Water markets for efficient management of water: Potential and institutional conditions in India

Piyush Tiwari
University of Melbourne, Australia
piyush.tiwari@unimelb.edu.au

Pavan Kumar Ankinapalli
IDFC Foundation, New Delhi, India

KEYWORDS
Water Markets, Australia, Institutional conditions, Murray- Darling river basin, Water rights

ABSTRACT
Water scarcity is among the main problems that the world faces today. While global demand for water is increasing due to rapid increases in population, industrial and food demand, supplies of surface water and groundwater are finite, variable, and increasingly at risk from climate change and environmental degradation. India is no exception, as it grapples with the problem of water shortage in many of its regions. Inefficiency in water use and irresponsibility in the management of water resources pose a serious threat to our water security and sustainability. According to a study by Water Resource Group (WRG), India is facing daunting challenge as the projected demand for water is likely to outstrip available supply by almost fifty percent by the year 2030. Nearly 85 percent of water is used by agriculture in India and that too inefficiently. There are numerous conflicts in making over water entitlements and rights across various stakeholders. The situation will only worsen in the future is 'business as usual' continues.
The development of efficient, flexible and sustainable approaches to allocating scarce and variable water resources between competing uses is therefore vital for continued economic and social development. Yet, flexible market-oriented mechanisms play little or no role in allocating water. Water is often allocated based on political mandate or outdated administrative arrangements.
India has had formal and informal water markets in states like Gujarat (for ground water) or in some villages for lift irrigation schemes for long. Literature suggests that these water markets are typically spontaneous (initiated by private individuals to achieve mutual gains), informal (transaction of water takes place without any legal bindings and to get mutual benefits between the buyers and sellers), unregulated (no strict regulation is followed), localized (mostly functioning at the village level), fragmented (geographical separation of sellers) and seasonal (demand varies across seasons). Given 'unclear' rights framework, conflicts among states over entitlements and outmoded 'formal' institutional arrangements, a formal market at the river basin level has not evolved despite its advantages in efficient water management as demonstrated by informal markets. A number of countries, some of which face similar challenges, have sought to introduce water markets, and Australia is prominent among them. The development of water markets in Australia particularly for Murray- Darling river basin has resulted from a concerted and ongoing effort across multiple levels of government, and from collaboration with users and water service providers. Yet it would be misleading to portray the development of water markets as the seamless rollout of a grand vision.
The paper has following purposes: (i) To identify key institutional features associated with 'informal' water markets in India and potential for their formalization into 'formal' market and scaling up (ii) To look at the evolution in water 'rights' framework and institutional conditions in Australia which facilitated the development of water markets there and how do these conditions compare with India? (ii) What market reforms were implemented in Australia and what are the key outcomes? (iii) What can be learnt from Australian experience and how could these be applied to Indian settings?

1. COMPLEXITY OF WATER PROBLEM IN INDIA

The water problem in India is complex. The total surface water potential in the country is about 1869 cubic Km. Of which, only 1123 cubic Km can be put to use (CWC, 2010). On a per capita basis, the water availability has declined from 5177 cubic meter per year in 1951 to 1588 cubic meter per year in 2010. According to the definition adopted by Food and Agriculture Organization (FAO) of the UN, India is a water stressed state. The disparity at the local level is far starker. Of the 20 major river basins in the country, 14 are water stressed and situation is deteriorating further due to increasing demands from various users and deteriorating quality. The problem complicates further due to seasonal and temporal variations in the availability during the year. Storage of water could ameliorate the variations. However the existing, planned and under development storage has already almost reached the

maximum possible but this will not be sufficient to meet future needs if business-as-usual continues. The groundwater, which is a steady source of water, has also been exploited to the extent that many regions in the country are facing problems such as sea water ingression in coastal areas and groundwater pollution (Gaur et al. 2011).

Though the scientific evidence is still being collected, it is clear that climate change is likely to cause water stresses in several regions in the country. Gosain et al (2011) argue that by 2050, most river basins would see an increase in the precipitation. However, the extent to which an increase in precipitation would result in higher water availability would depend on the rate of evapo-transpiration, which will also increase due to rise in temperatures. Increased precipitation and its intensity would have severe implications on sediment erosion. Most river systems would face higher sediment load. With climate change of drought will also increase. Some of the major river basins would see 5 to 20 percent increases in drought by 2050 despite increased precipitation (ibid). Instances of floods and low flow levels will also change drastically. Current practices of designing water management system that do not fully account for the implications of climate change, would come under severe pressure (Majumdar, 2011).

On the demand side, the largest consumer is agriculture accounting for 85 percent of water use, followed by domestic (about 7 percent), industry (6 percent) and energy (2 percent). These different users, some are economic activities while others are necessity for life, compete for access to water. Going forward the demand from non-agricultural uses would rise at a faster pace. When we look on ground there is also the problem of inequitable access to water resource. For example, in rural areas the problems with drinking water are inadequacy and poor quality. As discussed later, drinking water is a fundamental right under “Right to Life” in Constitution of India to which no citizen can be denied. However, government investments and programmes have not been able to supply adequate good quality water to rural households. Much of the rural drinking water is supplied by groundwater. Declining water tables in many regions and pollution of groundwater has rendered government schemes unsustainable. In many states, local level institutions - Panchayati Raj Institutions (PRIs), who are responsible for operation and maintenance of rural water supply schemes, have faced capacity constraints and lack of financial resources. The top-down approach to plan and implement these schemes with no or little involvement of PRIs makes it difficult for PRIs to take over the scheme for O&M. In fact, many PRIs have shown unwillingness in taking over the completed schemes (Planning Commission, 2011).

The situation with regard to availability of water to urban households is not very different than for rural households. Urban water sector in India is in a state of despair as evident from various statistics such as proportion of urban households who have piped connection, water availability per capita and quality (Bhatnagar et al. 2011). Performance indicators of water utilities indicate their operational inefficiency and fiscal insufficiency. Assets created for water supply have deteriorated in quality over time due to continuous neglect in their maintenance. The focus of public agencies has been on asset creation with limited or no incentive for their O&M. Institutional fragmentation with regard to policy making, financing, regulation and service delivery has also contributed to the current state. There is lack of alignment between the responsibility for investment, which is at the state level and O&M, which is at the urban local body (ULB) level. Dependency of ULBs for funds on higher level of governments undermines their motivation for effective asset management, service delivery and cost recovery. Further, the capacity of cities to carry out water and sanitation services is also weak due to years of neglect. The problem is further complicated as a number of unorthodox systems for water supply have emerged in the urban areas (Zerah and Jaglin, 2011). These are a consequence of unreliable and inadequate water supply by the public utilities which have led to emergence of informal and private means of water supply. They take variety of form: sophisticated water supply system in “high income” localities leading to exit of “wealthy households” from public water supply system to a range of strategies used by poor to meet their water needs. Strategies of poor for access to water include local politician mediated access to public system, private operator and tanker supplied and NGOs supported collective water supply system. These informal arrangements directly come in conflict with formal systems and undermine their potential for improvement.

Irrigation, which is the largest consumer of water with the largest potential for efficiency improvement, is gridlocked between the perception that policy makers have and the ground realities. The focus of policy and public investment is biased in favour of canal irrigation even though nearly 62% of irrigation is done using groundwater. Even the efforts aimed at reversing the deceleration in canal irrigated areas by stepping up investment in last-mile projects has not yielded favourable results. In fact, the net

irrigation command areas under canals have continued to decline (Shah, 2011). Nevertheless, governments at the centre and state levels have continued to construct large public irrigation projects. As the new canal projects are decreasing returns to scale, to justify, planners have over-estimated the design command area and realization of unrealistic irrigation duty. Irrigation departments have remained construction oriented with little incentive and capacity for management of existing systems (ibid). The poor management of canal systems has led to a shift towards groundwater irrigation. "Green revolution" policies favouring high yielding varieties of cropping which required intensive and timely irrigation only added to its meteoric rise. This was complemented by cheap and un-metered electricity, and subsidized credits for irrigation dug-cum-bore wells. Groundwater irrigated farms performed better compared to those irrigated by other sources in terms of cropping intensity, input use and yields. Equity wise also groundwater is relatively more equitable than surface irrigation though recent trends towards deeper wells have favoured richer farmers.

In the industrial water sector, demands are rising and pollution caused by the discharge of wastewater by industries threatens sustainability of water resource. Nearly 70 percent of the wastewater generated by industries is discharged untreated. Water productivity in industries is also low. One of the main reasons for inefficient use of water by industry is poor pricing of water. Industries pay three charges related to water: a water cess that serves to raise resources for state pollution control boards, tariff to local bodies or other supplier of water, and cost of extraction of water from rivers or groundwater. The levels of these charges are so low that overall these constitute a very small proportion of the cost structure of an industry (Aggarwal and Kumar, 2011).

The above discussion illustrates that the government administered response towards water management has not worked. Policies and programmes across various sectors have not led to efficient water management. Instead the complexity of increasing demand, poor water resource management and inadequate institutional arrangements to address them, have only contributed to a number of conflicts that have arisen. These conflicts have taken the form of conflicts over equitable access, conflicts over competing uses, conflicts over dams and displacement, conflicts over privatization, conflicts over water allocations, trans-boundary, inter-state and intra-state conflicts (Paranjape and Joy, 2011).

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2. EXISTENCE OF INFORMAL WATER MARKETS IN INDIA

There has been no explicit policy in India on water markets, even though they existed since 1920s in Gujarat in India (Shah, 1993). Water markets in India are typically spontaneous (initiated by private individuals to achieve mutual gains), informal (transaction of water takes place without any legal bindings and to get mutual benefits between the buyers and sellers), unregulated (no strict regulation is followed), localized (mostly functioning at the village level), fragmented (geographical separation of sellers and fragmentation of land holdings) and seasonal (demand varies across seasons) (ibid.). Numerous geographical regions and socio cultural boundaries have given rise to a range of water management regimes (Ananda, 2012). These regimes include Warabandi, Shejpali, Assured Irrigation Area System (Satta) etc. Some of these approaches are supported by government policies, albeit, which are ineffective.

In India, all surface water is legally under the control of the state governments. Ground water, however, is treated as the private property of the person holding the overlying land (though this position has been contested in some judicial pronouncements). Therefore, states had followed non – interference policy vis-à-vis ground water markets. Even the existing regulations that govern ground water in some or other way have been ineffective. States government departments concerned with only irrigation. These organisations deliver water to outlets serving more than one farmer. Below each of these outlets, farmers are collectively responsible for water distribution and management of the network (Brewer et al, 1999 in Ananda, 2012).

The groundwater markets are other important source for agricultural production in India. Data from NSSO 54th Round on cultivation practices at the household level reveal that about 46 per cent of the area irrigated under five major crops was based on hired services from other households, which indicates the extent of water markets development for irrigation country (TERI, 2008; Mukherjee, 2007). With an estimated 30-million groundwater extraction structures, India is fast hurtling towards a serious crisis of groundwater overuse and groundwater contamination (Planning Commission, 2012). In India, Ground water rights are attached the land following the Indian Easement Act, 1882. Under this act, land owners have an absolute right to water under their land. These rights pass with the land when it is sold and cannot legally be separated from it. As the *de jure* property rights over ground water are not defined clearly over volume of water that could be withdrawn, *de facto* rights allow owners to extract water as much as they can. This leads to indiscriminate use of resources. As a result, the landless people who do not have any land but constitute a significant share of rural farm population (about 30 per cent) do not have any rights over the ground (Mukherjee, 2007).

In India, availability of tube – well technology and electricity in 1970s led to the emergence of groundwater markets. Higher water supply through ground water brought changes in cropping pattern and intensity, and more formalised institutions emerged (Ananda, 2012). Ground water irrigation requires a significant amount of investment which is not available for small farmers. Even the farmers who have large land holding also could not irrigate all the land using single pump, as there is high degree of land fragmentation. A major institutional response to this has been the emergence of informal groundwater markets (Mukherji and Shah, 2012). In ground water depletion areas such as northern Gujarat, forming cooperative tubewell organisations is very common to secure water for irrigation and sell the excess in the market. These organisations also emerged because the small landholdings and high investments associated with new tube – wells (Dubash, 2002). However, where there are large land-holdings, individual ownership is prominent. The single point of contact for the government for the purpose of regulation is the electricity utility. While the spacing norms for wells imposed by banks and financial institutions, power pricing policy of electricity boards played their part in regulating the groundwater markets, they are also another reason for 'monopolising' these markets.

While, the reviews of groundwater markets in India by many scholars suggests that they are effective in promoting efficiency in water use and equity in the access to water by small farmers, they have also led to aquifer depletion and inter-generational inequity (Shah, 1993; Palanisami, 2009; Mukherji and Shah, 2012). Farmers have little incentive to concern about the scarcity value of the water until the cost of their pumping is equal to market price of water (Ramasamy, 1992). This suggests that informal markets may exacerbate the over drafting or depletion problem. Yet, formal markets also may not work any better unless water rights are established and enforced. Therefore the problem is with the water markets rather it is lack of exclusive property rights for water.

2.1. Nature and characteristics of informal water markets in India

In this section we review the nature and characteristics of water markets (largely informal markets) in India which will improve our understanding of the markets and provide useful inputs which could form the basis for the design of formal markets. Shah (1993) and Mohanty and Gupta (2002) identified few essential characteristics of informal water markets in India. These markets are 'localised and fragmented'; mainly 'driven by surplus supply'; have 'monopoly power'; are 'influenced by social factors'; work on 'widely varying terms of payment'; and lead to 'groundwater overexploitation' (Shah, 1993; Mohanty and Gupta, 2002).

Ground water markets are largely localised and fragmented (Shah, 1993, Palanisami, 2009; Mukherji and Shah, 2012; Mohanty and Gupta, 2002) and mostly limited to irrigation sector. Unlike in Australia, there are no concrete legislations or regulatory mechanisms to ensure efficient water trade in India. Water trading in informal markets is largely between farmers. In few cases, water trading is reported for non – agricultural activities. Palanisami (2009) observed informal inter-sectoral water markets in and around the major river basins in Tamil Nadu.

Second, the market is driven by excess supply. In other words, groundwater markets largely depend on rainfall, groundwater availability, energy costs, cropping patterns etc. Most of the sellers are farmers who own deep wells and large capacity pumps and most of the buyers are small farmers and farmers with large landholdings but with geographical fragmentation. Sellers increase their incomes by selling surplus capacity of their wells or Water Extraction Mechanisms (WEM) (Shah, 1993 and

Mohanty and Gupta, 2002). Researchers argued that, while enhancing the wealth of the sellers, these trades have promoted equity by providing access to water to resource poor farmers (Shah, 1993; Saleth, 1994; Palanisami, 2009).

Third, the existing water markets are strongly biased towards sellers and do not provide bargaining power to the buyer, because of the low density of wells, uneven geography and possible seepage losses (Shah, 1993; Saleth, 1998) and low amount of rainfall, high spacing norms, lack of access to canal water (Shah and Raju, 1988 cited in Palanisami, 2009). This has given sellers a degree of monopoly in the markets (Easter et al 1998; Shah, 1993; Palanisami, 2009). This monopoly power also helps sellers not only in raising prices but also in compromising the quality of service they offer (Mohanty and Gupta, 2002). However, in few cases in Gujarat, farmers have pipelines from three to four different suppliers coming to their fields (Shah, 1993), which allows them to buy water from the supplier who offers the best price and service.

Fourth, the transactions are sometimes influenced by agrarian relations between the buyers and sellers. The development of water markets and transactions are, sometimes, determined by social factors and agrarian relations. Wood (1995) found out that buyer's position in the society (in Bihar) - especially their relation with the sellers, determines their access to water and the cost of water, rather than their ability to pay (Mohanty and Gupta, 2002). This has also been the experience in Andhra Pradesh[1]. Similarly, in Gujarat, there is evidence that many water transactions are inbuilt into existing landlord-tenant relations (Debash, 2000).

Fifth, the transactions in informal water markets vary widely by crop, volume, area and by season. Payments include both cash and non – cash payments (typically in the form of crop sharing). Shah (1993) found out that the hourly price ranges between Rs 3 in West Godavari district, Andhra Pradesh to Rs 45 in Mehasana district in Gujarat. The per hour rate in Nellore district, Andhra Pradesh was Rs 16 during 2000 and has gone up to Rs 42 in 2012[2]. It is also observed the area based prices are in the range of Rs 500 per acre in Nellore district, Andhra Pradesh. Over and above this, the buyer will have to arrange for the fuel (kerosene) for running the pump set. Non – cash payments in typically are about 20 per cent to 50 per cent of the total output as the share of seller (Shah, 1993). There are other contractual arrangements that are existing in Andhra Pradesh, wherein the seller 'sells' only the water and the buyer arranges for pump set and fuel for that period and pays a nominal amount. These contracts work as 'double – sided' incentive, providing the seller an incentive to ensure a timely and reliable water supply to the buyer and the buyer an incentive not to shrink in the application of labour (Mohanty and Gupta, 2002).

Sixth, since the property regimes represent 'open access' in groundwater markets, there is an evidence of excessive and competitive ground-water extraction (Mohanty and Gupta, 2002; MWR, 2012). As long as this is the case over exploitation cannot be controlled, as water price in groundwater markets only implies pumping costs and other related costs. This problem is further compounded by the subsidies in electricity and diesel (Shah, 1993; Mohanty and Gupta, 2002; Mukherji and Shah, 2012). Another important effect of this overexploitation, apart from loss of ecological balance, is that poor farmers who could not deepen their wells are drive out of farming (Mohanty and Gupta, 2002). The regulatory measures in the form of spacing and depth norms for wells have largely failed (Gupta, 1993; Easter et al, 1998; Saleth, 1998; Palanisami, 2009; Ananda, 2012).

Above discussion on water markets in India as an informal arrangement highlights a problem that is pertinent to such informal arrangements – lack of thinking amongst market participants at a macro level, say hydrological basin level, or inter-generational level, or environment sustainability level. In the absence of supply-side rules or constraints, informal arrangements have devised rules only on the demand side of the market, which to some extent gives monopoly power to those who have 'unlimited' right to water.

3. WATER MARKETS: AUSTRALIA AS A CASE[3]

[1] Authors discussion with farmers in Gundemadakala village, Andhra Pradesh

[2] Authors discussion with farmers in Gundemadakala village, Andhra Pradesh

[3] This section refers extensively the following source: National Water Commission (2011), Water markets in Australia: A short history, Australian Government, Canberra.

Australia has created fully functional water markets. This section reviews (i) drivers for a move to water markets (ii) evolution of markets and necessary changes (iii) outcomes and (iv) challenges that still loom large. Though there are now a number of water markets in Australia, the focus here is the development of water markets in Murray– Darling Basin (MDB).

3.1. Evolution of water markets in Australia

As a development history for water rights in Australia, the first water laws following European settlement were based on English common law, which gave rights to use water in water bodies to the adjacent (riparian) landholders. However riparian rights were seen as inadequate for Australia because of the inherent variability of supply and the consequent need for storage and delivery infrastructure to enable water to be used when and where required. Hence, early Australian statutes during the late 19th and early 20th centuries (commencing with the Victorian Irrigation Act 1886) sought to limit riparian rights by vesting the right to 'the use and flow, and to the control of water resources' in the Crown (that is, the states). This allowed separation of water rights from land rights. States established centralised systems controlled by public authorities for allocating water rights (National Water Commission, 2011). These legislations that created highly centralised systems for allocating water are antithesis for water markets as they evolved later, they were nevertheless a significant precursor to the later establishment of clearly specified and tradeable water entitlements because it gave government the power to limit total extractions and to define relatively homogeneous rights to the resource (ibid).

The management of the shared water resource of the River Murray was another major issue at the turn of the 20th century, and water was a battleground for state sovereignty in protracted discussions about Federation (see Connell 2007). Even after the Federation, interstate tensions over water continued until 1915 when the River Murray Waters Agreement was signed by the Commonwealth Government and the governments of three states South Australia, New South Wales and Victoria (MDBC 2006, as quoted in National Water Commission (2011)). The agreement paved a way for sharing of water: equal sharing of the flow of water at Albury between New South Wales and Victoria, with each state retaining control of its tributaries below that point, and guaranteed a minimum entitlement for South Australia. The problem with this agreement was that it focused on consumptive uses and the management of common resources, but did not limit total diversions. Each state used the agreement as a tool for productive consumptive use for economic development within its jurisdiction. This narrow perception and focus on regional economic development defined the key contextual feature for reluctance to trade water interstate later (National Water Commisison, 2011). The Agreement provided for the construction of water storage infrastructure: storages, weirs and dams to ensure a permanent flow of water for irrigation and navigation and created the River Murray Commission to approve designs of proposed water infrastructure (MDBC 2006, Connell 2007). Costs of infrastructure development were to be shared equally between the states and the Commonwealth, whereas operating and maintenance costs were to be shared equally between the states. Other than some procedural matters, all the decisions were to be taken in unanimity by the states and the Commonwealth. The agreement was a major development towards a cooperative cross-jurisdictional approach (National Water Commission, 2011). This also marked the beginning of serious federal government involvement in water resource planning and in financing irrigation which hitherto were largely states responsibility (Smith 1998).

A licensing system was used to grant right to use water, which were granted virtually on demand. Each state established statutory licensing systems and these rights were granted, in the form of statutory privileges (such as licences and permits to take water), rather than property or proprietary rights in the legal sense (Tan 2002). This approach continued until 1970s even though some sections of the irrigation community were raising their own concerns. Licences for irrigation were generally issued based on the area of irrigable land. Government water administrators made judgements about the most suitable crops in particular irrigation districts and their water needs (National Water Commisison, 2011). The problem was that these administratively determined initial endowments formed the basis of tradeable water access entitlements (ibid). There was another concern that governed the water licensing policy: water (and land) should not be allowed to accumulate in the hands of large corporate entities. Governments minimised the corporatisation of agricultural land and water rights by limiting farm sizes in public irrigation developments to the assumed needs of a family farm, limiting the area of land that could be irrigated on any single land parcel and tying water rights to the land on which the water was to be used (ibid). This implicitly meant that though water rights were delineated from land rights in 1915, the link between land and water still remained a central feature of

water policy in Australia for many years and was one of the key hurdles to be overcome in the development of water markets.

Early period was largely dominated by command and control type policies with no real scope or incentive for trading as water resources were freely available. However, a couple of notable exceptions occurred during droughts: temporary transfers of water rights in New South Wales during the droughts of 1966–67 and 1972–73; trading in Victoria during the drought of 1966–67, and over the period from 1982–83 and in 1986–87 (National Water Commission, 2011). These one-off responses became forerunners of the trading that later became necessary to address water scarcity.

3.2. Preconditions for water markets

Australia is an arid nation with frequent droughts (some of which have lasted many years) and inconsistent rainfalls. By the 1980s, it was realized that surface water and groundwater systems, particularly in the MDB, were fully developed. The opportunities to hedge against droughts, increasing demand for water and regional variations were few. A number of other factors such as globalization which exposed domestic agriculture to international competition, declining financial capacity of governments that reduced their willingness to fund large infrastructure and low cost options were already exploited, disenchantment with government-led water development program for the community and increasing environmental consciousness led to the belief that alternatives for efficient management of water resource than those employed at that time would need to be explored.

The prevailing system of water allocation through licenses got a major blow once it became clear that the water resources in particular catchments were fully allocated. After limits on total use of water were implemented, the only way for existing or new users to gain access to more water to commence or expand their activities was to get it from someone else who already held a licence. However, because water licences were tied to land, there were no readily available mechanisms to transfer water or licences from one user to another. Those wishing to secure more water were often forced to purchase the land to which a water licence was attached, incurring considerable costs and delays.

To address those problems, some users and policymakers began to advocate for the ability to reallocate water between users via trading. The 1980s and 1990s saw the first tentative steps towards water trading. However, reservations about the treatment of water as an economic good led to a very closely controlled and incremental approach to introducing water trading (National Water Commission, 2011). One of them was to allow ‘temporary’ seasonal allocation trading in some areas before ‘permanent’ entitlements could be bought and sold. Trading was initially confined to geographically defined areas, such as within public irrigation districts (ibid).

By the early 1990s, the focus of water management had shifted even further away from regional development objectives and engineering solutions towards ensuring that resources were used more efficiently and sustainably. The twin objectives of economic efficiency and environmental sustainability were integral to the greater involvement of the Commonwealth in water management particularly in relation to interjurisdictional management of MDB. The Commonwealth progressively extended its role in water management in the MDB through the establishment of the Murray–Darling Basin Commission in 1988 and later the National Water Commission in 2004 (National Water Commission, 2011).

A major impetus for the development of cohesive water markets in Australia, particularly in the MDB, was the 1994 national reform agenda agreed by Council of Australian Governments (COAG) as part of the broader National Competition Policy. The COAG Water Reform Framework shifted the water allocation arrangements away from administrative allocations by government and towards a market oriented approach based on clearly defined and tradeable property rights. It was seen as signalling a new urgency on the part of governments, both state and federal, to promote the efficient, sustainable use of water in Australia.

The COAG water reform framework included agreement that: water be used to maximise its contribution to national income and welfare, within the social, physical and ecological constraints of catchments, comprehensive systems of water allocations or entitlements be established, backed by the separation of water property rights from land title and clear specification of ownership, volume, reliability, transferability and, if appropriate, quality, cross-border trading be facilitated and arrangements be consistent, where that is socially, physically and ecologically sustainable, allocations for the environment be created, and the environment be established as a legitimate user of water and

environmental allocations be determined on the best scientific information available (National Water Commission, 2011).

In 2003, COAG agreed to develop the National Water Initiative (NWI) to review and refresh its 1994 water reform agenda. A key driver for the NWI was the desire to balance the need for secure property rights (which give water users confidence to invest) with the need for adaptive management of the environment as scientific knowledge improves over time. While they are 'property rights' in the economic sense, the legal status of water entitlements was an ongoing point of debate in the development of water markets (Connell 2007). The key issue here is the assignment of risk between water entitlement holders and governments in circumstances where it becomes necessary to reduce the consumptive pool or in other ways restrict the volumes of water that can be taken under an entitlement. Increasing calls on governments to 'claw back' water for the environment engendered a major debate about property rights. The key question was whether compensation should be paid when pre-existing entitlements to water are reduced, and the level of such compensation (ibid).

The adoption of nationally agreed water reform packages in 1994 and 2004 facilitated the expansion of water markets across connected valleys and eventually state borders in the MDB. Number of developments has taken place since these early agreements: tradeable water access entitlements now have a secure statutory basis, trading rules have been developed and refined to enable market transactions to better reflect hydrological realities, complementary tools for managing third-party impacts have been introduced and more robust trading platforms and accounting systems have been put in place (National Water Commission, 2011).

The Commonwealth played a central role in driving reforms in the MDB. The Australian Government instituted the program of environmental water recovery in the basin, using market-based approaches to achieve environmental objectives and smooth the transition to sustainable diversion limits.

3.3. Australian water market structure

The genesis of water markets is the basic idea of a 'cap and trade' system wherein the cap represents the total pool of the resource available consistent with sustainable levels of extraction, individual users are provided with entitlements to a share of the total pool, entitlement rights and the quantity of water allocated to an entitlement each season (a water allocation) are tradeable so that ownership, control and use can change over time and the price is determined in the market by the value placed on water by many buyers and sellers.

One of the key components of market is establishment of cap which is environmentally sustainable. However, since people have different values, a key challenge lies in developing a shared vision of sustainability. To address these differing opinions and consequent problems of market failures, role for Governments in the markets is necessary. In water markets, acting on behalf of the environment, governments can purchase water entitlements or allocations and reduce the amount of water extracted for consumptive purposes.

Water markets with cap on total pool of resource will promote economic efficiency by enabling water resources to be reallocated to those who value them most highly in both the long and the short terms: Seasonal water trading enables the water available in any given season to be reallocated across crops, locations, irrigators and other water users in response to seasonal conditions (the concept of allocative efficiency). Water trading can facilitate investment and structural adjustment in response to changing conditions (known as dynamic efficiency). In a capped system in which no new entitlements are available, trade enables new water users, such as a new 'greenfield' irrigation developments, to establish and develop. The corollary is that water markets provide a mechanism for existing users to retire or move on. As a result, markets enable dynamic changes in the size and composition of water using industries over time. Water trading can also promote productive efficiency. The price signal for water in the market provides an incentive for users to make efficient use of all inputs and invest in improving the efficiency of their on-farm water use. However, for the decisions of individuals to be consistent with the broader public interest, water markets must operate within the physical and hydrological realities of surface water and groundwater systems. Therefore, to be efficient, water trading needs to be governed by rules that reflect those realities.

3.3.1. Nature of entitlements

Entitlement is a generic term for the entire range of different water rights available in Australia. The National Water Initiative (NWI) defined 'water access entitlement' as 'the *perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan*' (NWC, 2011; pg.12), where as water allocation is defined by NWI as '*the specific volume of water allocated to water access entitlements in a given season, defined according to rules established in the relevant water plan*' (ibid.;pg.12) The volume of water available to a water access entitlement depends on factors such as climate change and other environmental factors. Water allocation is announced for water access entitlement on a seasonal basis, depending on how much water exists in the water resource. Jurisdictional government or the water authority in the region/area makes the announcement of the water allocation as percentage of the total share in which water access entitlement holder is entitled.

Water access entitlements include 'bundled' and 'unbundled' entitlements. 'Unbundling' at the most basic level separates a water entitlement from a land property title. This allows trading of the water entitlement by the entitlement holder without trading of the land (NWC, 2011). Water access entitlement can be traded with land in a 'bundled' system and without land in an 'unbundled' system. However, water allocation is tradeable without land. Water users are can use their entitlement or buy/sell water allocation; or buy or sell or lease entitlements. Users are also given the choice to 'carry over' water, in case they do not use/sell their entitlement, to next season for use or trade. This provides some security for the availability of water in the next season.

Water access entitlements have to be recorded in reliable and publicly accessible water registers, under the National Water Initiative (NWI). The states and territories should manage these registers as part of their statutory responsibility. These registers record the details of the water access entitlements and water allocations, including ownership, location, interests and trading activity.

3.3.2. Water trading and, extent and scope of water trading

Water trading in Australia was a gradual process. Initially trading of water was limited to defined locations, types of users limited to private diverters, and types of trades that were limited to annual allocations. As a result, some segments were developed earlier than others. There was greater acceptance and willingness for trading within irrigation districts rather than between districts, with temporary allocation trading than the permanent trading of entitlements (NWC, 2011). States used different approaches to enable trading ranging from legislative reforms to discretionary powers of the minister under the existing legislation.

Many cumbersome administrative processes with regard to bundling of land and water rights were addressed with the introduction of water trading. There were very few takers for available opportunities in transfer or allocations and entitlements. While this reflected the restrictions placed on scope of trading, it also reflected a lack of understanding and experience in water trading when there was relatively plenty of water in 1980s and 1990s. When the model of 'cap and trade' was not being particularly effective in addressing the 'cap' part of the model was recognised, this has led to concerns that entitlements would be cut at some point of time. This has had limited entitlement trading. Other pervasive effect that the trading had was the activation of licences that were 'sleeping' or 'dozing off'. Water trading has made the 'sleeping' licence holder realise the value of the entitlement they were holding. These holders started selling their rights for new developments, which led to increase in aggregate water use in Australia. All these factors indicated the need for a more comprehensive and coordinated approach for water trading. During 2000s, there was a period of broadening and expanding water markets. This process was characterised by a much more comprehensive approach to reforms across states.

As a result of these initiatives, the Australian water market has become one of the largest in the world. Australia does, at present,not have a single water market as there is no hydrological connectivity between the water systems that exist in vast distances apart. Markets in Australia can be categorised into three geographical segments – the southern connected MDB, the northern MDB and outside the MDB territory. More than 90 per cent of the water market activity is in the southern MDB that comprised 13 water trading zones (NWC, 2011). Water trading is possible across states over large boundaries in this region. The volume of water trading in this region reached to $ 3 billion in 2009-10 (ibid.). Outside MDB, water trading largely limited to smaller surface water and groundwater systems

3.3.3. Risk allocation

One of the major issues facing water markets, since the cap on extractions had been introduced, is how the risks of reduced or less reliable water allocations would be shared between water access entitlement holders and governments, including the compensation to be payable to entitlement holders. The risk framework in Australia specifies the following (NWC, 2011; pg.59):

- Water access entitlement holders bear the risks of any reduction (or less reliable water allocation) from seasonal or long-term changes in climate and periodic natural events.
- The risks of any reduction as a result of improvements in knowledge of sustainable extraction levels are to be borne by users up to 2014. Changes after 2014 are to be shared between water access entitlement holders (bearing the first 3% reduction), state and territory governments and the Australian Government (sharing, respectively, one-third and two-thirds of reductions in water allocations under water access entitlements of between 3% and 6%, and sharing equally reductions greater than 6%).
- Governments bear the risks of any reduction or less reliable water allocation that is not previously provided for, arising from changes in government policy (for example, new environmental objectives).

3.3.4. Interstate allocation and entitlement trading

The Council of Australian Governments (COAG) agreement of 1994, with a view to move water to its highest valued use, specified that 'where cross-border trading is possible, that the trading arrangements be consistent and facilitate cross-border sales where this is socially, physically and ecologically sustainable' (NWC, 2011; pg.60). When states and the Murray – Darling Basin Commission (MDBC) began the process to enable interstate allocation and entitlement trading, they were quick to realise the need for developing a range of complementary regulatory and administrative instruments. An interstate Entitlement Trading Pilot Project was started in 1998 and gradually expanded over time to reach a level where the Murray – Darling Ministerial Council agreed to expand the scope of the project to entire southern connected MDB which at presents shares 90 per cent of Australian water trading. Following the National Water Initiative's endorsement to interstate entitlement trading, a revised agreement was adopted in 2006, which significantly enhanced the tradability of water entitlements and allocations in MDB.

3.3.5. Regulation of water markets

In Australia, the approval procedures for entitlement trades were more stringent than for allocation because of the long term nature of the entitlement trades. These were perceived to be necessary for ensuring that the trading of entitlements did not have any adverse impacts on environment; that the trade did not diminish the entitlement of the others, i.e. protection to third party rights; that the trade was hydorlogicaly possible; that there is sufficient delivery capacity for delivering the allocation to the new entitlement holder; and that was a mechanism to determine the exchange rate to be applied for accounting of losses as a result of the trade (Allen Consulting, 2006). However, in mean time, more contentious and debatable regulations were developed in response to the socioeconomic impacts of the large scale exportation of water from irrigation districts and to the nature of markets which might be concentrating on ownership of entitlements. As water trading expanded, government introduced a range of trading rules and procedures to avoid and manage such impacts.

These rules include, the regulatory approvals and procedures to address hydrological realities and environmental concerns that disallow trade when there is no or insufficient hydrological connectivity between trading zones; restriction on trade to address stranded assets and socioeconomic concerns that restricts volume of water entitlements trades out of irrigation districts and restricts ownership by non – water users (those not owning land in that region); arrangement for trading entitlements between regions that addresses the conversion of the entitlement of the source to an entitlement of the destination region through various instruments such as exchange rate system and 'tagging' approach.

3.3.6. Water registration and titling system

Water licence registers were maintained by responsible authorities in the past to simply record the existing statutory privileges. Licences were not tradable hence there was no need for changed associated with the transaction. After the separation of water entitlements from land rights, the licences have become tradable assets and the water registers needed to perform the functions of clarifying titles and facilitating trading. Water access entitlements have to be recorded in reliable and publicly accessible water registers, under the National Water Initiative (NWI). The states and territories have introduced these registers as part of their statutory responsibility. These registers record the

details of the water access entitlements and water allocations, including ownership, location, interests and trading activity. These registers also intended to improve transparency and accountability of water entitlements.

3.3.7. Water accounting systems

Water accounting system was required to track the accumulation of allocations, trades and water volumes accrued under water entitlements. This system is also required to monitor the compliance with the MDB cap.

3.3.8. Development of trading platforms

Water trading, in the initial stages of the water markets in Australia, involved informal bilateral arrangements. The limited scope provided by these could not fillip the trade outside the local area and could not provide scope for the users to identify the best deal possible. Governments, water businesses and private brokers introduced electronic water trading platforms in the MDB in late 1990s and early 200s. The Victorian Department of Sustainability and Environment established Watermove, which is one of the first centralised exchanges, in 2002 to support the development of water trading across the state Watermove now offers a number of water trading options, including a weekly pooled exchange and an online trade room environment. These platforms significantly reduced transaction costs, ensured a deeper water market and provided information on prices and other components.

3.3.9. Institutional capacity and governance arrangements

The institutional capacity and government arrangements have evolved in an incremental manner during 1990s and 2000s. These arrangements got matured over time to accommodate the new requirements for the water market development. The Water Act of 2007 allocated responsibilities to all levels of governments agreed by them with bi – partisan support. This indicates that the institutions are flexible and adaptive to the conditions. The adaptability is, doubtlessly, is linked to what the nation has perceived as a national crisis and the motivation of the political leaders to address this issue. The capacity of the institutions is another critical factor. While the capacity existed at the state level as they are responsible for policy and regulatory decisions, capacity at federal level was developed in the context of changes in legal governance of the Murray – Darling basin. The MDBC had played an important role in bringing the state together to had set up an independent regulator to ensure the compliance with the MDB cap and other institutional reforms.

3.4. Outcomes of Australian Water Markets

3.4.1. Economic

Water markets have provided users with more options through flexible and tradable entitlements. This has helped them in identifying the real opportunity cost of their decisions with regard to their water rights. This has also helped them to respond to external factors such as drought, climate change and commodity market changes. These benefits accrued at the individual level have translated into benefits to communities and regions, particularly in the MDB where more than 90 per cent of the Australian water trading happens. During the time of 'millennium drought', water trading was crucial in helping cities and towns to secure water supply and in helping horticultural, rice and irrigated dairy industries.

3.4.2. Social and environmental challenges

Many of the feared adverse social and environmental impacts that were perceived at the time of introduction of water markets have not been materialised because of the rules, procedures and complementary tools established for water market governance. Water markets by increasing aggregate water use, in the absence of restrictions on trading of entitlements, may likely to generate environmental challenges. However, water trading in fact has helped users survive tough times during the drought.

Water trading can also have significant impact on local communities and industries because of the decline in the water use. However, this was not the main driver of those changes as it 'merely enabled structural adjustment to occur'

3.5. Lessons from Australian water market

The Australian experience indicates that it is feasible to develop working water markets in complex hydrological systems, including across jurisdictional boundaries. Markets could be beneficial as they signal the value of this scarce resource and can help their efficient utilization. Situations where

resources are fully developed for consumptive use, there is variability in water availability, there are a large number of connected water users and whose demands vary, where water users are exposed to global economic forces and demands for urban and environmental water are increasing, water markets are appropriate construct.

Prerequisites for effective water markets include (National Water Commission, 2011):

- setting an effective cap on total sustainable extractions
- establishing entitlements that are clearly specified, monitored and enforced
- having a sound regulatory and governance framework within which water trading can take place
- Implementing fundamental elements of good water management, such as metering and water accounting.

While Australia adopted an incremental approach to water market development, its benefits will be forgone if suboptimal arrangements are left in place too long. While developing markets it is important that measures to address environmental and social outcomes that could be affected by water trading should be carefully considered and targeted to limit interference with the operation of the market. Some interventions, such as restrictions imposed on trade, are costly and have unintended negative consequences (ibid).With market maturity, roles and responsibilities influencing market outcomes need to be assigned carefully to avoid conflicts of interest, which can undermine reform objectives.

4. LESSONS FOR INDIA FROM AUSTRALIAN EXPERIENCE: LEGAL, INSTITUTIONAL AND OPERATIONAL MEASURES

In India, the institutions that currently govern water allocation do not promote water markets as a solution to water problems. A new perspective on role of information and incentives is required to bring about a change in institutions and policies (Anderson and Snyder, 1997). The lack of well defined enforceable property water rights has promoted centralised decision – making (ibid.). Central government and state governments are involved matters related to water use and distribution, albeit in an ineffective manner. Water rights must be established to enable individuals and communities to determine water allocation in an efficient manner. This needs '*a new socio – ecological dynamic that is best understood in the environmental economics framework'* (Shah, undated; pg.2).

The following section details out the legal, institutional and operational measures required to formalise the water markets in India. However, establishing legal and institutional measures does not guarantee the practice of water rights and the smooth implementation of water trade regime. Putting these measures can sometime take years because water allocation often invokes emotional response from the gainers of the status quo (Mohanty and Gupta, 2002). To come up with a 'critical minimum' reforms and measures and operational measures, we examined Australian experience which has about two decades of experience in the establishment an implementation of water markets.

Lesson1: Manage surface water on a river basin basis
Indian law treats that all surface water as the property of the state. While the central government is responsible for regulation and development of inter – state rivers and river valleys, state governments are responsible for water supplies, irrigation and canals, and other structures (Mohanty and Gupta, 2002). Water is treated to be a state subject, as the de facto interpretation of these responsibilities given the states preeminent power. This has led to serious complications in the subjects of inter – state development and allocation. In the absence of legal rights and shares over the water resources, each state has demanded for as large as possible. Therefore, it is important to establish a mechanism to manage water on river basin basis. Already, the Draft National Water Policy (2012) and the Draft National Water Framework (2012) recommended that water resources should be managed taking river basin/ sub – basin as a unit. This will be the pre – condition for the introduction of water markets.

Despite historically being a state - based water markets, the Australian experience showed that it is possible to develop water markets that can operate across jurisdictions despite all the complexities. As discussed, above, Australia adopted an approach in which access rights are specified to a proportion of the total pool of water available each year. That way, the exact volume can change from year to year depending on the seasonal conditions. This approach has also established clarity on individual user rights for surface water which, otherwise, often leads to litigation and conflicts. Like India, Until the Water Act of 2007, Australia too lacked formal linkages across all the levels of governments

except those between catchment authorities and state governments. The vertical and horizontal linkages developed in Australia have also helped in the effective implementation of the water policy. Cross government agreements formed as part of the Council of Australian Governments (COAG) have become the basis for water reforms since mid 1990s. Willingness from the states to cooperate and concede power to the federal government in return for benefits has also been critical in water implementation process.

Lesson2: Separation of land rights from groundwater rights

Second, there is a need for separating right to groundwater from rights to land. This will ensure that individual property rights over land will not come in the way of the right to water for all. The Draft National Water Policy (2012) made an attempt to address this issue. The policy recommends that the '*existing Acts, such as Indian Easements Act, 1882, Irrigation Acts, etc., may have to be modified accordingly in as much as it appears to give proprietary rights to a land owner on groundwater under his/her land'* (pg.2). There is also a need for establishing limits for withdrawal of groundwater. The Draft Water Policy (2012), however, does not explicitly prescribe ways of doing this. Not addressing this issue can have serious equity and ecological implications, because it allows large farmers with high pumping capacity will have disproportionate claim on the resources. The separation of water rights from land rights has some basis in India. Though not explicitly stated in the Constitution, by judicial pronouncement water is held in public trust by the state for the community. Expanding this view implies that (i) economic or commercial use of water by some must not adversely affect the lives and livelihood of the community, and (ii) public trust doctrine applies to all forms of water, including ground water (which conflicts with the current legal status of ground water) (Upadhyay, 2011). Another important aspect of water from legal perspective is the "right to water". This right relates to basic water requirements for life and is separate from the economic uses of water. By judicial interpretation, this is a fundamental right and the state has the responsibility to ensure that this right is not denied to anyone (ibid).

Early Australian statures during the late 19th century and early 20th century limited the riparian rights by vesting the right in Crown (i.e. states) to ' the use and flow and the control of water resources'. This has allowed the states to separate water rights from land rights. States have established centralized systems for allocating water. Although some riparian rights still exist, essentially water rights can be traded across catchment without buying land where the water rights are originally located. These water rights include high reliability entitlements – where holders of these rights would receive their full allocation, and low reliability rights where in dry years they may not get any allocation. This has ensured allocations, based on rainfall, availability of resources every year, without disturbing the ecological balance. One of the major issues as a result of this approach has been the risk of reliable water allocations in the market. Water access entitlement holders bear the risk of any reduction on the account of seasonal and long term changes in climate. Government bears the risks of any reduction or less reliable water allocation that is resultant of changes in government policy.

Lesson 3: broadening of water markets

Third, there is a need for broadening of the market. Irrigation infrastructure and distribution networks by joining different systems should be developed to give more choice to both sellers and buyers. This will also fillip inter – jurisdictional water trades. Institutional structures should be flexible and organisation changes are necessary for this (Mohanty and Gupta, 2002). While the markets are developed over a large spatial area, there have been very few inter – sectoral trades such as agricultural – urban trades. This is largely due to the control of state government on urban water supply with a view to protect rural communities and livelihoods rather than the legal restrictions.

Lesson 4: need for adaptive institutions and administrative capacity

The Water Act of 2007 was a radical shift in water planning and management. The act allocated responsibilities to all levels of governments agreed by them with bi – partisan support. This indicates that the institutions are flexible and adaptive to the conditions. The adaptability is, doubtlessly, is linked to what the nation has perceived as a national crisis and the motivation of the political leaders to address this issue. The capacity of the institutions is another critical factor. While the capacity existed at the state level, capacity at federal level was developed in the context of changes in legal governance of the Murray – Darling basin. While in India the central government appears to have capacity relative to its states, the institutions dealing with water at all levels should follow the route of Australia, if the recommendations of the Draft National Water Policy (2012) are to be realised.

Lesson5: Conflict resolution

Fifth, there is a need for institutional arrangements for resolving conflicts over water rights. The Draft National Water Policy (2012) largely vests this responsibility with the state and central governments. As the experience of Australia suggests, conflict resolution powers should vests with both states/basin authorities and catchment level authorities. Therefore, there is need that Water User Associations (WUAs) also be given the power and responsibility to deal with conflicts at the grassroots level.

Lesson 6: Initial allocation of rights
While the water rights may be established legally, it is possible that they may overlook the complexity of customary rights. Initial allocations can also be contentious, if the users are provided with lower shares than they had historically. Experience from countries suggests that the water allotments are defined by a gradual negotiation process that recognises the slow maturation of institutional capacity building. Defining allotments would, however, also assume that 'state would engage in a genuine process of empowerment of water users. This may be an optimistic view given the progress achieved in having users participated in water management (Molle, 2004). The challenge that the Australia had faced is to reallocate water rights from existing users in a way that is equitable and achieve social and environmental goals. Federal government had purchased water rights from willing sellers through general tax revenues (Connell and Grafton, 2008 cited in Grafton et al, 2010). This has also addressed the concerns over perceived abuses of market power in water trading. A separate arm of the federal government is vested with the power to address the potential issues of market power and to ensure competitive water markets. The recommendations and advisory of this arm are incorporated into water market rules that are implemented in Murray – Darling Basin (Grafton et al, 2010).

Lesson 7: Registration/Title of Water Rights:
The registration of water titles is a necessary step to ensure comprehensive water trading in formal water markets. Public authorities can allocate rights in blocks to local institutions such as Water Users Associations (WUAs) and these rights should be registered with a public registry, like in the case of Australia. The registry should be at the national level and be compatible with the goals and objectives of the Water Policy. There should also be a nominal registration charge to meet its operational costs thereby ensuring the fiscal autonomy of the registry (Mohanty and Gupta, 2002). Currently, Australia has the most complete system of registration of water rights and titles. However, these are set at the set at the state level and therefore there are substantial differences across states that often impede inter – state water trades (National Water Commission 2009a, p. 120).

Lesson 8: Protection of third party rights
Impact on third party can arise when water trades impose costs on others that may not accounted for in the transactions. Protecting third party rights is particularly important where reuse of return flows is significant. Mohanty and Gupta (2002) argue that specifying water rights into consumptive and non-consumptive portions would also protect the third party rights. While the consumption portion can be sold without restriction, non – consumptive portion can only be sold if it does not affect the other users. However, the calculation of consumptive portion will be difficult. In Murray – Darling basin in Australia, the agreement among the states only focused on consumptive uses but it did not limit total diversions. Each state expected maximum allocations and used it as a tool for productive consumptive use. This narrow perception had led to reluctance to interstate water trading later. Limits are also imposed on the quantity of sales so as to protect the downstream communities from reduced water diversions. These restrictions have had unintended consequences on the efficiency of the water markets. This indicates that the measures to address impact of water trading on environmental and social outcomes should be carefully considered and these should not interfere with the operation of the market.

5. CONCLUSION

In this paper we reviewed the nature of markets, policy framework for water markets and governance and institutional barriers for water markets in India. The paper has largely drawn policy framework and required institutional conditions, and governance and regulatory framework from Australian experience for establishing water markets in India. The Australian experience suggests that water markets could be developed across jurisdictional boundaries and well-designed water markets can deliver significant benefits in a system where there is a scarcity of water, by signalling the value of water in a dynamic manner.

The first desirable condition for water markets is flexibility. Well defined water rights separate from land rights, as the experience from Australia suggests, in comparison to rigid nontransferability of water allocations, permits the trading and transfer of water allocations in an efficient manner and also

address social equity and ecological sustainability. While the perception is that the well functioning markets would require sophisticated and large – scale conveyance systems and physical infrastructure for water allocation, the experience suggest that even simple division devise could also be used for the water allocation (Rosegrant and Gazmuri, 1994).

The second issue is related to water allocations and rights. Based the experience of Australia, while we could argue that water rights and allocations should be established, but realising and implementing these measures is a difficult task. The design of these measures should be informed by the history and characteristics, and pre-existing customary rights of the area. It is worth a discussion on the both defining rights through a bureaucratic prescription and generating rights through a gradual bottom – up negotiation processes.

In India, as discussed in this paper, water rights have been interpreted separately from land rights by some judicial pronouncements. First and foremost, water right should be included in the Constitution as a separate right held by government in the interest of public.

Irrespective of the process we choose for generating rights, there is an implicit assumption about the technical capacity with regard to necessity to address the supply, volume of the allocation, protecting third party rights etc. Developing technical and institutional capacity to resolve the conflicts related to the issues is necessary which, otherwise, would place heavy burden on the administration and judicial system.

It is also important that water markets capture the real opportunity costs of water resources. Shah et al (2011) suggest that the inability to manage ground (and surface) water and energy economies as a 'nexus' led to chaotic race to extract groundwater in India. The genesis of this problem is in the policy decision of many states to supply unmetered subsidy power to agriculture sector. The experience from Australia and other countries indicates that while there are states providing subsidised power to agriculture sector, most of the states provide it through metered connections. Therefore, a rationed power supply and acceptable tariff system, however, could prove to be a powerful tool for the management of ground water and energy use.

Finally, as Cullet (2012) argues, the fact that all these measures are politically sensitive matters cannot be an excuse anymore for inaction from the governments on the grounds that these reforms could affect some political constituencies. This inaction can only increase the existing inequities in access to water and has a price that should be borne by the future generations as result of the ecological imbalances.

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