent less than half of actual operational and maintenance expenses and in some states, only 5 percent (World Bank 1999a), reflecting low tariff (due to political reasons) and unwillingness among farmers to pay in view of poor irrigation services.[8] Not surprisingly, a large part of the canal network is in disarray. In many parts of India, farmers at the "head end" (typically rich) get excessive water and tend to use water inefficiently, while those at the "tail end" (typically poor) hardly get any water. Reform efforts in recent decades have focused on cost recovery. Without addressing the accountability question, exhortations to increase cost recovery however have largely failed. The surface irrigation sector is thus caught in a logjam, in which services are poor, farmers do not pay and service quality declines. Groundwater, in contrast is in private domain and capital costs and operational and maintenance costs of extraction – albeit highly subsidized – are borne by the well-owners. As stated earlier, zero marginal cost together with the open access common property character of groundwater and ineffective regulations have led to unsustainable extraction. While water is being inefficiently used in irrigation sector, rising demand from cities and industries are being met from new supplies mainly to avoid conflict situations.

Clearly, the current sector framework is not in a position to cope with the problems at hand. Further, focus on tariff reforms, while necessary for

financial sustainability of infrastructure, will not be able to fully address the emerging issues, because the tariff revision required to reflect scarcity value and attain allocative efficiency would be much higher than what would be politically feasible.[9] and can be effectively implemented. Given limited supplies and growing and changing demands, "the need is obviously for a management framework which stimulates efficiency and which facilitates voluntary transfer of water as societal needs change" (Briscoe and Malik 2007).

Introducing formal water markets in India

In India, there has been no explicit policy statement in favor of water markets. At the same time, though there is no legal basis for informal markets to exist and function, the state has followed a policy of non-interference *vis-à-vis* such markets. Under such a dispensation, when informal markets have grown and served a useful purpose, why do we then need formal markets? Some of the major benefits that a formal market is expected to yield are:

- This would allow water transfers to take place on a large scale and also between sectors, thus allowing a reallocation of water to higher productive use. For instance farmers instead of producing low-value, water intensive crops might sell water to a neighboring city if it fetches them a higher price. At the same time, the possibility of large-scale intersectoral transfers could postpone or make unnecessary construction of costly hydraulic infrastructure. La Serena city, for example, was able to meet its water needs by purchasing water rights from farmers and this was attained at much less cost as compared to building a dam.
- Second, the nature of informal markets is such that trading cannot be regulated. In contrast, since property rights are well defined in formal markets, trading can be regulated. Regulation can lead to better resolution of the negative side effects of trading such as aquifer depletion or monopoly creation or equity issues – which have acquired significant proportion in India – more effectively.
- Third, formal markets, based on an explicit water right system, can help potential investors and water companies gain secure long-term access to water. An important factor inhibiting private investment in water sector in India, particularly in urban water supply, is that potential investors do not feel confident of meeting their service obligations in the absence of secure long-term access to water.
- Fourth, legally well-defined and registered property rights reduce transaction costs involved in water trading. These costs include monitoring and enforcement costs, conveyance costs, and costs of designing contracts. Low transaction costs would encourage trade and thereby expand the scope of the market.

Clearly, formal markets that retain and extend the potential gains of informal markets and counteract many of their negative features, are preferable. Before introducing formal water markets with tradable property rights, however, some legal and institutional issues would have to be resolved. These are discussed below.

Legal and institutional measuresManage surface water on a river basin basis

Indian law treats all surface water as state property. The fragmentation of basins by state boundaries and lack of cooperation between states is a critical issue for interstate water development and allocation. In the absence of legal clarity on what individual states' shares are, conflicts between states have grown. It is therefore important to introduce necessary legal arrangements to facilitate the management of surface water on a river basin basis.

Clarify legal position on individual usufructuary rights for surface water

There is also a lack of clarity on individual usufructuary rights for surface water, as the legislation has failed to devise a system for providing secure, defensible and enforceable surface water rights. Although courts have upheld the riparian rights – individuals abutting upon a (natural) stream can use water without disturbing a similar benefit to other riparians – as natural rights, individualized rights of abstraction and use of such water can only be established through time-consuming litigation (World Bank 1999b). Furthermore, states' sovereign rights over surface water have in the past been challenged in courts by riparian landowners, who claimed that their rights had been infringed upon by the government in pursuit of its irrigation projects (World Bank 1999b).[10] Unless surface water rights are better clarified and in favor of individuals, conflict and litigation will grow in the future and formal water markets will not be possible.

Separate rights to groundwater from rights to land

Under the law of riparianism applicable in India, ownership of groundwater accrues to the owner of the land above. By virtue of these laws, groundwater is "attached like chattel" to land property and cannot be transferred separately from the land to which it is attached (Singh 1992). This has constrained the potential for inter-sectoral allocation. To establish an active water market, rights to water use must be authorized separate from land.

Establish limits for withdrawal of groundwater

Under the current laws, there are no quantitative limits on groundwater withdrawal by individual users. This provision together with the provision

of tying land rights with water rights has serious equity implications, because it allows larger farmers with higher pumping capacity and deeper tube wells to have a disproportionate claim over water than others. Further, sellers can get a payment from the very group whose water rights get infringed by the seller's activities (Saleth 1994). Besides, withdrawal limits will promote efficient water use. Furthermore, in a theoretical sense, an efficient operation of a market is critically dependent on the prior existence of an effective legal institution of property rights establishing the initial resource endowments of individuals. There is therefore a need to specify water withdrawal limits by individuals in volumetric terms.[11] Although establishing individual withdrawal limits can promote equity and efficiency, ecological sustainability requires collective withdrawal limits keeping in view annual recharge.

Broaden the market

It is not enough to give users the option to buy and sell water. Such options should be as numerous as possible to make the market competitive. This requires not only institutional and organizational changes but also improved canal infrastructure to make sure that trading can take place over a larger area – for example, by joining different systems. Similarly, management may have to be improved so that buy and sell orders are easily executed. Improved control structures are also necessary which would allow managers to easily increase the flow in one canal and decrease it in another.

Create conflict-resolving institutional arrangements

Further, institutional arrangements are needed for resolving conflicts over water rights. Committees of water users comprising elected representatives of the community created for cooperative management can play this role for disputes among their members. The institution to resolve conflicts among user groups and between user groups on one hand and states' irrigation departments on the other must have necessary independence and capacity.

Attempt to establish formal market: the case of Maharashtra

While the measures outlined above would be required in an ideal situation, not all of them are possible to implement at the current stage, especially those relating to groundwater. Yet it is possible to introduce formal water markets in a limited way, as has been demonstrated by the state of Maharashtra. Maharashtra has embarked on a pioneering reform initiative, which involves the creation of a formal water market (only in its irrigation command areas). The program is at an early stage and the rules of the

game are still unfolding; yet it is useful to examine how it works and its implementation issues.[12]

The program rests on four pillars. First, the State Water Policy, 2003 sets priority among uses as well as principles of tariff setting. Second, the Management of Irrigation Systems by Farmers Act 2005 mandates the creation of Water User Association (WUA), a legal body with elected representatives. Third, the Maharashtra Water Resources Regulatory Act (MWRRA), 2005 ("the Act") has established a water resource regulatory authority ("the Authority") outside the Government. The primary objectives of the Authority are to determine, regulate and enforce distribution of entitlements (surface water) between uses and within each use, act as dispute resolution authority, set criteria for trading entitlements and fix bulk tariff. Finally, a separate bill for groundwater is being enacted with focus on regulation of groundwater extraction and creation of institutions for cooperative management in areas suffering groundwater depletion.

How does the system work? Allocation among uses is subject to priorities set in the State Water Policy. Under the Policy, as amended in May 2011, drinking water is given the top most priority followed by agriculture and industry respectively. (Earlier, industry enjoyed higher priority over agriculture; this meant that a part of agriculture's quota given at planning stage could be reallocated to industry at the implementation stage. After the policy amendment, this is no longer possible. A cut in agriculture's quota can only be undertaken to boost allocation for drinking water.) By government order, 15 percent of reservoir capacity is allocated for drinking purpose among urban and rural local bodies and 10 percent for industrial purposes at the planning stage. Allocation to these two categories is not affected by reduced availability in reservoirs except in drought years. Allocation to irrigation, however, is subject to availability in reservoirs even in ordinary years. (Thus while the right to irrigation water is permanent, its quantum varies from year to year.) The basis for allocation within a category of use also differs across categories. While allocation within local bodies (for drinking water) and industries is based on "first come, first served basis" and considerations of "reasonable use," allocation for agriculture is according to land ownership. In irrigation, entitlements are distributed to WUAs by specifying (i) volumetric allocation per hectare and (ii) volumetric quota for each WUA (based on land under WUA's jurisdiction). Mirroring allocation among WUAs, allocation to each farmer within a given WUA is made proportional to his or her land ownership.

To ensure transparency, gauge registers (i.e. measuring devices installed to deliver volumetric supplies to WUAs) are made available with both the Irrigation Department and WUAs for independent verification and independent regulators are appointed by the Authority to test check gauge readings. Allocation at the individual farmers level is operationalized through the instrument of "irrigation passes," which are sanctioned by the concerned WUAs. In matters relating to distribution of entitlements

among WUAs, the Authority is the appointed body for dispute resolution, while WUAs are authorized to resolve disputes between individual farmers within their respective jurisdiction.

As regards trading of entitlements, the Act provides an enabling framework, although the contours of trading are still being worked out.[13] According to the Act, River Basin Agencies (RBAs) are the appointed bodies with which trades are to be registered. They have the authority to deny any proposed transfers on grounds of damage to third party rights or incompatibility with operation of projects.

The framework was initiated through 6 pilot projects in 2006, which were later scaled up. Currently, there are about 240 projects in the implementation program with around 800 WUAs. The experience gained from these projects is being used in framing rules to operationalize the new legal framework. Two important elements of recent experience are worth noting. First, even though the Act provides for determination of rights to subsurface water as well, it is not being pursued, as setting and monitoring of such rights have been found to be extremely difficult in practice. Difficulties arise from technical reasons, as aquifer flows are not very predictable. Further, such flows are continuous and beneath the land belonging to several people; a new well, for example, can affect "safe yields" of those who already own wells in the same vicinity. Given that wells are very large in number and widely scattered, enforcement would also be difficult. This has forced the government to formulate a separate bill for groundwater. Second, a large part of the canal network is in a state of disrepair and rehabilitating the network is costly and time consuming. Since well-functioning canals are a prime requirement for WUAs to be effective, WUAs has taken over distribution operations yet. While WUAs have begun to receive their entitlements, water distribution is still being predominantly done by the Water Resources Department.

During this limited period of implementation, a number of issues have cropped up, significantly:

- Large-scale investment is necessary upfront to have meaningful peoples' participation. The same holds for almost all states of the country. Do states have the necessary resources?
- There is no clarity on whether allocation to individual farmers constitutes legal rights. The current interpretation is that the Act provides legal rights to WUAs, but not to individual farmers. Without legal rights at the individual level, the benefits of trading would be limited.
- Although the Act allows trading across sectors, the present thinking is to limit trading to "among irrigation users" only. There would then be no scope currently for industries and local bodies to purchase water rights from WUAs. If on the other hand this position is only an intermediate stance before inter-sectoral trading is allowed, the bigger question arises: would sale of water by farmers to industries not entail

a misuse of agricultural subsidies, which aim at increasing food security?

- According to the Approach Paper of the Authority, only up to 50 percent of Entitlement can be traded. This may in some cases prevent farmers from reaping the full benefits of water saving techniques. For example, a farmer wishing to produce the same output as before, may do so with less than 50 percent of her Entitlement by using water saving techniques. The trading restriction would mean that she would then be left with some surplus water, which she would not be allowed to trade.
- In case of dispute resolution, it is not clear as to what should be the nature of compensation. Should it be monetary or in terms of larger allocation to the aggrieved party in the next irrigation rotation within the same season or even in the next season.

Despite these implementation issues, the reform program is a step in the right direction. The issues that have arisen can be resolved in the light of the lessons learnt from other emerging countries that have adopted similar reforms, but within the context of India's own political economy surrounding water. The reform program is appropriately moving in a gradual manner by building consensus among stakeholders and taking into account the administrative and political realities. A broad consensus has already emerged in the following three significant reform areas. The first relates to transparent distribution of entitlements. Several farmers who are at the tail-end of the irrigation system will benefit from this. Second, unlike in the past, allocation and tariff would no longer depend on crops grown. Entitlements are now given to WUAs depending on the land under their jurisdiction. This together with the new practice of volumetric supplies would create appropriate incentives. Third, the Water Resources Department would be subject to discipline because of active involvement of WUAs. While these three will yield significant benefits, the scope of trading in its current, restrictive form will not. Of course, as experience is gained and the market is better understood by water users, it would be easier to build consensus to widen the scope of trading.

Summary and conclusion

In India, water markets have been informal, confined mainly to trading of groundwater between irrigators. These markets are localized, fragmented and primitive, displaying feudal characteristics in some instances. Although these markets have led to some efficiency gains and have expanded the access to irrigation for many resource poor farmers, gains have been limited. Large scale transfers of groundwater from peri-urban areas to cities have created serious problems. Further, with difficulties in implementing effective regulation, these markets have in many instances compounded the problem of overexploitation. Meanwhile, the problem of scarcity is

growing and the sector profile of demand for water is changing. These challenges have emphasized the need for significant changes in water allocation and efficiency improvement.

In this context, it is imperative that India explores the option of formal water markets that assign property rights to individual users, vastly expand the scope of trading and make large scale inter-sectoral water transfers possible. Since formal water markets have legal basis, they can be subject to adequate regulation. The markets will be of significant relevance to the urban and industrial sectors, which have been suffering from acute shortages of water, but have not been able to access informal markets. While tariff rationalization can improve the financial sustainability of infrastructure, they would need to be complemented by formal water markets to address the fast growing and changing water demand. A beginning has already been made in water markets by piloting Entitlement projects in the irrigation command areas of Maharashtra, albeit with limited scope for trading. With gain in experience and stakeholder consultations, the scope of trading can be expanded to a point that cities and industries can benefit. Given the practical difficulties in determining and monitoring property rights to groundwater for millions of wells in India, formal markets in groundwater is (appropriately) not being attempted.

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Notes

1. The water rights themselves under any of these systems are defined volumetrically as a share of the stream or canal flow or of the water available in a reservoir/lake, or in terms of shifts or hours of availability at a certain intake.
2. This discussion is based on Holden and Thobani 1996, and Rosegrant and Binswanger 1994.
3. It is assumed that pumpset rentals inherently involve water sales for all fixed pumpsets permanently fitted to wells or connected to electric power lines.
4. For example, in some parts of Gujarat water is provided to tenants by the land and well owners, where the buyer receives one-quarter of the crop, while the seller receives three quarters. Of the three quarters that water sellers receive, half is on account of land and one quarter is on account of water.
5. According to the report on the third Census of the Minor Irrigation Schemes (2005), India had about 18.5 million wells in 2001; the number is expected to have gone up since then.

6. As the number of tube wells increased in the 1970s and 1980s, states found metered billing costly and difficult (due to rampant meter tampering and corruption at the meter reader level) and switched to flat tariff system (Shah *et al.* 2007).
7. An over-exploited block is one where groundwater draft is higher than groundwater availability and the water table shows significant long-term decline in pre- or post-monsoon or both.
8. In 1997, Punjab made water and power free for irrigation!
9. Besides, the huge agricultural subsidies given by industrialized countries are compelling the farmers of developing countries including India to demand for subsidies on water, energy and other agricultural inputs.
10. Both the Madras High Court in 1936 and the Bombay High Court in 1979 have established that the Government's sovereign rights do not amount to absolute rights.
11. In addition to legislative efforts, quantification of ground water rights in an operational context requires technological changes.
12. Based on discussions with Mr. A. Sekhar of the Maharashtra Water Resources Regulatory Authority, Mumbai, Maharashtra, India
13. The Authority has, in June 2011, floated an Approach Paper indicating the contours of trading for public consultations.

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