MARKET-BASED INSTRUMENTS FOR WATER ALLOCATION IN INDIA: ISSUES AND THE WAY FORWARD.

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Abstract

Institutions do matter in managing water scarcity. Institutional reforms in water sector in recent years have tried to replace the existing 'command-and-control approach' with more innovative and comprehensive market-based approach. Based on a comprehensive literature review, this paper highlights various issues involved in market-based institutional reforms in the water sector in various countries. This paper finds that even though there are some problems, the market-based institutional reforms are capable of generating relatively higher benefits through efficient, equitable and sustainable water allocation mechanisms. This paper also provides policy suggestions on introducing market-based instruments formally in the water sector in the Indian context.

1. INTRODUCTION

The existing literature dealing with water scarcity that causes negative externalities in agriculture sector mainly revolves around three major aspects namely, physical scarcity of water (Rosegrant, 1995), financial scarcity affecting water sector (Winpenny, 2003) and institutional scarcity of managing water resources (Saleth and Dinar, 2004). Conventionally, the literature has focused mainly on how physical scarcity of water arising from depletion and degradation of water resources causes adverse impact on production, productivity and profits in the agriculture sector. The major argument in this literature is that addressing water scarcity, especially in physical terms through various water augmenting measures, can be the solution to reducing the negative impact of water scarcity. In this direction, policy measures such as introducing watershed programs, rain water harvesting and rejuvenating water bodies have been initiated. Another section of the conventional literature treats financial scarcity as a major cause for water induced negative externalities in the agriculture sector. Declining investment and lack of adequate amount of public investments on water conservation measures, caused mainly by low level of capital formation, have attributed to the problem of water scarcity and the resulting impact of negative externalities. The implication is that the water sector experiences a relative scarcity phenomenon (see Barbier, 1989) characterized by lack of financial resources to augment water resources and therefore, reducing the financial scarcity is viewed as a solution for resolving the problem of physical scarcity of water. In this regard, policy measures such as participatory irrigation management that reduces the financial burden of the governments, tariff reforms and introducing user-pay-principle in order to increase the government revenue became some of the highlights of the government policies. Basically, that part of the literature dealing with physical as well as financial scarcity of water looked at the issues within the framework of either market failure or government failure or both. More precisely, the underlying fundamental assumption is that resource allocation within the water sector at present is inefficient and this inefficient allocation is guided mainly by incomplete markets for water or by misguided government policies in the relevant sectors. However, a substantial amount of water scarcity related negative external impacts still prevalent in the regional economies could not be fully explained by the analysis that utilizes the above theoretical frameworks and therefore, it is felt that the policies should adopt more innovative and comprehensive institutional framework to reduce the negative externality impacts. Need for such as an innovative framework has arisen from the fact that in many areas where neither

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water scarcity in physical terms nor financial scarcity discussed above is predominant, the impact of negative externalities is still felt substantially suggesting that water related issues fall beyond the purview of physical and financial scarcity. This generated a new wave of studies that focused on institutional scarcity. The major argument of the institutional literature is that the 'institutions do matter' (North, 1990) and therefore, restructuring the existing inefficient institutions and devising appropriate efficient institutions to manage water scarcity will result in expected outcomes in the relevant sectors. The present paper attempts to highlight some of the advantages as well as issues involved in introducing such alternative institutions in the water sector. The major focus of this paper is how market-based institutions such as tradable permits in the water sector can play a crucial role in allocating scarce water in an efficient manner, and what kinds of issues are involved in introducing such alternative institutions for allocating water resources. To highlight the feasibility of introducing tradable water rights, especially in the Indian context, the paper draws largely from the empirical studies on tradable water rights from different parts of the world. Appropriate theories are also put forward to support the arguments.

1.1 Need for Institutional Reforms in Water Sector

It should be noted that in most of the developing countries, existing water policies in general and polices pertaining to irrigation in particular are mainly supply-side oriented; major components in the water policies, such as, tariff rate and institutional components for supplying irrigation water, do not adequately reflect the actual preferences of the farmers using irrigation water. The supply-side oriented policies are embedded in the 'command-and-control' type approach followed by the governments, where the rules and regulations within the policies are framed on the basis of what the agents of the governments think. This may not be adequate to reflect the preferences of the farmers because the preferences of farmers towards irrigation water are influenced by various kinds of region-specific, socio-economic, political, geographic and institutional factors. In other words, the government agents cannot predict the preferences of the farmers whose mental models influencing their preferences differ. Capturing these mental models and the preferences associated with them is a costly affair as far as the government agents are concerned. Therefore, these agents will have to use certain assumptions about the farmers' behavior in relation to water scarcity, which in many cases do not exactly predict the farmers' actual behavior. Since government policies are formulated with a limited amount of information on farmers' preferences, there arises a discrepancy between what the government agents want to do and what the farmers actually expect them to do. This discrepancy leads ultimately to failure of the policies in achieving the expected goals in the relevant sector, which is broadly described as government failure or policy failure. Many empirical studies in the developing country context have documented how the above mentioned discrepancy has become a dominant phenomenon in the water sector policies. For example, a macro level study has highlighted how government failure in the water sector has resulted in pervasive negative externalities in the economy (Venkatachalam, 2004). At micro level, a study in the Malaprabha river basin in Karnataka reveals that farmers are willing to pay many times greater than the existing government fixed water rates, provided they are supplied with reliable irrigation water under alternative institutional arrangements (Durba, 2008). Very often, the discrepancies and the associated failures observed in the present policies can be attributed mainly to the existing command and–control policies prevailing in the water sector. When incentive-based institutional arrangements are introduced, we would expect the farmers to receive different types of incentives and this will not only result in increasing their farm income but also their willingness to pay (WTP) for water since the WTP value is influenced mainly by the expected income. It is strongly felt that devising the incentive-based institutions can be an appropriate strategy to break the vicious circle in the water sector (Gulati and Narayanan, 2001), which is induced by lower level of farmers' WTP and capital formation in this sector.

Since the government or policy failure has become an inherent feature in the water sector, a modern economic philosophy in water allocation is essential to deal with the present water scarcity problem; one such philosophy is to use appropriate market-based instruments under a new institutional regime to allocate water in an economically efficient, equitable and sustainable manner with adequate concern for ecosystem preservation (see Crase et al., 2001). Among different types of market-based instruments, the tradable water rights (Thobani, 1997), stemming from the theory of property rights by Coase (1960), has been proposed as an efficient instru-

ment in terms of allocating scarce water resources in an efficient, Pareto-optimal manner. Advantage with tradable property rights systems is with its inbuilt incentive and disincentive mechanisms that promote water use efficiency and conservation at the end user level. As we have already seen, secured property rights over water will provide incentives for the farmers to conserve water, use it efficiently and trade it with other users on the basis of opportunity cost principle (Rosegrant, 1995).

2. ADVANTAGES WITH MARKET-BASED INSTITUTIONS

Thobani (1997 and 1998) highlights various benefits from introducing market-based institutional regime in the water sector. Under tradable water rights regime, the production system is expected to automatically adjust to the new scarcity regime. With the new efficiency level in the water use system, the economic system also settles down at a new, efficient level of equilibrium. Similarly, adjustment to the changed level of scarcity will take place with time as well. It should be noted that the command-and-control system does not adequately respond to the increasing demand for water. To fill this gap between supply of and demand for water, informal water markets emerge. Since, groundwater sector experiences a problem of tragedy of commons (Hardin, 1968) all suppliers in the informal market will tend to exploit the groundwater in such a way that they could maximize their profits through water sale. Thus, nobody will have any incentive to conserve water but everybody would be willing to free-ride generating enormous social cost due to over-exploitation. All these arise because of ill-defined property rights over water resources. Therefore, economists insist on the importance of ensuring tradable water rights (Thobani, 1998) to the farmers so that the formal market mechanism can ensure efficient utilization of scarce water on the basis of buyers' willingness to pay and sellers' willingness to accept compensation for a particular quantity of water exchanged.

Within a Coasian framework, assigning water rights to the buyers implies that these rights could be appropriated at a cost, reflected in terms of their WTP for acquiring the rights. The WTP value, which reflects the true scarcity value of water at the existing level of scarcity, would automatically compensate the sellers of water, provided that the willingness to accept (WTA) compensation by the sellers is at least equivalent to the WTP value of the buyers. The water rights to the sellers on the other hand implies that they could sell the water to the buyers with high value uses, based on the opportunity cost of their water use. As economic theory suggests, the market brings equilibrium between demand for and supply of water irrespective of who owns the initial property rights, provided that a conducive, competitive environment is created for minimizing the cost of transaction. Therefore, the concept of water rights fundamentally recognizes that acquiring property rights over water involves a considerable amount of opportunity cost of resource transfer in terms of its alternative uses. Any alteration of quantity or quality of the stock of the water due to transfer would cause both positive and negative externalities altering the existing level of distribution of welfare among the farmers. So, at level of scarcity an efficient outcome arises.

In a world of absolute water scarcity, a market-based approach is justified on the ground that the water has become an economic commodity[1] (Rogers et al., 2002) and therefore, it is argued that the market can be a more efficient institution to allocate this scarce resource to its optimum use. Many economists put-forward different types of economic arguments to support this normative stand. One of the arguments is based on the 'big-bills theory' articulated in mainstream economics. If the big-bills theory is extended to the water sector, it implies that there is a substantial amount of unexploited benefits in this sector due to inefficient policies followed under the command-and-control regime. When the market-based instruments are introduced, the rational farmers would be able to exploit these benefits appropriately, which in turn will increase their WTP for water. The enhanced benefits under the new regime is realized in terms of increased producer surplus and reduced transaction cost[2] due to efficient use of water. Under the market-based regime, a win-win situation arises where not only the farmers could exploit considerable amount of previously unexploited benefits but also the governments

[1]For an excellent critical review on water as an economic commodity, please see Hanemann (2006).

[2] Saleth and Dinar (2004) define transaction cost as follows: 'The transaction costs cover both the real and monetary costs of altering the regulatory, monitoring and enforcement mechanisms related to water development, allocation and management'.

could garner larger amount of benefits (or, the big-bills) through enhanced revenue. As we have already seen, many empirical studies on farmers' WTP for improvements in irrigation water supply have also provided strong evidence to strengthen the big-bills theory argument in the water sector. Moreover, studies on informal water markets in the agriculture sector reveal that farmers are already spending a substantial amount of their farm income on obtaining irrigation services. Therefore, introducing tradable water rights system is assumed to transfer a major part of their income to the government sector while reducing the transaction cost incurred by them in the informal water markets.

3. MEASUREMENT OF TRANSACTION COST

The underlying theory on tradable permits in water sector derives broadly from a blend of inputs from new welfare economics and new institutional economics. The welfare economics framework is essential in the sense that any institutional or policy change is to be viewed in terms of change in the welfare effects it brings to the users of resources. More precisely, an institutional arrangement is efficient when the net benefits under the new institutional regime are greater than that under the old regime. Changes in the welfare affected by the alternative institutions are realized broadly at two levels : at government level and at the farmers level. While the welfare change at the government level can be estimated by using the transaction cost incurred or saved by the government sector under the new institutional regime, the same at the farmers' level can be done by measuring marginal change in 'producer surplus' that includes savings on transaction costs under the new institutional regime. Transaction cost analysis of alternative institutional regime is a special case in the analysis of water scarcity. Analysis of transaction cost is an integral part of institutional change because institutions without transaction cost do not matter much in any economic analysis (Coase, 1992) of water scarcity. Saleth and Dinar (2004), based on their stage-based perspective, classify stages of institutional change into four major categories: the first stage where change in the mind set takes place; the second stage with political agreement for change; the third change where institutional supply occurs; and the forth one with behavioral changes reflected in terms of water allocation and management. All these stages are associated with different transaction costs. However, there are certain difficulties in measuring the transaction cost of institutional changes. One such difficulty arises from the fact that the users of enhanced water availability resulting from alternative institutional arrangements may not always be aware of the transaction cost involved in those arrangements. This is due to asymmetry of information obtained for taking decisions to minimize the transaction cost. This implies that such decisions are constrained mainly by the availability of information; if additional information is provided to the farmers or the policy makers, then the decision will lead to a new, efficient equilibrium level. The farmers or the policy makers are assumed to be unboundedly rational in processing additional information and are capable of moving to the appropriate equilibrium position, accordingly. However, asymmetric information about the transaction cost may sometimes lead to sub-optimal decisions as well. This being the case, the studies measuring the transaction cost that rely on farmers' information may provide biased results for policy making. The second type of difficulty arises from bounded rationality of the farmers or the policy makers in minimizing the transaction cost. Under this bounded rationality assumption, it is found that even if full information is available on transaction cost under the new institutional regime, the farmers may not be able to minimize the same due to cognitive constraints in processing the information. While errors in measurement due to asymmetric information can be corrected by adopting a methodology in which changes in decision making can be observed for changes in the information made available, the error coming from the bounded rationality can not be corrected because of the scarcity of cognitive abilities. Moreover, if the researchers measuring the transaction cost are also boundedly rational, then the error in predictions will be acute. Therefore, it is argued that more bounded rationality based economic models will have to be used for measuring the transaction cost (Conlisk, 1996) in water sector in coming years. Despite these theoretical difficulties, it should be noted that work in measuring the transaction cost in the water sector is progressing with the assumption that the transaction cost is measurable with minimum error.

The fundamental principle of introducing innovative institutions like tradable water rights is that institutional arrangements that facilitate functioning of market-based instruments in water sector, with appropriate regulation, are capable of bringing spontaneous order among the rational farmers towards achieving efficient

allocation of water. It should be noted that market-based instruments are not treated as perfect substitutes for the present command-and-control regime. Rather, there is a right mix between the command and control method and the market-based methods, which is determined mainly by the socio-economic, political and institutional factors prevailing in a particular region. Indeed, one of the major challenges in the ongoing water sector reforms in many of the developing countries revolves around identifying what is the right-mix of government and market, for a given level of the region-specific factors that determine this mix (see Williamson, 2005). It should be noted that as the new institutional economics (Williamson, 2000) suggests, the right-mix of institutions is to be determined mainly by the transaction costs involved in alternative institutions.

The transaction cost analysis is based on the assumption that the interest groups (Olson, 1965; see also Livingston, 2005) will bring in collective action among themselves (leading sometimes to conflicts as well) based on the expected costs and benefits of institutional change, as well as the transaction cost under the new institutional regime. Change in the transaction cost at government level and change in the producer surplus at the farmer level lead to welfare change at the macro level through cascading effect. The cumulative welfare effects of the institutional change at the macro level, both in terms of change in the utility and producer surplus – will have to be captured through computable general equilibrium (CGE) models. At present, the welfare change at the macro level is captured using partial equilibrium analysis due to various constraints such as availability of data on welfare at macro level, inadequate information about institutions influencing changes, etc. Within the partial equilibrium analysis, a sector-wise approach is warranted. Measurement of transaction costs at the government level needs to be captured through change in the cost incurred by the government in order to administer, implement and monitor the new institutional arrangements. It should be noted that many studies that attempt to measure the transaction cost of institutional change in the water sector look mainly at change in the transaction cost at the government level (see Saleth and Dinar, 2004). However, the change in producer surplus (opportunity cost of existing institutional regime) realized at the farmer level does not figure in adequately in these studies, with few exceptions such as, Crase et al. (2002). It is to be noted that the major economic actors involved in the institutional change need to be properly accommodated in the partial equilibrium analysis. This is because the institutional change sometimes may result in improvements in the efficiency in one sector by transferring the inefficiency to another sector. This may lead to a situation where the reduction of transaction cost in one sector can be off-set by the increase in transaction cost in another sector. Alternatively, transaction cost may increase in one sector while it might have reduced in another sector, leading to net increase in the transaction cost altogether. So, the outcome is only zero-sum in nature. Therefore, partial equilibrium analysis should take into account any trade off between different sectors involved in the institutional arena.

The measurement of transaction cost at the farmer level is a challenging task. It should be noted that the benefits enhanced due to water availability –*citeris paribus*- in the changed institutional regime should be treated as transaction cost incurred by the farmers under the *status-quo* institutional regime. Nevertheless, the enhanced benefits may be due to various other factors such as increased inputs and overall cropping pattern change due to innovative technologies. The issue here is, whether the change in the benefits due to change in all other factors should be treated as reduction in the transaction cost or only that part of the benefits which occur over and above the influence of normal factors should be treated as transaction cost. The 'opportunity cost approach' used in some of the studies at present treats entire benefits as an indicator of change in the transaction cost. This is because the benefits forgone are considered to arise from the non-availability of water, which is now being eased by new institutional change. So, the entire change in the benefits is considered to be enhanced by new institutional arrangements. However, this approach will be misleading in assessing the efficiency of alternative institutions. Appropriate methodologies are available from environmental economics to deal with this particular issue and these standard methodologies should be used extensively in empirical studies, in the coming years.

4. INSTITUTIONAL REFORMS IN WATER SECTOR: INTERNATIONAL EXPERIENCE

There exist relatively rich empirical literature that deal with country specific studies on market-based institutional reforms in the water sector (e.g. Backeberg, 2005; Bjornlund, 2004; Brennean, 2001; Doukkali, 2005; Garrido, 1998; Griffin, 1998; Hearne and Easter, 1998; Howe, 1998; Horbulik and Lo, 1998; McKay,

2005; Saleth, 1998 and so on). The existing literature on market-based reforms provide insights into the nature of water sector reforms carried out in the respective countries and regions, institutional arrangements for water sector reforms, factors influencing such reforms, the cause and effect relationship between reforms and transaction cost in the water sector. It should be noted that the institutional reforms, in one way or other, deal with assigning user rights over water, though the degree of control over these rights by the users differs across different countries.

When we look at the country level experience on market-based instruments, we find that the US pioneered in introducing formal water markets in the area of water allocation. The nature and intensity of these formal markets differ between surface water and groundwater; they also differ between different states depending on factors such as scarcity of water and nature of the law facilitating water trade (Griffin, 1998; Howe, 1998). In many parts of the US where the formal markets are active, trade in water takes place mainly between agriculture and urban sectors. In the US, water scarcity has been the driving force behind these formal markets which brought spontaneity among different agents through proper incentives and disincentives towards conserving water. But a most crucial aspect is that this spontaneity has been brought about by appropriate laws enacted by the governments (Griffin, 1998). So, appropriate mix of government and markets plays a major role in making water trade more efficient. Australia is another pioneering country, which has adopted institutional reforms with more roles for formal tradable water rights in allocating water in some of the scarce regions such as, New South Wales (Crean and Young, 2001). The ongoing institutional changes in Australia are essentially tuned to provide an integrated approach to water management where the role of market, the role of government and the role of community are recognized as instrumental in managing scarce water resources (McKay, 2005). While the exogenous factors (such as, economic reforms at the macro level) provided conducive environment for water sector reforms, it is the endogenous factors (such as, water scarcity) which warranted a more focused reform in the water sector in Australia. Also, the political structure at the federal level and the social structure in relation to water use have also been taken into account adequately in the water reform measures in this country (McKay, 2005). The Chilean experience suggests that water sector reforms with market instruments became an integral part of overall economic reforms at macro level (Hearne and Easter, 1998). The institutional arrangements were made in such a way that the farmers could continue to trade water rights while the government controlling the full property rights over the entire water resources (Crase *et al*., 2001). It should be noted that in Chile, relevant institutional arrangements were put in place, prior to taking up the reform measures in water sector. For example, special water law providing exclusive rights for water use was enacted in 1981; water user associations (WUAs) have been created exclusively for managing water at local level and the irrigation administration has been strengthened adequately to provide overall support; appropriate regulation and conflict resolution mechanisms were established so that full potential of the markets could be adequately tapped; and, in order to learn lessons and correct the mistakes, a step-by-step approach has been adopted to introduce reform measures at the river basin level (Hearne, 1998). However, Chilean water markets still experience problems like, unregistered markets adversely affecting the efficient transfer and use of water, as well as investment on water.

In Morocco, historical and colonial factors played a role in enhancing reforms in water sector in the initial period but the social, economic and political factors strengthened such reforms in the latter period (Doukkali, 2005; see also, Saleth and Dinar, 2005). It should be noted that it is the macroeconomic crises in Morocco which led to major reforms in the water sector in the latter years (Saleth and Dinar, 2005). Experience in South Africa also reveals that reforms have been influenced mainly by the macro economic reforms carried out during the 1990s; the endogenous factors such as drought and issues related to water sharing with other neighboring countries also provided strong justification for such reforms in the water sector (Backeberg, 2005). In order to achieve maximum benefits from reform measures, the government took certain specific initiatives such as change in the constitution, formulating water policies and water legislation, integrating water policy with policies in relevant sectors, etc. (Backeberg, 2005). In Mexico, the water reform measures initiated in a comprehensive manner progressed over 20 years time period with mistakes being corrected regularly; the reform measures are characterized by number of government regulations of private property rights over water (Shah et al., 2004a). Reform measures in China are lauded for their ability to provide market-like incentives for the communities to

participate in water management effectively, while the overall control over water lies with the government (see Shah et al., 2004b).

The stage-based institutional reform measures in water sector in Sri Lanka are considered an integral component of the macroeconomic reform measures initiated at macro level (Samad, 2005). In the first stage of reforms, a micro-based approach has been adopted in which the irrigation sector reforms were given more priority and this yielded substantial benefits in the agriculture sector with minimum political risk; the second stage of reforms, which are at the maco level, focused mainly on the entire water sector, which generated only meager benefits, apart from attracting political risk. However, present reform measures in Sri Lanka focus mainly on overcoming the issues encountered in the past and this provides lot of scope for making these measures more effective in the coming years (Samad, 2005). Other countries in Asia such as Thailand and Vietnam have also ventured into reforming the water sector in a rigorous manner, especially in recent years. In Thailand, for example, water reform measures embody IDRM approach at the river basin level. Similarly, water reform measures with substantial amount of economic inputs are being carried out at specific river basins in Vietnam (Turrol and Malano, 2001). It should, however, be noted that since the results of these micro level reforms in these Asian countries are not available adequately, we could not arrive at any conclusion on the issues and the outcomes of these reforms. Countries such as Namibia which adopted water reforms very recently are learning through their experience since adequate institutions and skills have not yet been developed to support full reforms in the water sector (Heyns, 2005).

International experience on institutional reforms and tradable water rights within the market setup provides us different kinds of lessons. Let us first discuss certain theoretical and methodological issues involved in these studies. Many empirical studies have utilized mainly the new institutional economics framework to analyze issues related to institutional reforms in the water sector. Majority of these studies have utilized one particular approach of new institutional economic namely, the transaction cost approach. All these studies give an impression that the major objective of the institutional reform measures carried out in many countries was mainly to reduce the transaction cost at the government level. It should, however, be noted that the transaction cost approach is not sufficient to capture all kinds positive and negative changes in the welfare resulting from change in institutions. For example, as we have already pointed out, the transaction cost approach does not address the issue of estimating the benefits derived from the institutional changes at the farmer level while the transaction cost at the government level could be measured relatively easily, mainly in terms of comparing the costs borne by the government sector under different institutional regime. However, there are non-quantifiable transaction costs at the government as well as the farmers' level, which cannot be measured easily in economic terms. Suppose, the non-quantifiable transactions costs are greater than the quantifiable ones, then the conclusions about the efficiency of individual institutions or the mix of institutions will be misleading. Since water generates substantial non-market benefits as well, these benefits should be properly identified and measured in economic terms so that the true opportunity cost of water use and the associated efficiency can be assessed effectively. In order to measure the change in overall transaction cost both at the government and at the farmer level, economic valuation methodology from environmental economics, which can be extended to accommodate the institutional features in a systematic manner, should provide better results. Another problem with the transaction cost approach is that the entire transaction cost analysis is based on the standard neoclassical nassumption that the economic players influenced by the institutions are unboundedly rational in terms of minimizing transaction cost. There are reasons why this kind of assumption may not be valid in the transaction cost analysis. For example, the government agents' objective may not always be transaction cost minimization. As new political economy literature (see Olson, 1967) suggests, the rational government agents who adopt rent seeking behavior may even try to maximize the transaction cost if such a measure would bring additional private benefits to them. It should be noted that in many countries, water sector reforms are resisted by the bureaucrats themselves since they have strong apprehensions that reform measures would dilute their power to generate side-payments. Moreover, the review of case studies suggests that the alternative theories of new institutional economics such as, bounded rationality theory (Williamson, 2000) that deals with non-minimizing objectives of the economic agents, have not been adequately used in analyzing water sector reforms. The point is that when the economic agents have difficulty in minimizing the transaction cost due to cognitive constraints, the standard models using rationality assumption will provide biased results. Therefore, the

theoretical approaches used in the present empirical studies are too narrow and they need to be expanded to accommodate other profound issues involved in measuring the transaction costs in water sector, in future.

What we understand from the empirical studies reviewed above is that the degree of control over property rights depends mainly on the political set-up, historical factors and the nature of institutions existing at the ground level. In certain countries, the user rights are strictly regulated by the governments (e.g. China) while in certain other countries the users enjoy more power over these rights (e.g. USA). Another lesson we have learnt is that the institutional reforms in water sector are considered an integral part of the overall macroeconomic reforms in the countries studied. In other words, the major objective of the water sector reforms in these countries seems reducing the financial burden of the government - especially, the burden realized in terms of transaction cost of managing water resources. While doing so, it might have so happened that even the efficiently run water supply systems in the irrigation sector in some of these countries would have been brought under the market domain. The empirical studies we have reviewed seem to be silent on these cases, however. Similarly, the institutional models used across different countries are found to adopt 'one-size-fits-all' type of approach, with some minor modifications on the basis of regional and local level socio, economic, political and other institutional factors. The models used, in many cases, are found to have been prescribed by the external funding agencies; this is evident from the fact that almost all water sector reform measures were preceded by macro economic reform measures promoted by such agencies. Moreover, the failure cases of institutional reforms are not reported in the mainstream, scientific literature. The studies that report failure cases are available mainly from the popular literature and therefore, using the results of these studies in reviews is constrained due to lack of scientific validity of these results. It is very important that in future, scientific studies should be initiated to analyze the failure cases so that we can understand under what circumstances some models fail.

5. CASE FOR TRADABLE WATER RIGHTS IN INDIA

It should be noted that the problem of water scarcity in India has reached such an extent where it constraints – both directly and indirectly - the economic development in general and agriculture development in particular. India adopted economic reform measures in the middle of 1980s and subsequently, some reform measures were initiated in the water sector during the 1990s (see Gulati and Narayanan, 2001). The initial reform measures focused mainly on the financial reforms in the irrigation sector in order to eliminate huge amount of subsidies given to the agriculture sector, which contributed to negative consequences such as over-exploitation of groundwater (Dubash, 2008; Gulati and Narayanan, 2001). The reform measures included pricing of irrigation water in such a way that wastage of water use could be discouraged. These measures gradually moved onto the institutional aspects such as introducing water user associations under the Participatory Irrigation Management System (PIMS) (Marothia, 2005). It should be noted that the institutional reforms are vague and are not adequate to manage India's scarce water resources; indeed, it is argued by Shah et al., (2004a) that India's water sector is still crying for real institutional reforms.

A meaningful institutional reform to address acute water scarcity in different parts of the regions in India comes in the form of introducing formal markets in managing water in an efficient manner. Like many other countries in South Asia, one of the unique features of India's water sector is the existence of informal water markets at a large scale (Shah, 1991; Saleth, 1996; see Meinzen-Dick, 1998) especially in the groundwater sector. These informal groundwater markets emerged as a strong institution to address the increased level of water scarcity in different pockets of India (Saleth, 1996). A good summary about economics and institutional aspects of these informal water markets in India is available in Saleth (1998). Saleth (1998) made a rough estimate of total monetary value of groundwater sales in the informal sector at US$ 1.38 billion per year, based on the assumption that 15% of the total groundwater irrigated area is benefited from purchased water. Since the informal water markets are very strong in the scarce regions of India, introducing formal markets should not pose any major problem in terms of transaction costs, as suggested by Easter et al. (1998). However, the existing informal water markets in different regions of India suggest that they are indeed inefficient in terms of minimizing the transaction cost and therefore, the existing institutional set-up under the informal markets may not be conducive to introducing formal markets in the water sector. The informal markets, for example, are not

competitive because of monopoly power of sellers who indulge in price discrimination and non-price discriminations such as, irregularities practiced in supplying quality and reliability of irrigation water. It is localized and highly fragmented in nature; characteristics such as, monopoly power of the seller, trade on the basis of surplus supply, trade being influenced by social factors, variation in payment place to place and time to time and inefficient use and over-exploitation of groundwater (Mohanty and Gupta, 2002) contribute largely to increased transaction cost, than reducing it. Since the tariff prevailing in these markets is usually greater than the competitive tariff, exploitation of consumer surplus becomes a predominant strategy of the sellers. Moreover, unregulated, informal markets lead to over-exploitation of groundwater, causing environmental problems that increase the social cost in the regional economy; availability of free electricity in different parts of the country intensify the existing adverse impacts arising from over-exploitation of groundwater (see Dubash, 2000).

It should be noted that huge amount of private investment on tube-wells and bore-wells to augment groundwater suggests that the farmers have already appropriated the water rights indirectly through their legal right over private land. In other words, informally the private water rights are being established through investment on groundwater augmenting measures, linked to the land rights (see Kumar, 2007). As demonstrated by many earlier studies on water markets, the farmers who do not have land rights could not acquire water rights and part of their producer surplus is being exploited by those land owners from whom they purchase water. The argument against the exploitation thesis is that if the exploitative informal water markets had not come into being in the water scenario, even the existing level of producer surplus enjoyed by the buyers would not have been produced; the end result would have been nothing but more farmers' distress in the country. The negative consequences of informal water markets suggest that these water markets indeed increase the transaction cost in the water economy and therefore, introducing formal water markets would reduce both the visible and invisible transaction cost in a substantial manner (see Saleth, 1998). The important questions that arise in this context are: Why the inefficient institution, namely, the informal market, emerged strongly and sustained itself in the water sector? If the formal water markets are efficient in minimizing transaction cost, then why these institutions have not emerged in the water sector at all? Is it due to initial burden imposed by additional transaction costs involved in moving from the present regime to a more market-based regime? It is due to the information constraint at the farmers' level that prevents them from switching over to formal trade? Is it due to the existing policy and institutions that facilitate trading activity at individual level informally but impose constraints on large scale formal trading of water? Is it due to physical constraints emanating from the hydrological features of the water related dynamics at river basin level? Switching from informal market to formal markets requires restructuring the existing institutional and policy arrangements and devising additional institutions that would support formal water trading. Let us discuss this issue in the subsequent section.

As far as India is concerned, no concrete policy exists to facilitate formal markets (Mohanty and Gupta, 2002) in the water sector. Rather, the existing polices dealing with water allocation are highly fragmented, embedded in piecemeal approach and highly ad hoc in nature. The Integrated Water Resource Management (IWRM) approach adopted in India's Water Policy 2002 prescribes introducing water rights for managing water resources at the river basin level (see Shah and van Koppen, 2006). However, very few states in India have adopted this IWRM approach and that also, only partially. The approach is also subject to various criticisms. For example, Shah and van Koppen (2006) argue that implementing the withdrawal permits for augmenting groundwater suggested in the IWRM requires effective monitoring; the very presence of informal groundwater markets at large scale makes the monitoring part more difficult and economically costly. Moreover, IWRM will work in those areas where the primary water diverters are large in size, body corporate are few in number, most water users are supplied by organized water providers and capital accumulation in terms of infrastructure creation is already high (Shah and van Koppen, 2006). Effective implementation of IWRM in the Indian context is hindered by existence of a large number of households who are the primary water divertors who self-supply water from the natural sources and generate very low level of capital accumulation in the water sector (Shah and van Koppen, 2006). Another major issue that has not been properly addressed in the IWRM approach relates to pricing of irrigation water appropriately so that the formal markets could function efficiently. However, no proper institutional mechanism is available for generating such information on pricing. Dharmadhikary (2007) points out some of the major problems embedded in the IWRM approach. For example, Maharashtra Water

Resources Regulatory Authority (MWRRA) has been created to implement IWRM in Maharashtra and the authority has been assigned with the task of creating trading water entitlements. The MWRRA is responsible for distributing the entitlements between various users so that these entitlements can be transferred, bartered, bought or sold on annual or seasonal basis within a market system. However, due to lack of information and guidance the prospect of the authority to effectively regulate the water markets has become grim. Also, many fear that tradable water rights suggested in the IWRM approach will lead to allocation of water to economically powerful people (Dharmadhikary, 2007) and therefore, there will be stiff resistance especially from the resource poor users of water (Kumar, 2003 cited in Kumar, 2007). Similarly, implementation of IWRM requires local or regional level institutions such as, the Catchment Management Institutions (CMAs) existing in countries like South Africa where the IWRM is more effective. Formation of CMAs, involving water user associations and developing appropriate technologies are some of the challenges in implementing the IWRM in the Indian context (Shah and van Koppen, 2006).

From the above analysis, one could get an impression that introducing formal markets in the Indian scenario is a difficult task, though not an impossible task. While discussing institutional options for water management in India, Saleth (1998) argues that '…a legally instituted and locally managed water quota system defined within an ecologically consistent overall withdrawal limit could eliminate the negative effects of markets and magnify their positive efficiency and conservation benefits. While the magnitude of benefits from observed water markets is tremendous, their contribution is only a fraction of the efficiency, equity, and sustainability gains possible from formal markets emerging within well-managed water quota system. The prevailing institutional vacuum thus makes the currently observed water markets only a distant second-best option' (Saleth, 1998).

6. THE WAY FORWARD

How to make the distant, second-best option as a practicable, 'best option' in the near future is an important question that we have to address here. As we have already discussed, the need for moving to the first-best option arises from the fact that water scarcity under the existing institutional and policy regime in India is becoming acute and generates huge social cost that is mainly invisible. This being the case, the importance of establishing tradable water rights especially for managing the groundwater in India has been already underlined by many researchers (e.g. Kumar, 2007; Saleth, 1996). However, we have no acceptable blue-print on how to introduce formal markets in the water sector which is characterized by a lot of complexity and what kind of the additional institutional arrangement is required for allowing formal markets so that water could be managed in an efficient, sustainable and equitable manner under the new regime. Since bounded rationality poses greater difficulty in understanding the required level of institutions, we need to look at those institutions in other parts of the world, which facilitate achieving the expected goals in the water sector under the market-based institutional regime.

In the case of macro level institutions, we have seen that many countries have introduced various kinds of institutional and policy measures such as enacting and amending water laws, introducing regulatory authorities, reforming water pricing, etc. that provide conducive environment for water trade. However, the actual implementation of these measures at the ground level depends mainly on the institutions at micro level that provide appropriate incentives and disincentives to the stakeholders to use manage water efficiently. In Texas, USA, for example, water districts or river authorities play an important role in managing surface water by way of facilitating markets through the tradable water rights. While partial ownership is exercised over the surface water, farmers enjoy absolute ownership over the groundwater in places like Texas. This means that the individual farmers having water rights are the basic entities in the water markets. Griffin (1998) argues that absolute ownership has not been effective in reducing the scarcity of groundwater because, transfer of invisible groundwater from one farmer to another that takes place due to reduction in one farmer's use of groundwater leading to increase in another farmer's use is not practicable. Similarly, the free-riding problem in the groundwater use encourages many farmers to exploit more water, rather than conserving it. However, measures such as metering of pumping wells, monitoring committees and establishing water banks have been put in place to transfer

groundwater across farmers and to manage it in a sustainable manner (Griffin, 1998). In Spain, trading of water takes place at community level. It has been demonstrated that in Spain, if the trade is allowed to take place across larger communities instead of individual communities the gains from water trade would be more (Garrido, 1998). In Canada, introducing water markets across sub-basins is found to result in increased benefits (Horbulik and Lo, 1998). In the developing country context, the institutional arrangements at regional and local level are somewhat different. In China, for example, the irrigation service providers play a major role in allocating water under the new regime, while the government has full right to water resources (Shah et al., 2004b). In Thailand, the basin working committees consisting of different stakeholders take up overall responsibility of managing water at the river basin level, while local water user associations control the allocation of water through market exchange (Patamatamkul, 2001).

In Indian context, both the central and the state governments have taken a few steps at macro and micro level to moot institutional reforms in the water sector. For example, the IWRM approach has been adopted in the national water policy, recognizing river basin as planning unit, water an economic commodity, etc. However, the IWRM approach is not being effectively implemented due various kinds of problems at the ground level. For instance, many issues such as, how to generate adequate information about the water use and values so that water could be allocated on economic principles, are not being properly spelt out in the approach. In the case of groundwater sector, many state governments have introduced groundwater laws to curb the over-exploitation of aquifers. But, these laws do not provide any incentive for the farmers to conserve groundwater because they restrict farmers' freedom of opportunities to use the groundwater efficiently. Moreover, there is no proper monitoring mechanism to control the extensive groundwater exploitation taking place among the unorganized users in the scarce regions. The transaction cost of monitoring and controlling groundwater exploitation becomes extremely high and therefore, the resource-poor government agencies are not able to properly monitor and control the overexploitation of groundwater. On top of everything, electricity subsidy provided to the farmers also intensifies the over-exploitation in already water scarce areas, apart from causing inequality among different categories of farmers. Similarly, some of the state governments like Maharastra have established regulatory authorities in the water sector to guide water allocation (Dharmadhikary, 2007). But these authorities are not effective because their roles and functions are not properly defined and they do not have access to required information for water allocation decisions. In some other states like Tamil Nadu, River Basin Boards have been created for some specific river basins. These boards consist of various kinds of stakeholders and the major aim of these boards is to resolve water scarcity problem at the basin level through efficient conflict resolution mechanisms. However, these boards are also not functioning well because of issues such as lack of political interest and lack of information available for decision making. In many state governments, WUAs have been created for managing water at local level, under the umbrella of 'Participatory Irrigation Management System (PIMS)'. However, the results are not satisfactory here as well (see, Marothia, 2005). Apart from these bodies which are directly involved in managing water resources at regional level, other organizations at local level such as village panchayats and non-governmental organizations are also involved in water managements especially, in watershed management in dry regions. The outcomes of these arrangements are also not satisfactory, on an average. Altogether, it should be noted that the governments in India have established more than adequate level of institutions to manage water but in a fragmented basis. In the existing policies related to water sector, a piecemeal approach is glaring everywhere. Therefore, if at all water scarcity needs to be addressed properly in the Indian context, an integrated approach is warranted for. One of the important aspects that is completely missing in the existing institutional arrangements is that there is no proper guiding principle on the basis of which the institutions function. One can bring in numerous institutional changes but if the overall policy guiding water allocation is still within the conventional regime, then the outcomes would be counterproductive. The existing fragmented institutions suggest that the transaction cost of creating and operating these institutions are enormous and in the present form, all these institutions are scarcity inducing rather than scarcity minimizing. Keeping this in view, it is argued that there is a need for redesigning water policies in such a way that more market-based instruments such as tradable water rights can be introduced in the future so that the existing institutions can be systematically integrated for achieving the goal of efficient, equitable and sustainable water management.

Once the appropriate policy regime has been created, then other practical problems related to water trade may crop up in the scenario. For example, at what level the trade in water should take place, what kind of trade is transaction cost minimizing, who has to be responsible for regulating water trade, what kind of infrastructure is required for facilitating water trade, etc. are some of the questions which need to be answered. It should be noted that the answers for these questions will have to come from the regional and local level factors affecting water trade. For example, though water trading may not be possible between individual farmers or between individual farmers and urban buyers, such trading can be effective across sub-command areas or across WUAs in each canal within the sub-command. Similarly, trading may take place between WUAs and urban water supply authorities, rather than on individual to individual basis. However, when the markets mature the individual farmer level trade becomes a viable option. In the case of groundwater, Kumar (2007) suggests that assignment of equal property rights over water irrespective of the size of the land will lead to equitable allocation of water since the large landowning farmers needing water over and above their own quota will end up buying water from small land farmers who have got surplus water to sell, bringing equity among the farmers. It may be noted that even if the small land farmers do not have adequate infrastructure to pump their own share of water, the rationality of the farmers will lead to arrangements in such a way that the big land farmers can pump water and share it with small land farmers depending on the total costs and benefits of doing so. At local level, the individual tradable permits may be issued on the basis of the renewable amount of water so that over-exploitation of aquifers will be avoided, especially in the scarce regions. In case the water trade causes negative externality, the institutions such as village level institutions, watershed committees and aquifer management committees can be established exclusively for addressing these negative externalities (Kumar, 2007). The overall regulation of trading in order to avoid any conflict or negative externalities at regional or basin level, may lie with the basin boards or with the regulatory authority.

Sometimes, the standard economic prescriptions such as enacting laws, formal institutional arrangements, under the broader model applied everywhere may not be effective because of huge amount of uncertainties about appropriate institutions and behavior of the economic agents to be shaped by laws. At the national and local level, the market operations are facilitated by non-conventional, behavioral factors such reciprocal behavior and rule rationality. Adequate inputs on these aspects need to be generated through scientific studies and should be incorporated in the design of instruments for water allocation. On top of everything, different types of institutional arrangements and their effectiveness need to be assessed in terms of the net gains achieved through transaction cost minimization. Studies within the new institutional economics frameworks - including bounded rationality framework are warranted for at the river basin level in order to assess the net gains of market-based institutions for managing water, in the coming years.

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