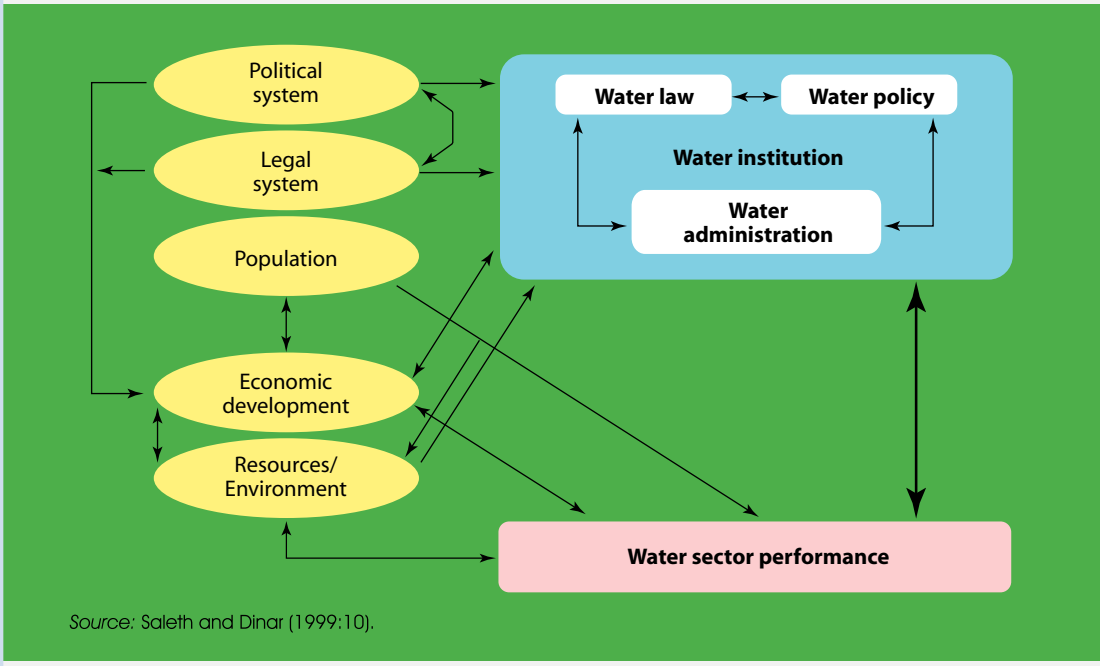
RESEARCH REPORT

79

Strategic Analysis of Water Institutions in India

Application of a New Research Paradigm

R. Maria Saleth



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Summary

The overall objective of this paper is to outline the analytical framework and theoretical approach underlying a new research paradigm and illustrate how this paradigm can be used for the strategic analysis of water institutions by applying it to the Indian context. The specific objectives are to:

(a) outline the analytical framework and theoretical approach underlying a new research paradigm needed for a strategic analysis of water institutions including their internal structure and external environment

(b) review the evolution, structure, and performance of water-related institutional arrangements in India, focusing first on the macro/formal institutional arrangements and then, on their micro/informal counterparts

(c) assess the performance of water institutions using a few objective criteria

(d) evaluate the recent institutional changes within an institutional transaction cost framework and identify the forces—both endogenous and exogenous to the water sector—that determine the depth and direction of water institutional changes in the country

(e) conclude by identifying some major implications for theory and policy in the realm of water institutional reform

In focus and scope, this paper is more eclectic rather than exhaustive in terms of its coverage because it focuses mainly on the most important aspects of water institutions that are receiving attention in current debates on water sector reforms both in India and elsewhere. While informal institutional arrangements operating at the micro level will receive attention, the major focus will be on the formal institutional arrangements that are operating at the national and regional levels.

The analytical approach and theoretical framework of the research paradigm is based on two aspects, i.e., the institutional decomposition and analysis (IDA) framework and the institutional transaction cost theory that generalizes the transaction cost theory developed originally by Coase and Williamson. The IDA framework provides the foundation for a systematic review of water institutions. This framework is based on a two-stage decomposition of water institutions. First, water institutions are decomposed to delineate the water institutional environment (governance framework)—as determined by the historical, constitutional, economic, social, political, and physical conditions of the country—from the water institutional structure (governance structure)—as determined by water-related law, policy, and organizational elements. And, second, water institutional structure is decomposed into water law, water policy, and water organization or administration and each of these institutional components are decomposed further to highlight a few of the most important institutional aspects.

In the water-law component, the institutional aspects receiving attention are: inter-governmental responsibility, water rights, and accountability. In the water-policy component, the institutional aspects getting coverage are: national water policy, project-selection criteria, water pricing and cost-recovery policies, and user participation and privatization initiatives. In the water organization component, the institutional aspects considered are: organizational framework, financing and management responsibilities, regulatory arrangements, and conflict resolution mechanisms. To

complete the analysis of the water institutional structure, informal/micro water institutions, such as localized institutions, rental markets for irrigation assets, groundwater markets, and water-based contract and conventions are also reviewed.

Having discussed the approaches that are possible for directly evaluating water institutional performance, the paper, then, identifies and uses an approach for indirectly evaluating water institutional performance via water sector performance. This approach is based on three gaps: the physical gap (gap between water resource potential and its utilization as well as the gap between water demand and supply), financial gap (gap between water sector investment and cost recovery), and economic/incentive gap (gap between the average value of water and the water rate being charged). Using some objective information on these criteria, the paper evaluates water institutional performance indirectly in terms of the performance of the water sector (especially, its irrigation sub-sector). The next section documents the nature, extent, and direction of recent water institutional changes both at the national and regional level. Using the institutional transaction cost framework, the paper also attempts to explain the factors behind ongoing institutional changes.

The reform initiatives, undertaken especially since 1991, provide observational evidence for the fact that reform benefits (or, the opportunity costs of inaction) are exceeding the corresponding economic and political transaction costs. But, the fact that the institutional changes are uniform neither across institutional components nor across water sub-sectors suggests that both the opportunity and transaction costs vary considerably by institutional and sectoral contexts. The reform process also provides clear evidence for the powerful effects that exogenous factors (e.g., economic liberalization policies, political forces, international financial and research institutions, and natural calamities) have on the opportunity and transaction costs of institutional change within the water sector. While India has to go a long way to set right its water institutional structure, from the perspective of a stage-based process of institutional change, the changes observed so far do signify that India is on the threshold of entering the substantive and irreversible phase of institutional reform. As the already initiated reforms begin to yield benefits, strengthen pro-reform constituencies, and reduce the technical and political costs of transacting additional reforms, the incentive balance within the institutional transaction cost framework is likely to move toward further reforms.

Strategic Analysis of Water Institutions in India: Application of a New Research Paradigm

R. Maria Saleth

Introduction

With increasing water scarcity and frequent occurrences of water-related conflicts at macro and micro levels, the institutional arrangements governing water resource development, allocation, and management are receiving increasing policy attention worldwide. The water institutional arrangements assume, however, an enhanced significance in India as the country is moving fast towards the ultimate limit of its utilizable water resource potential. Although India is using only about 57 percent of its total water resource potential at present, it is already using about 66 percent of its irrigation potential (MOWR 2000). While water demand is increasing fast with a growing population and an expanding economy, further development of water resources is seriously constrained by investment bottlenecks, environmental concerns, and political and legal snags inherent in inter-regional water transfers. As the gap between projected demand and potential supply is likely to grow further, the physical scarcity of water, which is already visible in a few regions and cities, is expected to assume national proportions in the not-too-distant future.

Unfortunately, most water institutions—being developed in an era of water surplus, especially during the colonial period—are becoming increasingly ineffective in addressing water challenges as the country enters an era of absolute water scarcity. Indian water institutions have undergone significant changes in recent years. However, these changes fall far short of the new and emerging institutional requirements of the water sector. To see the magnitude and consequences of this reform gap, we need to first review the water institutional structure and then, attempt an evaluation of its efficacy and performance. The review of both the water institutional structure and the evaluation of its performance can be more illuminating when it is based on a conceptual and analytical framework based on the institutional decomposition approach. Similarly, the nature and direction of the recent institutional changes, and the factors leading to these changes can be understood better within a theoretical framework based on the institutional transaction cost approach that accounts for the role of both economic and political factors.

Objectives and Scope

The overall objective of this paper is to outline the analytical framework and theoretical approach underlying a new research paradigm and illustrate how this paradigm can be used for the strategic analysis of water institutions—with application in the Indian context. This paper attempts to realize its overall objective by addressing the following specific objectives:

(a) outline the analytical framework and theoretical approach underlying a new research paradigm needed for a strategic analysis of water institutions including their internal structure and external environment

(b) review the evolution, structure, and performance of water institutional arrangements, focusing first on the macro/formal institutional arrangements and then, on their micro/informal counterparts

(c) assess the performance of water institutions using some objective criteria

(d) evaluate the recent institutional changes within an institutional transaction cost framework and identify the forces—both endogenous and exogenous to the water sector—that determine the depth and direction of water institutional changes

(e) conclude by identifying some major implications for theory and policy in the realm of water institutional reforms

In focus and scope, this paper is more eclectic rather than exhaustive in terms of its coverage of the legal, policy, and administrative or organizational aspects governing the water sector. The emphasis will be on the most important aspects of water institutions that are receiving considerable attention in the current debate on water sector reforms both in India and elsewhere. Such a selective coverage is necessary partly due to the need for a more focused analysis and partly due to the continental nature of India having a wider regional diversity in terms of both water institutional arrangements and water sector features. Nevertheless, as much as possible, region-specific aspects of both water institutional arrangements as well as water sector features will be highlighted in all relevant contexts. While informal institutions operating at the micro level will receive attention, the major focus will be on the formal institutional arrangements that are operating at the national and regional levels.[1] This is because formal and macro-level institutions are more amenable for purposive reforms than their informal and micro-level counterparts.

[1]As we know, in the case of water institutional arrangement in countries such as India, the formal/macro level institutions are related mostly to canal-based surface irrigation systems, whereas most of the informal/micro level institutions are mainly associated with groundwater and tank irrigation irrigation systems. Also, there are formal institutions governing urban and rural water supply and water quality. While the formal/macro institutions, especially those related to the irrigation sector, cover most part of the water institutional arrangements in India, our major focus on them does not mean that the approaches proposed here do not have a generic application to all the remaining institutions—both at the micro and macro levels.

Analytical Framework

The research paradigm that we propose for the strategic analysis of water institutions is centered on two complementary analytical and theoretical components, i.e., 'Institutional Decomposition and Analysis' (IDA) framework and the 'Institutional Transaction Cost' theory that are recently developed by Saleth and Dinar (forthcoming). Before indicating how this research paradigm can allow us to have a strategic analysis of water institutions as well as the factors contributing to their evolution and change. Its underlying analytical and theoretical components are described first.

Institutions are entities defined by a configuration of legal, policy, and organizational rules, conventions, and practices that are structurally linked and operationally embedded within a well-specified environment. A simple analytical decomposition can enable us to have a better understanding of their innate nature and inherent features. Institutional decomposition can be attempted at different levels and detail. From a very broad perspective, institutions can be decomposed by distinguishing the *institutional structure* (or, governance structure) from its *institutional environment* (or, governance framework) (Williamson 1975; North 1990a). While the institutional environment is characterized by the overall physical, cultural, historic, socio-economic, and political milieu of a country or region, the institutional structure is defined by the interactive effects of the legal, policy, and organizational or administrative components and their constituent aspects. Since the institutional structure is embedded within the institutional environment, the evolution of the former is invariably conditioned by changes in the latter. This does not mean that there is only a one-way flow of effects between the two, as changing the institutional structure also influences the institutional environment or governance framework.

Like all other institutions, water institutions too have their own institutional structure as well as their institutional environment (Saleth and Dinar 1999 and 2004). The water institutional environment is characterized not only by the factors determining the overall institutional environment but also by those related to water resource conditions as well as to other water-related sectors such as agriculture, environment and forest, and urban development. The water institutional structure is defined interactively by three institutional components, i.e., water law, water policy, and water administration (or, water-related organizations). As such, the water institutional structure can be broadly decomposed into these three interrelated components.[2] It should be noted that the institutional components cover not only the formal and macro-level arrangements but also the informal and micro level arrangements such as those reflected in local customs, conventions, and informal contracts.

The formal *institutional components* (and, to some extent, their informal counterparts) can also be decomposed further to highlight some of their major *institutional aspects* (Saleth and Dinar 1999 and 2004). For instance, water law can be decomposed to highlight: (a) inter-governmental

[2]Such decomposition is not arbitrary. It has a strong theoretical basis and analytical similarity with the Institutional Analysis and Development (IAD framework developed by Ostrom (1990) and Ostrom, Gardner, and Walker (1994). This framework characterizes institutions in terms of three hierarchically related categories of rules: constitutional-choice rules, collective-choice rules, and operational rules. As we take a deeper look at these categories of rules, it will become apparent that they can be approximated respectively by laws (legal rules), policies (policy guidelines), and organizations (organizational rules). For, laws are the outcome of constitutional choice and policies are the results of a collective choice through the political process whereas the operational rules come into play when the laws and policies are operationalized by the administrative mechanisms involved in their implementation, monitoring, and enforcement.

responsibility, (b) water rights, and (c) accountability provisions and mechanisms. Similarly, water policy can be decomposed to shed light on: (a) project selection criteria, (b) pricing and cost recovery, and (c) user and private sector participation policy. In the same way, the organizational dimension of water institutions can be decomposed to focus on: (a) organizational structure and the relative role of government layers, (b) financing and management, (c) regulatory mechanisms, and (d) conflict resolution arrangements. It is this kind of institutional decomposition that will be used as the analytical framework for organizing the review and description of the water institutional structure in India.[3]

Three critical features of this analytical framework need to be noted. First, although it is not that detailed and exhaustive, it still captures most of the institutional issues that are currently receiving major attention both in national and global policy debates. Second, the decomposed institutional components and their constituent aspects are treated as independent entities only for analytical convenience. In reality, the institutional aspects are functionally nested and interlinked both within and across the institutional components.[4] In this sense, the decomposition exercise enables us to trace the linkages among institutional components and institutional aspects and this tracing procedure can, in turn, allow us to understand how these institutional linkages function as a medium for transmitting a change in one institutional component or aspects to their counterparts.[5] As we will see later, due to their role in facilitating institutional change downstream, these institutional linkages also have significant implications for the overall transaction costs of institutional change. Finally, as the institutional decomposition proceeds to minute levels, i.e., beyond the institutional aspects, the exercise can identify the configurations of rules underlying each of these institutional aspects. However, in view of the obvious reasons of simplicity, we are not going for such a minute level of decomposition here.

The theoretical framework that used here for explaining water institutional evolution and change is based on the institutional transaction cost theory originally developed by Coase (1937), Williamson (1975), and North (1990b). While a simple but more general representation of this theory, as applicable to the particular context of water sector, can be found in Saleth and Dinar (2000 and 2004), here, we provide a brief description. In simple terms, the institutional transaction cost framework first identifies all the major factors affecting water institutions and then, traces their effects either on the transaction or opportunity costs of institutional reform. While the factors influencing water institutions are many and diverse, for analytical convenience, they can be grouped into endogenous factors that are internal to both water institutions and the water

[3]To distinguish this framework, which is applicable mainly at the macro institutional level, from the IAD framework of Ostrom and co-workers, which is applicable at the micro institutions, it is called IDA framework by Saleth and Dinar (2004).

[4]For instance, within the water law component, the aspects of water rights, conflict resolution, and accountability are interrelated as do the aspects of pricing, cost recovery, and user and private participation within the water policy component. Notice also that water policy is a political translation of water law (or, water law is a legal representation of the policies, which have gained political consensus or withstood the test of time) and water administration is the implementation arm for both water law and water policy. As such, these three institutional components are themselves nested and linked both organically and operationally.

[5]To illustrate how institutional linkages function as a vehicle for conveying changes across institutional components/aspects, let us consider the case of irrigation management transfer. Although irrigation management transfer is an organizational change (from state management to farmer management), it has a favorable effect on policy dimensions such as water pricing and cost recovery. Organizational change can also pave the way for higher level technical and institutional changes such as the introduction of volumetric allocation procedure and the establishment of a water rights system. That is, the organizational change can be much more effective if it is coupled with corresponding changes in the legal and technical dimensions. Thus, institutional linkages play a key role in determining both the individual and joint performance of water institutional components and aspects.

sector and exogenous factors that are outside the strict confines of both water institutions and the water sector. In broad terms, these endogenous and exogenous factors can be considered to capture the key features of the institutional structure and the institutional environment, respectively. However, there is an exception. For analytical convenience and on practical considerations, the physical and ecological features of the water sector, which are actually the components of the water institutional environment in a strict theoretical sense, are considered here as endogenous and not as exogenous factors.[6]

The endogenous factors include water scarcity, water conflicts, financial and physical deterioration of water infrastructure, and operational inefficiency of water institutions. Another very important endogenous factor that is often overlooked or underestimated in most institutional analysis pertains to the internal linkages among water institutional components and aspects. These institutional linkages have implications not only for institutional performance but also for the overall transaction costs of institutional change itself.[7] The IDA framework, as described in the previous section, provides a mechanism for incorporating the performance and transaction cost implications of institutional linkages within the formal context of the institutional transaction cost theory. The exogenous factors, on the other hand, represent the general aspects such as economic development, demographic growth, technical progress, economic and political reforms, international commitments and pressures, changing social values and ethos, and natural phenomena such as floods and droughts.[8] Thus, the exogenous factors represent the overall institutional environment facing water institutions whereas the endogenous factors reflect the internal features of water institutions and the water sector in a given context and point in time. Understandably, it is the interactive and joint effects of these endogenous and exogenous factors that will determine the structure, performance, and change in the water sector and its institutional arrangements.

Although it is difficult to isolate the individual effects of the exogenous and endogenous factors, it is still possible to track them, especially by conceptualizing their effects either in terms of the transaction costs or in terms of the opportunity costs. The transaction costs cover both the real and monetary costs of instituting and changing the legal, policy, regulatory, monitoring, and enforcement mechanisms related to water development, allocation, utilization, and management. The opportunity costs, on the other hand, cover both the real and economic value of opportunities foregone (i.e., the net social costs of inaction or '*status quo*'). In this sense, the opportunity costs are actually the potential benefits of the

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[6]This exception allows us to distinguish the physical aspects of the water sector from other exogenous factors that are operating outside the strict confines of the water sector and its institutional arrangements. Although the physical aspects of the water sector are included with other endogenous features of water institutional structure, their interaction will be still very much a part of our analysis. The water sector features, ranging from the degree of water scarcity to the physical layout of the water supply systems, have a fundamental impact on water institutional performance. For instance, in his comparative study of south Indian and Korean water control institutions, Wade (1982 and 1985) has shown that the physical and ecological setting of water systems plays a powerful role in determining institutional performance.

[7]For instance, a legally and organizationally mature user organization tends to minimize the cost of establishing volumetric allocation, which, in turn, can pave the way for the eventual development of a water quota system including some decentralized arrangements for conflict resolution and accountability. Needless to add, since these local level arrangements tend to reinforce the macro level conflict resolution and accountability mechanisms, there will be mutual synergy among these institutional arrangements creating the necessary conditions for improved institutional performance.

[8]Notice that it is these exogenous factors that together, in fact, define the overall institutional environment for the water institutional structure. As such, our analytical framework captures also the transaction cost implications of changing institutional environment as characterized by both economic and non-economic factors.

institutional change. That is, when the institutional change cannot be effected, these benefits are reckoned as social costs in terms of the opportunities (or, benefits) sacrificed or foregone to maintain the *status quo*. The institutional transaction cost theory predicts that institutional change occurs whenever the opportunity costs exceed the transaction costs so as to give the much needed political economy thrust for reform.

The opportunity and transactions costs of institutional changes are not static but change continuously due to changes in factors both endogenous and exogenous to the water sector. For instance, as water scarcity becomes acute due to economic development and population growth, the real and economic costs of inappropriate water institutions tend to rise. Similarly, the economic reforms magnify the fiscal implications whereas natural calamities such as droughts and floods aggravate the political implications of the opportunity costs of institutional reforms. Political reforms involving nation-wide institutional changes, on the other hand, reduce the transaction costs of water sector reforms directly because the institutional changes within the water sector form only a small part of the overall reform process. Likewise, technical progress can also reduce the transaction costs of institutional changes. As the exogenous factors tend to magnify the opportunity costs of the water crisis and reduce the transaction costs of water sector reforms, they often provide a powerful economic urge and political thrust for water institutional changes.

We can also clarify two additional aspects to dispel any possible confusion or misunderstanding as to the nature of the transaction and opportunity costs as well as the issue of how and by whom they are reckoned. First, these costs can be reckoned *ex-post*, i.e., after having observed the actual impacts of institutional change. But, such a post mortem analysis, though providing considerable insights into the relative role of the factors that led to the institutional change, is of little value for providing predictive inputs into an ongoing and future process of institutional change. What is more relevant here is the *ex-ante* evaluation of the transaction and opportunity costs by various stakeholder groups. Such an *ex-ante* evaluation necessarily involves subjective elements including a subjective and adaptive evaluation of even objective factors. Subjective and *ex-ante* reckoning of these costs are, in fact, inevitable in view of the dynamic and inter-disciplinary nature of institutional changes, lacking both observed data as well as an unified and trans-disciplinary framework needed to integrate and process diverse information (Saleth and Dinar 2004). And, second, the transaction and opportunity costs are reckoned not just by the state but equally also by the communities, groups, and individuals. It is the convergence in the transaction cost calculus of the majority or the most powerful groups that determines the nature and depth of institutional changes both at the macro and micro levels.[9]

Institutional change is not a one-time event but rather a continuum involving gradual changes over time in response to the changing dynamics and relative magnitude and distribution of reform costs and benefits. As the reforms initiated in earlier stages brighten the prospects for downstream reforms, there are intricate linkages between the transaction costs of

[9]To explain how such convergence occurs and how it leads to institutional change, Saleth and Dinar (2004) have proposed a subjective and stage-based theory of institutional change. According to this theory, institutional change occurs through four stages: mind change of stakeholders (as induced by subjective and objective evaluation of existing and future state of affairs), political articulation of such change (due to the role of political entrepreneurs), policy changes and actual implementation (through the process of interest group politics and political bargaining), and performance improvement (as measured against objective criteria and subject expectation of stakeholders). These stages are not linear but cyclical because when performance improvement is below expectation, the process will again go through the four stages. Depending on country or regional context, the time dimension and quality of the process at each stage can be different.

subsequent reforms and the opportunity costs of earlier reforms.[10] Similarly, since the institutional changes within the water sector derive considerable synergy from exogenous factors that reflect changes elsewhere in the economy, the transaction costs of water sector reforms can also decline due to scale economies in institutional change.[11] The opportunity and transaction cost implications of these dynamic and internal features of institutional linkages and reform sequencing are an important and inherent part of the institutional transaction cost theory (Saleth and Dinar 2004).

The institutional transaction cost theory, as outlined above, captures not only the role of factors both within and outside the water sector but also the strategic significance of certain dynamic aspects of institutional change such as institutional linkages and scale economies (Saleth and Dinar 2004). Since it provides a unified framework to track and account for the effects of various factors affecting institutional changes in the water sector, this theory can indeed be used to explain both country-specific and cross-country variations in the nature and direction of water institutional changes. While the set of factors affecting water institutional change does not vary much across countries/regions/sectors, their relative role and significance in the opportunity-cost transaction cost calculus can vary considerably across countries/regions/sectors. It is the contextual nature of these variations that, in fact, explains why countries/regions/sectors differ in terms of the extent and depth of water institutional reform observed both in the past and at present (Saleth and Dinar 2000). It is for reasons such as these that we consider the institutional transaction cost theory as an appropriate theoretical framework for a strategic analysis of water institutions. The strategic significance of this framework lies in the fact that it enables us to exploit the performance and transaction implications of favorable institutional features (e.g., institutional linkages and path dependency) and institutional environment (e.g., political and macro-economic reforms, droughts, and international agreements) promote water sector reforms.

Water Institutional Environment: An Overview

The institutional environment of water institutions in India can be characterized in terms of a synoptic overview of the country's history, constitutional framework, socioeconomic conditions, political arrangements, and finally, the physical setting of the water sector itself. India is known for a long history and rich cultural traditions. Its present administrative and judicial systems have evolved through a long process involving a strong central Asian and Persian influence during the Mogul period and British influence during the colonial period. It is, however, the British who improved and perfected these diverse systems into a relatively uniform but centralized administrative and judicial system. With the consolidation of a centralized government bureaucracy and the spread of markets and commercialization, local and

[10]For instance, with the establishment of a transferable water rights system, the creation of other institutional aspects such as the conflict resolution mechanisms and water markets becomes easier due to the linkages that the transactions costs of the latter two institutional aspects have with those of the former.

[11]The scale economies in transaction costs emerge from the fact that the cost of transacting water institutional changes is lower when water sector reform forms part of an overall country-wide economic reform (e.g., China) and political reconstruction (e.g., South Africa) than otherwise (Saleth and Dinar 2000).

community-centered institutions have lost their relevance and gradually disappeared. The British influence can also be seen in the Indian political system characterized by multi-party democracy based on the parliamentary system. India has a federal form of government operating with a modern constitution that demarcates the responsibilities of the central, state, and local governments.[12]

India covers an area 3.29 million km^2 and has a population of over a billion. Despite the constraints and burdens imposed by heavy demographic pressure, the Indian economy is able to grow annually by around 6 percent with a current per capita income of US$ 450.[13] Comparing the pre-Independence situation with the present, India has displayed remarkable economic performance with the achievement of food self-sufficiency since the early 1970s and also self-reliance in most industrial products since the early 1980s. But, India is still largely a rural economy as two-thirds of the population still live in rural areas, though the rural areas themselves have undergone remarkable transformation in recent years, thanks to the expansion of transport and communication facilities. Although the share of agriculture in the gross domestic product has declined now to 30 percent, this sector is critical both as a major source of employment (70 percent share in total employment) and as a key predicator of the pace and tempo of the overall macro-economic performance itself. Rural poverty, which used to be as high as 56 percent during 1973-1974, has declined to 41 percent during 1984-1985 (Planning Commission 1993:37-40). In recent years, this figure hovers around 33 percent (see Saleth, Samad and Namara 2003).

Understandably, the water economy plays a critical role in the overall structure of the Indian economy. Being a vast and monsoon-dependent country, water resources availability in India displays a wide variation across time and space.[14] From an overall perspective, the total water resource potential of the country is estimated to be about 1,953 billion m^3 of which only 1122 billion m^3 can be utilized under current economic and technological conditions. But, the actually developed water resources—from both surface and groundwater sources—at present is only about 644 billion m^3 representing 57 percent of the utilizable potential. But, the total water requirement of the country is projected to be in the range of 694-710 billion m^3 by the year 2010, 784-850 billion m^3 by the year 2025, and 973-1180 billion m^3 by the year 2050 (MOWR, 2000).[15] Such an increasing supply-demand gap, especially in the face of economic growth and demographic expansion, leads to a continuous decline in per capita water availability. For instance, the per capita water availability, which was about 5,277 m^3 in 1955, has declined to about 1970 m^3 at present (MOWR 2000). Although non-irrigation demand is likely to quadruple, the essentially rural and agricultural basis of the Indian economy will continue to orient the water sector towards its irrigation sub-sector.

One key feature with considerable institutional implications is the administrative demarcation of different water sub-sectors. While the canal irrigation sector is developed and

[12]Although the central government is strong as per the constitution, the state governments are becoming politically powerful in recent years due to the growing influence of regional parties both in state assemblies and in the national parliament.

[13]When evaluated in terms of purchasing power parity, this per capita income is equivalent to about $2,150 (see World Bank 2000, 274).

[14]For instance, the average annual precipitation varies from 130 mm in the Rajasthan desert to 11,000 mm—the world's highest rainfall—in the Assam Mountains. Notably, a three-fourth of rainfall in India is received just in four months during June-September.

[15]These estimates are based on assumptions concerning projected population growth, agricultural needs and urbanization. Given data limitations and uncertainty, there is no way for checking whether these assumptions are realistic and hence, whether the figures are reliable. But, the fact remains that future water needs of the country are going to increase much more rapidly than the ability to augment water supply.

managed by public agencies, groundwater irrigation is developed and managed by millions of independent farmers.[16] Groundwater irrigation is made possible by 9.8 million electric and 4.4 million diesel pumpsets that are fitted with some 5 million shallow/deep tubewells—located mainly in the Indo-Gangetic and deltaic regions—and 10 million dugwells—spread essentially in the hardrock region covering western and peninsular India. Besides, there are about 0.17 million surface water-based lifts located mostly in the deltaic regions of West Bengal and Orissa. On the other hand, water supply in urban and rural areas is largely managed by semi-autonomous water supply undertakings, municipalities and local governments. Households rely on their own water supply developed from groundwater sources both in urban and rural areas. Finally, institutions related to other resources involved in water resource development and utilization as well as those related to general economic and sectoral management also form part of the water institutional environment. These include the land, forest, and agriculture-related institutions (e.g., land tenure and tenancy, inheritance laws, and forest and environment acts, agricultural pricing policies, and trade policies and international agreements).

Water Institutional Structure: A Macro Perspective

For a more focused treatment, our review of the structure of formal and macro-level water institutions is organized within the analytical framework based on institutional decomposition. This framework distinguishes three institutional components, i.e., water law, water policy, and water administration, and highlights a few key institutional aspects under each of these three components.[17] The ensuing review concentrates only on these key institutional aspects under each of the three institutional components.

Water Law

Water law assumes a central place in the functioning of water institutions as it gives the full legal backing to water policy as well as providing the operational framework and enforcing power for water administration including its regulatory arrangements. Although India does not have any separate and exclusive water law, there are water-related legal provisions dispersed across various irrigation acts, central and state laws, constitutional provisions, court decisions, customary laws, and various penal and criminal procedure codes.[18] Besides the irrigation and groundwater-related laws with a direct effect on water resources development, allocation, and use, there are also legal provisions with indirect but significant effects on the water sector. These provisions are those associated with other water-related natural resources such as land, forest, and

[16]However, groundwater development is supported by the government both directly in the form of public or state tubewells as well as indirectly in the form of credit support and massive investment in rural electrification programs.

[17]For more details on this framework, see Saleth and Dinar (2004).

[18]For a detailed review of irrigation acts and other water-related legal provisions, see the works of Jacob and Singh (1972), Jacob and Mahesh (1976), and Singh (1991 and 1992). While Jacob and Singh (1972) and Jacob and Mahesh (1976) present a well conceived proposal for the unification and simplification of irrigation acts, Singh (1991 and 1992) argues for the creation of an exclusive but broad domain of water law by bringing together various water-related constitutional, civil, and criminal provisions. Unfortunately, these proposals have not yet received their deserved attention from Indian policymakers.

environment.[19] As most of the water-related legal provisions enacted in the past were characterized by water surplus conditions, they fail to reflect the current conditions of water scarcity and water conflicts. Although there were some periodic, though marginal, changes in some of these provisions related to irrigation, especially during the post-independence period, they are too inadequate to develop a legal system capable of meeting the emerging challenges within the water sector.

Inter-governmental Responsibility

The legal provisions related to inter-governmental responsibility in the water sector are derived from the overall constitutional division of power between the central and state governments as effected by the Indian Constitution of 1952.[20] As per the Entry 17 in the State List under the Seventh Schedule of the Constitution, it is the states that have jurisdiction over water resources within their borders. But, the powers of the states are subject to Entry 56 in the Union List that allows the central government to regulate and develop inter-state rivers and river valleys when this is declared by parliament as a matter of public interest. The central government also has regulatory roles in the water sector vide Article 252 related to inter-state water projects as well as in terms of the Forest Conservation Act of 1980, which requires the states to get central clearance for executing ecologically sensitive water projects.

More importantly, the central government also has an important role in resolving inter-state water disputes as per the provisions under Article 262. It is in pursuance of this Article that the parliament has enacted the Inter-state Water Disputes Act of 1956 and it is under this act that a number of tribunals were set up to resolve water disputes among the states.[21] Besides, the centre can also acquire legislative powers on water when two or more states desiring to have uniform water legislations request the union government with the approval of their respective assembly (Jacob and Singh 1972). Despite these legal provisions as well as other administrative and financial leverages (that we will see later) of the central government, the final legislative powers are still with the states in the sense that constitutionally speaking, water-related laws can be passed only by or with the support of the state legislature. While this arrangement is good to address state-specific concerns, there are also serious problems with the present constitutional division of power in the water sector that does not allow the central government to have a more proactive role in water matters. As a result, the central government is unable to provide the kind of leadership and guidance needed for reforming the legal and institutional basis of the water sector, both at the national and state levels.

[19]The categorization of laws in terms of their direct and indirect effect on water is somewhat artificial considering the powerful effects that forest laws have on water resources development. For instance, as we will see below, the Forest Conservation Act of 1980 places major limits on the development of new as well as the extension of old water resources development projects in ecologically sensitive areas. Similarly, civil and penal codes designed to prevent third party effects in water use, though directly related to water use, are ineffective as they are costly to enforce.

[20]This constitutional division of power creates three lists of sectors/activities/jurisdictions. These are the Union List where the central government has exclusive power [Article 246(1)], the State List where the state governments have exclusive powers [Article 246(2)], and the concurrent list where both the central and state governments exercise powers [Article 246(3)].

[21]Since the Act has failed to specify the authority to implement the decision as well as the time limit for tribunal decision, it was amended twice—first in 1980 for authorizing the central government to establish the implementation authority and then, in 2002 to specify a six-year time limit for tribunal decision (Salman 2002; Richards and Singh 2002).

Water Rights

The issue of water rights as a mechanism for allocation and accountability assumes importance with increasing scarcity and conflicts both at the macro level of regions and sectors as well as at the micro level of distributaries, communities, and individual users. Unfortunately, India does not have any explicit legal framework specifying water rights, even though various acts have a basis for defining some form of such rights. British legislation in India during 1859-1877 recognized the customary water rights of individuals and groups. But, a radical shift occurred with the Easement Act of 1882 that made all rivers and lakes the absolute right of the state.[22] While state's absolute rights can affect the development and managerial aspects of water, from the perspective of water use, it is the *de facto* control over water by actual users at the micro level that is more important.

Individual rights to both surface water and groundwater are recognized only indirectly through land rights. Thanks to the 'dominant heritage' principle implied in the Transfer of Property Act IV of 1882 and the Land Acquisition Act of 1894, a land owner can have a right to groundwater as it is considered an easement connected to the dominant heritage, i.e., land.[23] In the case of canal water, the rights to access are limited only to those having access to land in canal command areas and these rights are only use rights and not ownership rights because irrigation acts, in the case of all states in India, do not allow the moving of canal water to non-canal areas.[24] Under conditions of unequal land ownership and income pattern, the practice of linking water indirectly with land and the fact of *de facto* control by better endowed persons only accentuates rural inequality and water use inefficiency.

The Model Groundwater (Control and Regulation) Bill of 1992, which was formulated and circulated by the centre for the consideration of the states, postulates a kind of groundwater permit system. However, it fails to set withdrawal limits (GOI 1992a). While the Bill did induce some legal initiatives in states like Karnataka, Maharashtra, and Tamil Nadu, it has not received any serious consideration by other states, even though the Bill was circulated again among the states in 1997. In view of the absence of any significant reform initiatives, the legal aspects governing groundwater resources continue to remain largely divorced from both resource realities and economic requirements (Jain 1976). Thus, the control over groundwater at the field level is governed by a *de facto* system of rights as determined by farm size, the depth and number of wells, pumping capacity, and economic power.

Accountability Provisions and Mechanisms

The two-way accountability, i.e., the individuals' accountability to each other and to the state, and *vice versa* could not be operationalized until a legal rights system is defined in the first place (Singh 1992:8). When law defines individual water rights, in effect, it defines not only the legal

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[22]This position gotconsolidated further with the Madhya Pradesh Irrigation Act of 1931 and also influenced subsequent irrigation and water supply acts enacted even in the post-independence period. But, a number of public interest litigations have led both the Madras High Court in 1936 and the Bombay High Court in 1979 to declare that the government's sovereign rights do not amount to absolute rights (Singh 1991).

[23]As we will see later, this provision not only constrains groundwater markets, which have emerged spontaneously in many parts of India, where water is sold apart from land but also legally excludes those without land to have any access to groundwater.

[24]However, this provision is either violated or bypassed in many states. For instance, in the canal schemes of Vidisha district in Madhya Pradesh, it is common for non-command area farmers to lift water from canals with diesel pumps. While similar instances are also observed in Periyar-Vaigai canal commands on a limited scale, the dominant practice in many canal regions of Tamil Nadu is not to move canal water directly but indirectly by lifting groundwater in canal regions and moving it to non-canal regions. Some of these informal water transfer schemes are very elaborate and extend up to 10 km. Notably, some of these schemes are financed by nationalized banks operating in rural areas.

boundaries but also the physical and economic boundaries of each individual's acts and their effects on others in the context of water use. By relating rights with duties, such boundaries could be legally handled with a reasonable quantification. Thus, the individual-based water rights system helps to trace externalities, assign payment responsibilities, minimize inter-personal conflicts, and achieve the legally grounded notion of two-way accountability. Equally important is also the issue of accountability of executives and officials to the state and to the people. As most irrigation and water-related acts in India have indemnity clauses to protect the executives against the consequences of wrong or non-implementation of stated policies, they do not provide enough incentives for the executives to be accountable either to the state or to the people.

The accountability of users is sought to be influenced by negative but indirect provisions evident in penal codes and other civil/criminal procedures (Singh 1991). While some of these provisions can be used to penalize users for acts such as non-payment of water charges or illegal water diversions, there are no corresponding provisions for penalizing officials for their failure to supply water at the right time or in the required quantity.[25] Although legal provisions are necessary to infuse accountability and responsibility, they are not sufficient as their operational effectiveness depends on the kind of accountability mechanisms postulated within water laws. The accountability mechanisms currently available are both formal such as the statutory, legislative, and judiciary-based mechanisms as well as informal such as the decentralized, people-oriented mechanisms (Devi 1992). Of them, while the formal mechanisms are costly in terms of both money and time, the informal mechanisms such as water user associations (WUAs) and stakeholder-based basin organizations—being more accessible and responsive—could ensure accountability and dispute-resolution quickly and with least social cost.[26]

Water Policy

Water policy relates to the declared statements as well as the intended approaches of the central and state governments for water-resource planning, development, allocation, and management. It includes statements not only on the overall policy framework but also on specific policy issues such as project selection, water pricing and cost recovery, and user and private participation. Notably, since both the general and specific policies within the water sector are also influenced often by other sectoral policies related to agriculture, public finance, and basic needs, the former cannot be dealt in isolation of the latter. For instance, the need for attaining food self-sufficiency and consolidating the productivity gains from the Green Revolution has led to the implementation of large irrigation projects, rural electrification programs, liberal credit policies, and heavy irrigation, power, and credit subsidies. Moreover, political considerations, macro-economic necessities, and environmental concerns including natural calamities (e.g., floods

[25]The poor recovery of water charges and illegal uses of water observed widely in many parts of India clearly suggest that these provisions against users are ineffective because they are seldom used for political and practical reasons.

[26]While a user-managed water rights system is ideal for inducing efficient water use, promoting accountability, and resolving conflict, many would agree that its creation is not an easy task in the Indian context. The existence of many small farms, poor conveyance structures, political risks in creating the legal and organizational apparatus, and conceptual/information problems in defining water rights in physical and legal terms are the frequently cited challenges. The issue of how to overcome these problems by building on the existing institutional potential and micro level experiments—e.g., Warabandi (time-based allocation), Shejpali (water distribution roaster), and Pani Panchayat (water council) systems—is dealt in detail elsewhere (see Saleth 1994a and 1996). If the introduction of a water rights system can improve use efficiency just by 10 percent in the irrigation sector, from a national perspective, this will mean an addition of 8.9 mha of irrigated area without any new water development projects. Such a simple calculation suggests that the benefits of creating the water rights system can outweigh the cost of transacting this institutional change.

and drought) also have a strong influence on water sector policies.

National Water Policy

Although the need for a national-level policy for the water sector was felt for quite some time, the immediate factor that prompted the National Water Policy (NWP) of 1987 was the unprecedented drought of 1987. The main goals of NWP are the promotion of conjunctive use of water from surface and sub-surface sources, supplemental irrigation, and water-conserving crop pattern and irrigation and production technologies (GOI 1987). It has called for raising the canal water rates and promoting user participation in canal management. While the diagnosis of the NWP is right, its prescriptions fail to address the serious economic and institutional vacuum within which the water sector is operating. Although the NWP has recognized the need to limit individual and collective water withdrawals, it has failed to identify the institutional mechanisms necessary for defining and enforcing such physical limits. Unfortunately, the new NWP declared in 2002—being almost a repeat of its earlier version—has also failed to address the major economic and institutional issues. But, this policy is still significant because of its explicit recognition of the role of private sector participation and the need for a paradigm shift from water development to performance improvement (GOI 2002). On similar lines, several states (e.g., Andhra Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu, and Uttar Pradesh) have also come out with their own water policy statements displaying the same flaws evident in their national-level counterpart.[27]

Project Selection Criteria

During the pre-Independence period, since the British treated irrigation projects as largely a commercial proposition, project selection policy was based on the Internal Rate of Return (IRR) criterion.[28] However, during the latter part of colonial administration, project selection criteria were relaxed with the distinction of projects in terms of their productive and protective character. IRR guided productive irrigation projects, where irrigation was provided throughout the year except during the canal closure period. Simple cost-based considerations guided protective irrigation projects, where irrigation was confined to a single season or to times of need. After Independence, there was a further shift in approach. Instead of a dominant commercial approach, irrigation projects were viewed as instruments for fostering socioeconomic development, especially by augmenting income, employment, and food production. Consequently, the IRR, which was initially lowered to 3.9 percent in 1949, was altogether abandoned in 1958 and in its place, a rather liberal benefit-cost ratio (BCR) was used as the project selection criterion. While the Gadgil Committee of 1964 recommended a BCR of 1.5, the Irrigation Commission of 1972 (GOI 1972) allowed a BCR of just 1 for projects in drought-prone areas. However, in 1983, following the suggestion of the Public Accounts Committee, the BCR was replaced by the IRR as the project selection criterion and the accepted IRR was 7 percent for projects in drought-prone and water-scarce areas and 9 percent for others. Admittedly, the reinstatement of the IRR is welcome. But, the minimum levels stipulated are far lower than the prevailing interest rate of about

[27]Let us also recognize that a mere declaration of policies may not mean much unless they are implemented to realize their impact at the field level. However, from the perspective of the long process of institutional change, the declaration of policy statements do signify a beginning of the change process.

[28]The actually used IRR was also based on the prevailing rate of interest in the London money market as irrigation investments were often made from borrowed funds. As a result, the IRR was also periodically revised, i.e., from 4 percent till 1919 to 5 percent during 1919-1921 and to 6 percent after 1921 (Sangal 1991).

10 percent. Besides, there are also cases where this project selection criterion was seldom applied or its requirements were compromised. As a result, although there were clear policies for project selection, they are not strictly applied for various political and socioeconomic reasons.

Cost Recovery Policy

As to the cost recovery policy in the context of irrigation projects, successive Finance Commissions since the Fifth one have insisted on the recovery of not only the full operation and maintenance (O&M) expenses but also a proportion of the interest on irrigation investment. While the Fifth Finance Commission suggested this proportion to be 2.5 percent, the two subsequent Finance Commissions have lowered this to just one percent. Although the Eighth and Ninth Finance Commissions were satisfied with just the recovery of the O&M costs, the Tenth Finance Commission reverted back to the stance of the Sixth and Seventh Finance Commissions, i.e., the recovery of full O&M costs plus one percent capital costs. This kind of cost recovery policy has also been supported by the Irrigation Commission in 1972 and the Jakhade Committee in 1987. The Committee on Pricing Irrigation Water in 1992 went a step further in recommending the recovery of not only the full O&M costs and one percent capital cost but also a percentage of the depreciation cost.[29] Unfortunately, the recovery policy, despite its widespread approval, was never implemented, as it involves not only an upward revision in water rates but also a radical change in the very method for determining them.

Water-Pricing Policy

While poor financial performance led to the recognition of the need for revising water rates, political pressure led to a delay in their implementation. The main reason why farmers resist higher water rates is the general perception of water as a public good. But, the 1972 Irrigation Commission has articulated, for the first time since independence, the private good characteristics of canal water. The Commission has also suggested that water rates have to be revised to cover, at least, 5 percent of gross income in the case of food crops and 12 percent in the case of commercial crops (GOI 1972). Despite the recommendation of this and several subsequent commissions and committees, the water charges actually recovered from farmers continue to form only a fraction of both the water productivity (i.e., the difference between the productivity levels of irrigated and rainfed lands) and the actual O&M costs.[30]

While the cost recovery role of water pricing policy was emphasized by many expert groups and statutory committees, the Jakhade Committee of 1987 has underlined the resource use efficiency function of water pricing policy. The Committee has suggested that if the method and level of water rates are such as to capture and convey the scarcity value of the resource, they can both induce efficiency and ensure full cost recovery at the same time. Although many states (e.g., Andhra Pradesh, Karnataka, Madhya Pradesh, and Tamil Nadu) have recently revised water rates up to three times, the present level and the method of fixing water rates is still unable to play these dual

[29]Although the 1992 committee suggested a larger cost recovery than its past counterparts, the recommendation is far short of full cost recovery, partly because of the interest and depreciation rates are far below the market rates and partly because of the underestimation of the O&M and replacement costs. The latter occurs due to historical underinvestment in actual O&M, which, in turn, contributes to higher replacement cost.

[30]Recovered water charges, as a proportion of O&M costs, vary from 4.02 percent in Uttar Pradesh to 73.33 percent in Orissa whereas the same proportion of water productivity varies from 0.28 percent in West Bengal to 5.19 percent in Maharashtra (GOI 1992b).

roles. These dual roles cannot be expected unless water pricing policy forms part of an institutional and technical arrangement needed for facilitating volumetric distribution, group-based allocation, and local management (GOI 1992b; Saleth 1996).[31] This institutional basis of water pricing policy is now recognized not only in current literature (e.g., Nagaraj 1999; Dinar and Saleth 2004) but also in actual reform programs (e.g., Andhra Pradesh, Karnataka, Madhya Pradesh and Tamil Nadu).

User Participation and Privatization

The policy towards user participation in irrigation management has evolved since 1974 when the Command Area Development (CAD) program was initiated to hasten the utilization of the created irrigation potential through farmers' cooperation. Additional efforts to mobilize farmers in canal areas were also made in the 1980s under the National Water Resource Management project funded by the World Bank. User participation under the CAD program was ephemeral and ineffective due to *ad hoc* attempts and the paternalistic attitude of the bureaucracy. But, the financial crisis and physical deterioration of the irrigation systems have forced the irrigation agencies to consider farmer groups as indispensable partners in irrigation management. As a result, farmers' role in outlet level water allocation, fee collection, and system maintenance was recognized and the policy of 'turning-over' the system below the outlet level was accepted in principle and also practiced with varying degrees of success (see Vermillion 1997; Brewer et al. 1999). But, the major change in the user participation policy occurred with the large-scale turn-over program of canal irrigation systems in Andhra Pradesh and Madhya Pradesh. To facilitate this, these states have also amended their irrigation laws by passing special acts. In many new and upcoming projects such as the Narmada and Sardar Sarovar projects, it is categorically specified that water will be distributed only to organized WUAs.[32]

The attention on private sector participation in the water sector has been an outcome of factors such as declining irrigation investment, poor financial performance of water projects, and the privatization of public sector enterprises initiated since the New Economic Policy of 1991. In 1995, the Union Ministry of Water Resources has constituted a high level committee to look into the legal, economic, and technical questions related to the privatization of public irrigation projects. This committee has submitted a report favoring a gradual, selective, and stage-wise process of privatization of the irrigation sector (GOI 1995). Similarly, the state government of Madhya Pradesh constituted a committee to look into the issue of sharing the primary benefits (water supply) and secondary benefits (power generation, tourism, aquaculture, and horticulture) between the government and the private parties involved in project construction and management. This committee has recommended that the primary benefits should be retained by the government but the secondary benefits can be given to private investors (GOI 1995:135).[33] The NWP of 2002, as approved by all states, has, in

[31]Volumetric allocation is not new as it was tried twice—in 1854 and in 1917 in the Ganga Canal—during the British period. Although the idea was abandoned because of its impracticality under the technology of that time, it has received periodic attention even during the post-independence period, especially since the Taxation Enquiry Committee of 1953. Conveyance structures conducive for volumetric allocation have also been established in recent projects such as Majalgaon Scheme in Maharashtra.

[32]In practice, however, this organizational requirement for water distribution has often been compromised either due to the lethargy of irrigation authorities or due to the pressures from influential local individuals and groups.

[33]The terms of benefits offered by Maharashtra are still better as the government has allowed also a 6 percent share in total storage in addition to the full rights on all the secondary benefits (Saleth 1997).

fact, encouraged the reliance on the private corporate sector as a potential partner for water resources development and management.

Water Administration

Water administration covers the organizational, financial, and managerial structures including the regulatory apparatus and conflict resolution mechanisms, which are directly connected to the water sector. Despite considerable variations in the name and structure of water administration across states, there are a few common features such as centralized and bureaucratic character, dispersed organizational responsibilities, and weak functional linkages. Some of these shared traits become apparent as we review the overall structure of water administration both at the national and state levels.

Organizational Framework

The general organizational framework of the Indian water sector can be briefly described by highlighting the key actors playing different roles both at the centre and in the states. The Union Ministry of Water Resources (MOWR), which itself evolved from the erstwhile Department of Irrigation under the Union Ministry of Agriculture, is the national organization that is responsible for the overall planning and management of the water resources in the country. The Central Water Commission (CWC), the Central Groundwater Board, and the National Water Development Agency—all under the MOWR—provide the overall technical support whereas the research and training support is provided by organizations such as the Water and Land Management Institutes (the name differs in some states), agricultural universities, and other research institutions. The Planning Commission at the national level provides project clearance and approves financial allocation to various water projects in different states. Other central agencies influencing the water sector, in one way or the other, include the ministries of agriculture, environment and forests, and housing and urban development.[34]

As noted already, the actual legislative and managerial responsibilities are with the public works, irrigation, or water resource departments at the state level. Usually, there are different departments to handle the groundwater and surface water sectors in the case of most states. The main department handling the water sector also has its own research and training facilities in some states. There are also important organizational arrangements to achieve inter-state and centre-state coordination. These include not only various river boards charged with the responsibility of coordinating water allocation among the concerned states in the context of few important inter-state rivers[35] but also the National Water Resources Council (NWRC) set up in 1983 and the National Water Board (NWB) set up in 1990.[36] The NWRC is an

[34]Understandably, the project approval and clearing process is not free from the political economy process. As a result, this process is not as effective as it is expected to be. However, in recent years, environmental activists, public interest litigants, and even donor agencies are beginning to exert considerable moral, legal, and financial pressures to improve the effectiveness of the process.

[35]Since these river boards, which were created under the River Boards Act of 1956, are bureaucratic arrangements—they are not to be confused with the stakeholder-based river basin organizations that are being advocated in recent years.

[36]The NWRC had only four meeting so far and the NWB had 11 meetings including a special meeting in 1994. The items discussed in the last meeting of the NWRC, for instance, include a water information bill, policy note on river basin organization, national policy on resettlement and rehabilitation, change in water allocation priorities, and approach to organizational changes in irrigation sector. Given the political nature of NWRC, its decisions on most issues remain inconclusive. However, the NWP of 2002 was passed unanimously after important compromises on inter-state water allocation issues. Given its composition, although NWB is less political, it is not completely free from the political process. For instance, the draft national policy guidelines for water allocation among states being considered since the special meeting of NWB in 1994 was considered as finalized for submission to NWRC only in 1997. But, this issue is still in the agenda for the next meeting of NWRC, the date of which is not yet certain.

important policy organ in the Indian water sector as it is the apex body chaired by the Prime Minister and includes the Union Minister of Water Resources and the chief ministers and the lieutenant governors of all states and union territories. The NWB—considered as the executive arm of NWRC—is chaired by the secretary of the MOWR and includes the chief secretaries of all the states/union territories, secretaries of the concerned union ministries as well as the Chairman of CWC. Although the state government (and, to some extent, the central government under few special drinking water-related programs) have a dominant role, local governments such as municipalities and *panchayat* (village council) unions also play an important role in drinking water supply. Donor agencies such as the World Bank actually try to enhance their role in urban and rural water projects as part of their strategy for decentralization. Similarly, while irrigation departments have a larger role in the provision and management of irrigation, users and stakeholder groups are also encouraged to get involved in cost recovery and management at the outlet and system levels. Pollution control boards operating usually under the ministry of environment and forests both at the centre and in the states have the responsibility for water quality aspects.

Financing and Management

Since water is a state subject, it is the states that are responsible for financing, cost recovery, and management of all irrigation and water-supply-related activities within their territory. They finance water development schemes from their own revenue, their share from the centrally collected revenue proceeds, and borrowings from financial institutions both within and outside the country. In recent years, some states such as Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, and Uttar Pradesh are also trying to mobilize funds from the private corporate sector as well as from the general public through deep-discount water bonds. As the cost recovery from irrigation and water supply projects is low and declining, many states are likely to rely more and more on such private and public sources of funds. Even though the states have the major responsibility for water sector financing, the centre also plays a significant role by providing finances to states through central assistance, undertaking the construction of projects of national importance, and implementing centrally sponsored schemes such as the CAD program in canal regions. Besides, the central government also facilitates, approves, and allocates external loans and aid to irrigation and other water supply schemes through the concerned organs including the Ministry of Economic Affairs and Planning Commission.

Although the central government is responsible for overall planning and coordination, the states are responsible for the actual management of the water sector. The state water administration—known variously as the Irrigation Department, the Public Works Department, and the Water Resources Department in different states—is responsible for the construction, maintenance, and management of water projects. Regarding water pricing and cost recovery, the administrative systems differ in different states partly due to historical reasons.[37] Water administration in many states also has diffused or unclear administrative and functional responsibilities inapt for developing an integrated approach to water management. Since water management responsibilities are often held by

[37]For instance, in Haryana, Punjab, Uttar Pradesh and West Bengal, the water rate assessment is done by the water-related department whereas the collection is done by the revenue department. But, in Andhra Pradesh, Karnataka, Kerala, Orissa and Tamil Nadu, both functions are performed by the revenue department. This administrative problem is due to the fact that in the case of most old irrigation projects in these states, there are no separate water charges, but only a higher land revenue assessment for irrigated lands.

ministries dealing with public works, internal transport, or public health, they are lumped together with activities such as road construction and port management. But, the activities that are to be aligned such as surface water and groundwater management and irrigation and water supply provision are dispersed across departments or ministries. This problem is addressed only partially by the recent organizational reforms in states such as Andhra Pradesh, Haryana, Tamil Nadu, Orissa, Madhya Pradesh and Uttar Pradesh (World Bank 1998). Despite the organizational reforms to the contrary, the spatial structure of water administration in most states is still based on administrative boundaries and projects rather than on any well defined hydro-geological boundaries.

Regulatory Mechanisms

While India has a relatively sound technical information base and expertise in water-related aspects, their utility at the practical level of regulation is extremely limited due to the lack of organizational arrangements for enforcement and monitoring. The top-down approach inevitable in any centralized administrative set up and the attendant inability to tap locally available informal institutional potential (e.g., water-related local customs, water sharing conventions, and monitoring and enforcement mechanisms) constrain effective enforcement of even well-conceived policies. While the well-spacing norm prohibits new wells within a radius of 200 m in most parts of India, the norm can be as high as 680 m in areas with deep tubewells and serious depletion (Shah 1993). Similarly, there are also depth restrictions, especially for deep tubewells. For instance, in Gujarat, as per the Bombay Irrigation (Gujarat Amendment) Act of 1976 (1979), tubewell depth was limited to 45 m, particularly for the Mehsana region. Later, the limit was not only raised to 100 m but also made applicable to most parts of Gujarat. Since these spacing and depth restrictions take effect only when a farmer applies for concessional loan/well permit/electric connection, they restrict mostly the poor farmers (Dhawan 1990).

While a restricted power supply policy provides some regulatory respite, it is of little consequence in the face of large pumps and multiple wells. The effectiveness of regulations based on power tariff and supply policies is severely undermined not only by the availability of the diesel pumpset option but also by the presence of a 'kink' in the power demand curve of farmers.[38] Although groundwater markets are found to improve efficiency and equity in water use (Shah 1993), they could, nevertheless, accentuate aquifer depletion under current legal and institutional regimes without water rights (i.e., legalized 'water quotas') (see Saleth 1996). Thus, current legal and regulatory policies as well as these markets reinforce rather than regulate the *de facto* control of groundwater by resource-rich and influential farmers. In the case of surface water resources, neither the usual policies based on water charge/supply manipulation nor the new ones based on rotational water supply are likely to generate sufficient impact effective enough to enforce discipline in canal water use. WUAs can certainly enhance cost recovery and improve system maintenance. However, they cannot generate incentives powerful enough to enhance water use efficiency unless they operate within the framework of a legally established but locally

[38]The kink in power demand emerges from the gap between energy cost and the net value of output per unit of power. As long as this gap is substantial and can also be manipulated by crop choice, farmers will not reduce power consumption and hence, their power demand will be insensitive to power tariff changes (Saleth 1997).

managed system of group and individual-specific water quotas.[39]

Conflict Resolution Mechanisms

Various arrangements exist for resolving conflicts at different levels. Water use prioritization specified in the NWP and implied in the constitution[40] can provide a general framework for resolving inter-sectoral water allocation conflicts. But, for a more effective solution, quantification of entitlements has to accompany prioritization and both should be defined within appropriate hydro-geological and organizational contexts. Unfortunately, the issue of quantification of entitlements is often left to administrative or political decisions. The most preferred arrangement requires the physical context of river basins and the organizational context involving stakeholder networks. In the case of inter-state (or inter-regional) water conflicts, the frequently relied on arrangement in the past involves negotiated agreements for developing/sharing water among the concerned states/regions.[41] But, when there is difficulty in reaching a negotiated settlement, the concerned parties can rely on the tribunal established by the central government under the provisions of the Inter-state Water Disputes Act of 1956.[42]

As the pressure for the renegotiation of existing agreements builds up with increasing water scarcity, the role of the tribunal mechanism is likely to increase in the future. Although the tribunal settles disputes by quantifying water claims, it involves a lengthy process to reach a final settlement. Even the six-year time limit specified by the 2002 amendment is too long given the urgency and gravity of disputes in some cases.[43] Besides, since the implementation of tribunal awards can be contested in the Supreme Court, it is crucial to provide legal binding to final awards. Although market or negotiation-based arrangements are not tried much in India, there is considerable potential for them. States can be encouraged to purchase and sell water either on a payment basis or on a barter basis (i.e., exchange of water for power or foodgrains). There are also cases such as the Krishna water transfer for Chennai (Madras) city where Tamil Nadu has paid for the entire project cost (implicitly paying for water).

As to the mechanisms for resolving water-related conflicts at the micro level, there are a few traditional and informal village-level institutions (e.g., tank-level organizations in Tamil Nadu). By rejuvenating these informal institutions as well as by strengthening the formal arrangements such as the *panchayat* institutions

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[39]Clearly, the need and urgency of such a water rights system are directly related to the transaction cost implications of water scarcity, water use inefficiency, and water conflicts. Thus, such a system may not be needed in water surplus regions. But, even here, if individualized water rights can be created with less cost, they can provide incentives and serve as an instrument to encourage water development and use. It is precisely for this reason that an officially granted non-transferable long-term individual water lease system was introduced in the deltaic regions of Orissa and West Bengal as well as in parts of Bihar and Madhya Pradesh—all known for water underutilization (GOI 1976:65).

[40]For instance, the constitutional provisions relating to fundamental rights to life (and clean environment) are often used as a basis for assigning top priority for drinking and domestic uses as well as irrigation and ecological water needs.

[41]There are about 58 independent water-related agreements among states concluded in the past—39 related to joint projects and 19 related to sharing of river waters—and all of these are under heavy pressure for renegotiation due to the increasing water requirements of concerned parties.

[42]Under this act, the central government has so far set up five tribunals and the three of them have come out with amicable decisions (Krishna in 1976, Godavari in 1979, and Narmada in 1979). Iyer (1999) provides a critical evaluation of the working of these three treaties. In the case of the tribunal dealing with the politically-sensitive Cauvery River dispute, there is only an interim award and this is strongly contested by one of the concerned states.

[43]For instance, in the case of Cauvery basin, the inability of Karnataka to deliver the required volume of water (due to rainfall failure in catchment areas) has caused serious disturbances to rice cultivation in most parts of the Cauvery delta in Tamil Nadu during the past several crop seasons. Such crop loss and farmers' unrest, and the brewing political animosity between the two states with its implications for the stability of the national government indicates what the magnitude of the economic loss and political damages could be, if the tribunal decision process continues over a six-year period. In such conditions, the time frame for tribunal decisions should not be more than two years.

and WUAs, it is possible to build more effective and accessible conflict resolution mechanisms at the grassroots level. However, the middle level conflicts across communities within a river basin or canal system (e.g., upstream users vs. downstream users or head-end users vs. tail-end users) as well as the conflicts between irrigation and water supply agencies are still rampant for want of proper forums for resolving differences. The arrangements forming part of the bureaucracy (e.g., divisional engineer or district collector) not only remain inaccessible for all but also turn out to be artificial as free expression of mutual concerns becomes difficult. A basin or system-level stakeholders' association involving user groups and officials can be a very useful forum for promoting both conflict resolution and accountability.

Water Institutional Structure: Micro Perspective

Although colonial policies as well as the post-colonial expansion of the government bureaucracy have severely eroded most of the indigenous water institutions, India still has a rich variety of locally managed water-related institutions, especially in water-scarce areas in Bihar, Maharashtra, Rajasthan, and Himachal Pradesh (Datye and Patil 1987; Sengupta 1993). These institutions are in the form of informal customs and conventions for water sharing as well as community-based organizations for water management. Although these institutions remain largely independent of formal water institutions and operate only at the periphery of the formal water sector, they can still provide very valuable insights for designing the kind of institutional mechanisms that are needed for filling the organizational vacuum existing at lower echelons of water management. In addition to these traditional arrangements, new forms of informal arrangements for sharing water and irrigation service have also emerged in recent years, especially in the groundwater regions. They are the rental markets for irrigation assets, groundwater markets, and myriad forms of water contracts. As these informal institutions—both the traditional and the emergent ones—have significant implications for the operation and performance of formal institutions, they deserve our attention.

Localized Institutions

Despite the fact that the legal system in India has not formally specified any water rights system, there are evidences for the operation of rudimentary water rights systems capable of being developed into an effective water rights system. Informal water rights—both for individuals and groups—have existed in India since ancient times (Siddiqui 1992) and continue even today, albeit in a much weaker form, in many tank irrigation systems of South India (Vani 1992). Some of the South Indian irrigation systems have informal and prioritised water rights not for individuals, but for different distributaries or command segments (Vaidyanathan 1985:63-64). The 200-year old *Phad* system operating in the Panijhra River area of the Dhule district and the the *Pani Panchayat* (water council) system being practised in parts of Purandhar taluk of Pune district, Maharashtra (Datye and Patil 1987:42-123; Thakur and Pattnaik 2002) have

the potential for creating a user-managed water rights system.[44] There are also a variety of other forms of cooperatively-operated and community-managed irrigation activities ranging from lift irrigation schemes in canal and groundwater areas to water harvesting and sharing arrangements in arid and mountain areas. Although these are well documented in existing literature (e.g., Datye and Patil 1987; Sengupta 1993; Singh and Bhallab 1996), their social and organizational potential for developing decentralized and locally-managed water rights systems are yet to be evaluated.

In the deltaic regions of Orissa and West Bengal as well as in parts of Bihar and Madhya Pradesh, there exists an officially-granted non-transferable long-term water lease system designed for encouraging farmers to use surface water (GOI 1976:65). More important and interesting is the *Shejpali* (water distribution roster) system being practised in the canal commands of western Maharashtra. Although this system is not enforced to the extent that it should have been, it shows the prevailing institutional potential for developing a form of water rights in the canal region. Under this system, the canal authorities issue 'water passes' on the basis of an application from farmers in the command on a 'first-come, first-served' basis. The duration of these water passes varies from six years to a single crop season and their priority varies somewhat directly with their duration (Gandhi 1981; Rath and Mitra 1989). Except for their non-transferability and quantitative specification, these water passes system closely resembles the water permit system practised in the mid-western states of the United States.

Rental Markets for Irrigation Assets

Over-investment on private irrigation assets (i.e., wells and pumpsets) by some farmers and non/under-investment on the same by others due to land, water and capital-related snags led to the emergence of the phenomenon of rental markets for irrigation assets. Since these markets allow farmers to irrigate their farms by renting the irrigation assets from neighbors, they contribute both to equity in water use and better utilization of irrigation assets. According to national sample survey information (NSSO 1984 and 1985), about 10 percent of the total pumpsets in the country are involved in pumpset rentals. Since about 63 percent of these rentals occur with dugwells/tubewells with electrically powered and permanently fitted pumps, it seems that the majority of the rentals involve water transfers as well. This is particularly so in the Indo-Gangetic and hardrock states. Since the rest of the rentals occur in the case of other water sources where pumps can be physically moved with little cost, it seems they occur independently of water transfers. This is particularly so in the deltaic states such as Bihar, Orissa, and West Bengal (Saleth and Thangaraj 1993).

The expanding phenomenon of pumpset rentals is an indication of the existence of surplus pumping capacity, particularly in the case of diesel pumpsets. In conditions where irrigation assets account for 16 percent of rural assets and up to 40 percent of private fixed capital formation in agriculture (Saleth and Thangaraj 1993), the underutilization of irrigation assets is a serious issue. The informal institution of rental markets has emerged essentially as a response of the farmers to address this problem. This

[44]Notably, under the *Pani Panchayat* system, the water share of users is based not on farm size but on water needs. Since water needs are calculated at about half an acre worth of irrigation per person, the allocation criterion is divorced from land ownership, but linked closely with family size (Singh 1991:35; Vani 1992:9-10).

phenomenon also brings forth certain conceptual and institutional implications. For instance, when there is the physical movement of pumpsets from one water source or location to another, they are just pure pumpset rentals as there is no water transfer between farms.[45] But, in the hardrock and Indo-Gangetic regions where pumpsets—mostly electricity-based—are permanently installed with dugwells/tubewells, pumpset rentals necessarily involve water transfers and hence, the rental activity is institutionally linked with groundwater markets (Saleth 1994b). Since NSSO data allows distinguishing pumpset rentals by electric and diesel power, it is possible evaluate the extent of the institutional linkages between pumpset rentals and groundwater markets. In view of the fundamental linkages between groundwater markets and rental markets, the expansion of groundwater markets in recent years also indicates a similar expansion of—either explicit or implicit—rental markets as well.

Groundwater Markets

Despite their localized, fragmented, and uneven nature across regions, groundwater markets are growing in magnitude and gaining in significance. While water selling practices in India are traced to the 1920s, more systematic documentation of this phenomenon started only since the late 1960s. Their characteristic features are that they occur without any formal water rights system and involve no sacrifice of self-irrigation.[46] While there is no systematic national-level study on the magnitude of water selling, based on his studies in Gujarat and Uttar Pradesh, Shah (1993:250) has projected the area irrigated through groundwater markets to be up to 50 percent of the total gross irrigated area under private lift irrigation. Understandably, there are considerable variations across regions. While the area irrigated through groundwater markets is projected to be up to 80 percent for north Gujarat (Shah 1993:205), the corresponding figure for Uttar Pradesh is about 60 percent (Shankar 1992:12). But, in Vaigai basin, Tamil Nadu, the area under purchased water was reckoned at no more than 30 percent of the total irrigated area (Janakarajan 1993). In contrast, there are also studies which report no water selling at all in their respective sample areas (see Shah 1993:55). Considering such regional variations and the potential bias in area/sample selection in most studies, it is more reasonable to consider the area under the influence of groundwater markets to be about 6 mha, representing just 15 percent of the total area under groundwater irrigation.[47]

Coming to the dominant technical and institutional features of water markets, although their geographic locus is limited by the physical characteristics of groundwater aquifers and farming systems, their size is often enlarged by elaborate underground pipeline networks. But, such market expansion is confined to very few regions and often leads to an unbalanced market structure as it adds more buyers than sellers to the market. Since buyers are mostly

[45]In their survey of few West Bengal villages, Kolavalli and Atheeq (1990:26) report such pure pumpset rentals where diesel pumpsets are leased on a seasonal basis with the lease rate per crop season varying between Rs 1,200 and Rs 1,500.

[46]Under these conditions, there is not only a conceptual issue (i.e., whether the sellers are selling water or excess pumping capacity) but also an economic question (i.e., the opportunity costs are undefined when there is no sacrifice of self-irrigation).

[47]This estimate has the following conceptual and empirical basis. Given the conceptual and institutional linkages between pumpset rentals and water selling, pumps being rented also involve water selling. In the case of dugwells and deep tubwells with electric and diesel pumps located in the hardrock and Indo-Gangetic regions, such water selling naturally involves groundwater. Given this fact and assuming that the extent of rentals observed by NSSO during 1976-1977 has doubled by now, about 20 percent of the 14.2 million pumps operating at present (i.e., close to 3 million pumps) can be expected to be involved in rental activities. Further, assuming that each of these pumps irrigates, on an average, 2 ha, the total area that is under the so called groundwater market can be about 6 mha. This can represent no more than about 15 percent of the total area under groundwater irrigation at present. For more details on the procedure, see Saleth (1998: 190).

small farmers, they have a weak bargaining position. For instance, a typical water sale-purchase matrix in Uttar Pradesh reveals that the demand side is dominated by smaller farms with less than 2 acres as they account for 81 percent of the total area under purchased water (Shankar 1992:33). In view of the monopolistic or oligopolistic tendencies in these markets, not only are the water rates several times higher than the pumping cost but also the price and non-price discriminations remain pervasive. The root cause for the sub-optimality of these groundwater markets lies not so much in their economic and organizational aspects but in the legal and institutional vacuum within which they operate at present. As a legally-instituted and locally-managed water quota system defined within an ecologically consistent overall withdrawal limit can provide more powerful incentives for water use efficiency, it could eliminate their negative effects while magnifying their positive benefits. The challenges, potentials, and opportunities for creating such a water rights system are discussed in detail elsewhere (Saleth 1994a and 1996).

Water-Based Contracts and Other Local Institutions

There are a variety of water-based tenancy contracts. Although these contracts are often treated as part of groundwater markets, they need to be differentiated as they involve the use of other resources such as land, labor, capital, and other farm inputs that are governed by distinct sets of other institutions. For instance, there are two distinct types of such contracts in Kheda district, Gujarat. They are: (a) a two-party contract where water sellers provide irrigation, share 50 percent of cash expenses (except labor costs), and claim 50 percent of output and (b) a three-party contract where water seller, land owner, and laborer share equally the cash expenses as well as crop output (Shah 1993:51-52). Similarly, in Karimnagar district, Andhra Pradesh, water sales occur as a part of different contractual arrangements such as labor contracts, crop sharing contracts, and crop and input sharing contracts. These contracts represent not only an institutional evolution of crop sharing within the context of groundwater markets but also link these markets with other rural input/output markets.

Apart from these water-based tenancy contracts, the pricing methods are also accompanied by certain informal conventions and contractual obligations with considerable implications for water use efficiency and risk-sharing (see Kolavalli and Atheeq 1990:38-40). For instance, although the area-based method involving crop shares provides lesser incentive for water conservation than the method involving hourly rates, it allows risk-sharing between buyers and sellers. It also involves some informal contractual obligation for sellers to provide irrigation for the whole season. Besides, in the case of both the area and per irrigation rates, there are also mutually agreed upon conventions (e.g., the level or intensity of irrigation constituting 'full irrigation') to avoid conflicts and water over use. Since water sharing contracts also lead to input selling/output selling contracts, there are also evidences for inter-linked input and output markets in rural areas (Janakarajan 1993). Thus, as the groundwater markets mature, they are getting more and more linked with other rural institutions.

To complete our discussion on the nature and operation of micro-level institutions, it is necessary to recognize many community and non-governmental initiatives in local-level water development, sharing, and management, especially in surface irrigation areas both in canal areas as well is in other ecologically fragile areas in dry and mountain zones. Some of them are spontaneous in nature—emerging from collective action by community groups and others have emerged through the efforts of community and non-governmental groups, including donor

agencies. These initiatives include water user organizations in few of the canal, lift, and tank schemes, community organizations in water sharing arrangements in mountain and desert regions, and *Pani Panchayat* and *Phad* system in part of Maharashtra. Most of these local-level water institutional arrangements are also well documented (e.g., Palanisamy and Easter 1983; Datye and Patil 1987; Sengupta 1993; Singh and Bhallab 1996; and Thakur and Pattnaik 2002). Although the area benefiting from these local initiatives is only a tiny fraction of the total area under irrigation, they are crucial for providing social and organizational models for similar initiatives elsewhere and even, for large-scale macro-level institutional arrangements. As these initiatives occur at the micro level essentially, as a response to local-level water-related challenges, they are largely divorced from institutional changes at the macro level. This does not mean, however, that they are entirely free from national and regional level legal, policy and organizational arrangements, as these arrangements do, in fact, serve as part of their institutional environment (Ostrom 1990). As a result, they can be promoted with appropriate legal and policy changes that are favorable to their functioning, success, and replication.

Evaluating the Performance of Water Institutions

The overall performance of water institutions depends not only on the individual effectiveness of the legal, policy and organizational components and their underlying institutional aspects but also on the joint performance as determined by the strength of the structural and functional linkages among these institutional components and aspects. Besides these internal and structural features, the performance of water institutions depends also on the general institutional environment within which they evolve and operate. While this perspective of evaluating water institutional performance is consistent with our institutional decomposition-based analytical framework, its empirical translation with objective information presents a major challenge. Nevertheless, this approach is amenable for empirical application when it is possible to use perception-based judgmental information collected from a carefully selected sample representing a cross-section of water sector stakeholders.[48]

When perception-based data cannot be collected due to the lack of time and resources, the alternative could be the reliance on the learned and balanced judgments of the researchers themselves. The key aspect for consideration in this respect can be the overall progressiveness of water institutions as captured in terms of their adaptive capacity, amenability for innovation, openness for change, and ability to tackle emerging and future water sector challenges (Saleth and Dinar 1999). As we reflect on these criteria over our brief description of the structure of Indian water institutions both at the micro and macro levels, we can derive a few general and qualitative results. For instance, we can see that micro-level institutions (e.g.,

[48]See Saleth and Dinar (2004) for an exposition of the theoretical justification of this approach and its empirical application using subjective and judgmental information from 127 water experts from 34 countries around the world. This study also can also provide valuable insights on how this approach can be used to measure the potential or expected performance of even the newly created institutions such as basin organizations and water banks.

groundwater markets) are relatively more responsive to changing local needs whereas macro-level institutions continue to lack the required extent of flexibility as changes are resisted by factors ranging from path dependency to political economy obstacles. Even within formal institutional components, water policy is relatively more responsive as compared to water law and water administration. Since the policy changes (e.g., water policy statements by national and a few state governments) are more in the nature of declaration of intentions or expression of aspirations rather than as attempts at practical implementation, they are politically easy to accomplish but operationally unable to deliver the intended economic benefits. But, policies related to more substantive aspects such as water pricing and inter-regional water transfers have not changed much. Similarly, in the sphere of water administration, changes such as administrative reorganizations are mostly superficial, whereas substantive aspects such as the oversized and functionally unbalanced staffing pattern, creation of basin organizations, and making water-related departments financially autonomous have not changed much.

From another perspective, water sector performance can also be used as a proxy for an indirect evaluation of water institutional performance. While the performance criteria applicable at the project and system levels are relatively more rigorous (e.g., Bos 1997; Burt and Styles 1997), those needed for evaluating the performance of water sector as a whole are more indicative rather than conclusive.[49] Recognizing this fact, we follow a simple yet meaningful approach of evaluating the overall performance of the Indian water sector in terms of three gaps: the physical gap, financial gap, and economic/incentive gap (Saleth 1996).[50] The physical gap can be evaluated both in terms of the gap between the water-resource potential and its utilization as well as in terms of the gap between water demand and supply.[51] The financial gap can be indicated in terms of the gap between water sector investment and cost recovery. Similarly, the economic/incentive gap can be reckoned in terms of the gap between the average value of water and the water rate being charged. Finally, while the physical gap is obviously evaluated for the water sector as a whole, the other two gaps are evaluated here only in the context of the irrigation sub-sector that uses up to 80 percent of total water withdrawals in India.

The utilization gap is already indicated in an earlier section as part of our discussion on the water institutional environment. The demand-supply gap that has already assumed serious proportions in local and regional contexts (e.g., Cauvery Basin, in southern India) is also growing at the aggregate level. In the particular context of the irrigation sub-sector, the demand gap is very serious as the actual irrigation potential created so far is only about 88 mha as against the gross sown area of 185 mha.[52] The problem is going to be complicated further by the declining share of irrigation caused by the increasing demand pressures from other water sub-sectors. From

[49]Even with well-developed objective performance criteria, water sector performance cannot be evaluated in all its dimensions due to the presence of crucial subjective and qualitative aspects of performance such as the smoothness of water transfers and the adaptive ability of water institutions. While proxies like the number of water conflicts can be used to capture this aspect, it is not clear, for instance, how one can factor in the evaluation aspect such as the relative seriousness of such conflicts.

[50]The underlying goals of the three performance criteria are respectively the physical and economic sustainability of the resource system, financial viability of the water sector, and the economic efficiency of resource use.

[51]Since the first gap indicates the physical sustainability of the resource system and the second one captures the economic sustainability of the water sector, these gaps together suggest the sustainability performance of the water system in a given context.

[52]Even if the estimated ultimate irrigation potential of 139 mha is fully developed, India will still continue to have this irrigation gap as the gross sown area is expected to grow further to 210 mha by 2025.

the perspective of institutional performance, what all these forms of physical gaps suggest is the fact that current institutions, particularly those related to inter-basin transfers, inter-sectoral allocations, and conflict resolution, are too weak to fill these gaps.

The financial gap in the water sector can be approximated by the difference between the total investment costs and total revenue in the canal irrigation sector. The total investment in canal irrigation during 1951-2000 is estimated to be Rs 790 billion at current prices (MOWR 2000). Even if we assume a simple rate of 8 percent to account for both interest and depreciation, the annual financial cost of canal irrigation provision comes to about Rs 63 billion. Although we do not have published information on the revenue from the canal sector, going by the estimate of the Committee on Pricing Irrigation water (GOI 1992b), we can reckon that the total revenue at present can be in the range of about Rs 3-5 billion. Such a huge financial gap clearly shows that the institutional aspects such as cost recovery and water pricing policies as well as the organizational mechanisms involved in water-charge collection are performing rather poorly.

Since the economic/incentive gap shows the extent that water charges remain below the economic value of water, it is clearly linked with the financial gap—especially water pricing and cost recovery policies. Water rates are not only very low but are also rarely revised, except in a few states, that too, only recently. As a result, they are related neither to productivity nor to provision cost. They cover hardly 5 percent of water productivity and 8 percent of O&M costs. Paradoxically, since the low water charges are not even fully recovered, the arrears are also accumulating over time in most states. Besides these effects on the financial side, low and uneconomic water rates also lead to an incentive problem causing widespread water use inefficiency. The incentive gap can be approximated by the gap among water productivity, supply cost, and water rates. In the context of canal regions, water productivity is reckoned in the range of Rs 714–5,812/ha and supply cost is estimated to be in the range of Rs 90–603/ha. But, water rates are in the range of Rs 6–1,000/ha (GOI 1992b). The incentive gap indicates not just the poor performance of pricing and cost recovery policies but also the absence of institutional conditions necessary for volumetric allocation such as water rights including their legal and organizational requirements.

Institutional Change: Nature, Extent, and Causes

The review of water institutional structure clearly shows that legislative powers, technical capabilities, planning skills, and operational responsibilities are dispersed across government layers. As a result, water institutions in India remain legally weak, functionally disjoint, and regionally uncoordinated. While the physical stress, financial crisis, and performance gaps have clearly exposed the legal, policy, and administrative weaknesses of the water sector, myopic political issues and administrative resistance continue to delay the implementation of the reform blueprint developed jointly by the GOI and the World Bank (World Bank 1998). Fortunately, this does not mean that there are no changes in the institutional sphere both at the central and state levels.

Nature and Extent of Changes

At the national level, the central government has constituted a number of national committees/ commissions to review specific water policy issues as well as plan for a long-term development of the water sector. Among them, the notable ones are the Committee on Pricing Irrigation Water (1992), Committee on Private Sector Participation in Major and Medium Irrigation Projects (1995), and the National Commission of Integrated water Resources Development Plan (1997). While the first one has revived the attention on the rationalization of water rates, volumetric water allocation, and system modification, the second one has documented the rationale, feasibility, and actual state level initiatives for involving the private corporate sector, especially in the construction and modernization of irrigation schemes. The national commission has developed a national master plan for the water sector by synthesizing and updating similar plans prepared earlier by the CWC as well as investigated the economic, technical, and institutional issues in the water sector from a national perspective.

Although these three initiatives seem to be like any other routine committees/commissions, they are very important as parts of the long process of water-sector reforms in India. In fact, some of their suggestions are reflected in the new NWP declared in 2002 with the consensus and approval of all states. It is true that the finally approved version is a substantially watered-down version of the draft of 1999 in view of the reservations expressed by few states, especially on statements related to water sharing. But, it does signify a consensus on two important policy issues that represent a somewhat radical departure from the past. These relate to the agreement on private sector participation in water resource development and on the need for a paradigmatic shift from water resources development to their allocation and management.[53] Besides the new NWP, there are also notable changes on the legal front—some initiated by the central government and others by public interest litigations by concerned individuals/ groups. To avoid the usual delay in tribunal decisions, the Inter-state Water Disputes Act of 1956 was amended in 2002 to specify a six-year limit for giving the final award. The Cauvery River Water Authority has been created to deal with the allocation conflict among the basin states.[54] While public interest litigations have invoked the Supreme Court to order the closer/relocation of many polluting industries on the banks of Yamuna and Ganges rivers, presidential intervention has invoked the same to order the central government to investigate the feasibility of linking major rivers.[55]

At the state level, there are also noteworthy changes, especially in the case of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, and Uttar Pradesh. These changes can be seen both in the

[53]It is necessary to qualify the 'consensus' that is being alluded to here, as these policy changes including the NWP of 2002 were brought about by the policy-makers and experts groups at the macro level without any public consultation with the participation of user groups and non-government bodies.

[54]This entity—patterned after the Murray-Darling River Basin Organization of Australia—is unique in the Indian context as this is the first time that a basin organization is chaired by the Prime Minister with the chief ministers of all the concerned states as members.

[55]This inter-basin transfer scheme—popularly known as the 'Garland Scheme'—has been proposed for a longtime not just by engineers and politicians but even by poets and other social thinkers. This scheme plans to connect 37 Himalayan and peninsular rivers through 30 links, 3,000 storages, and 12,500 km of canals. While this gigantic water grid that is expected to handle 178 billion m^3 of inter-basin water transfer will cost US$120 billion, it will add 35 giga watts of power and 35 mha of irrigated area. In fact, the NWDA has also been systematically investigating the feasibility of linking various rivers in the country for quite some time. The feasibility reports—covering both the socio-economic, environmental, and hydro-geological impacts—related to some of the segments of the inter-linking scheme are already available and others are being now prepared by NWDA through various research and technical institutions in India. Yet, this scheme is not beyond controversy given the legal thrusts, financial costs, political obstacles, and environmental consequences (see Iye, 2002). Clearly, this scheme makes it inevitable for the country to make sensitive decisions and tradeoffs.

organizational spheres (e.g., administrative reorganizations including the creation of basin organizations in states such as Tamil Nadu and Uttar Pradesh) as well as in the policy spheres (e.g., declaration of water policy statements by most states).[56] There are also more substantive changes in a few states. For instance, Andhra Pradesh and Madhya Pradesh have gone for a statewide program for the transfer of the management responsibilities of almost all canal irrigation below the outlet and minor levels.[57] Notably, such transfers occurred with the full legal backing under specifically enacted legislations. With the transfer of irrigation management responsibilities and the organization of regular elections and functional training to the office-bearers of WUAs, these states could also see their farmers accepting an increase in water charges up to three times and undertaking cost recovery and maintenance functions below the outlet level.[58] Although irrigation management transfers in other states are not of the magnitude observed in these two states, they do indicate both policy commitments and concrete actions for the devolution of allocation, cost recovery, and maintenance functions to WUAs (Joshi and Hooja 2000; Hooja et al. 2002). Admittedly, the progress in these states is obviously much slower. Even in states such as Andhra Pradesh and Madhya Pradesh, the effects are seen more in terms of cost recovery and system improvement rather than in terms of water allocation decisions and water use efficiency.

Other important changes at the state levels include the creation of autonomous corporations by Karnataka and Maharashtra for mobilizing public funds as well as the initiatives of Andhra Pradesh, Gujarat, Madhya Pradesh, and Maharashtra for soliciting corporate investments in the water sector. In 1994, Karnataka formed the Krishna Bhagya Jal Nigam Limited (KBJNL) under the Companies Act with the specific purpose of mobilizing public funds for developing the Upper Krishna Project. Thanks to the high return (about 17.5 percent) and government guarantee, the water bonds issued by the KBJNL during 1995-1999 have fetched an unexpected sum of Rs 23 billion.[59] Almost similar is the case with the Maharashtra Krishna Valley Development Corporation (MKVDC) floated by Maharashtra in 1996. The water bonds of MKVDC also promise a 17.5 percent return payable half-yearly with a maturity period of six years for the first 50 percent of the value and seven years for the remaining 50 percent of the value. Besides, these bonds also allow an up-front discount of 2.5 percent of their face value. As a result, the first public issue of MKVDC undertaken in July 1996 has fetched an amount of Rs 4.28 billion as against the original target of Rs 1.5 billion. Encouraged by such an overwhelming response, the Maharashtra

[56]It would be rather naïve to believe that the mere creation of basin organizations or the declaration of water policies would be sufficient enough to have an immediate impact on water sector performance. But, at the same time, from the perspective of institutional change as a long and sequential process, these initiatives do remain significant, as they create some of the necessary conditions for initiating additional changes in the institutional structure and an eventual improvement in water sector management and performance.

[57]For instance, under its Farmers' Participation in Irrigation Management Act of 1999, Madhya Pradesh has transferred outlet management responsibilities of all surface irrigation schemes to 1470 legally constituted and formally elected WUAs—466 in major, 158 in medium, and 846 in minor schemes.

[58]In the case Andhra Pradesh, the recent elections for WUAs have been postponed. Also, there were a series of amendments to the Farmers' Participation in Irrigation Management Act that have reinstated some of the powers back to the irrigation department. These factors are creating the impression that the reform process is gradually getting reversed.

[59]Since a high credit rating of these bonds has led to over-subscription, the KBJNL has revised down the return to 14.25 percent in July 1998. But, the fact remains that in real term, even this lowered rate is still high given the declining bank interest rates. More importantly, there is also the looming doubt as to the long-term ability of the KBJNL and MKVDC both to servicing and to repay the amount collected through these bonds. Much depends on whether such a financial burden will create pressure for improving their commercial viability and financial performance.

government has plans to mobilize over Rs 36 billion through MKVDC (Saleth 1999).

In addition to its efforts through MKVDC, the government of Maharashtra is also trying to tap direct investment from the private corporate sector. For instance, in 1996, it has invited private bids for 52 irrigation projects worth Rs 150 billion. Along similar lines, the governments of Andhra Pradesh, Gujarat, and Madhya Pradesh have also tried to tap the private sector both for the construction and modernization of a few water projects (GOI 1995). Interestingly, in its Agricultural Policy Resolution of 1995, the Government of Karnataka (GOK) has indicated its willingness to grant financial autonomy to the irrigation department by converting it into a corporation and making the farmers co-owners of the irrigation structure with 'water equity shares' (GOK 1995).[60] Finally, for completeness, let us also state that the changes in the informal institutions at the grassroots level are substantial. These changes are induced by both macro-level changes (e.g., irrigation management transfer) as well as the micro-level changes in conventions and contractual arrangements (e.g., irrigation assets and water sharing conventions).

Explaining Changes within a Transaction Cost Perspective

The observed changes within the institutional transaction cost framework outlined earlier, reveal some interesting insights into the role and relative significance of various factors motivating these changes in the Indian context. The socioeconomic consequences of widespread groundwater depletion, ecological costs of large-scale water development projects, storage loss from siltation, and command area loss to water logging and salinity have remained fundamental factors providing a strong economic motivation for water institutional reforms. Unfortunately, the financial and performance crises of the water sector have failed to gather the political economy thrust needed for prompting concrete actions. From an institutional transaction cost perspective, what this means is the fact that although the opportunity costs of inaction were high, the perceived political costs of taking actions were still high enough to undermine the reform initiatives.

Fortunately, there were a number of developments—mostly exogenous to the water sector—since the mid-1970s that have not only reduced the political costs but also magnified the opportunity costs of water institutional reforms. For instance, the earlier practice of making water policy subservient to the food self-sufficiency policy has lost its relevance when India eliminated food imports in 1971 and started building a comfortable buffer stock (often going beyond 20 million tons in recent years). Although the first NWP was prompted by the water-related phenomenon of the widespread drought of 1987, it is the political and media fallout associated with this natural event that, in fact, galvanized the necessary political will to declare even such a simple non-binding policy statement. But, the transaction cost calculus with respect to water institutional reform changed rather dramatically with the macro-economic crisis of the late 1980s and the subsequent declaration of the New Economic Policy of 1991 focusing on financial discipline, economic liberalization, and liquidation of public sector enterprises.

The major impact of the New Economic Policy on the water sector has been a radical decline in its budgetary share. For instance, the share of the irrigation sector alone has declined from 23 percent of total planned expenditure in the 1950s to 7 percent in

[60]The other states where this sort of change is more likely to take place in the near future are: Haryana, Rajasthan and Tamil Nadu (Gulati and Meinzen-Dick 1996).

recent years. In the wake of such budgetary cuts, water-related departments were forced to take a harder look into ways of cost saving and fund raising within the sector itself. At the same time, farm lobbies that were resisting water rate revision have also realized that farm income is getting increasingly affected by unreliable water supply from poorly maintained irrigation systems. It is these macro-economic conditions and their micro-economic consequences that have magnified the opportunity costs of reforms from the perspective of both the government and water users. The situation, therefore, has become favorable to revise water rates, involve farmers in cost recovery and system maintenance, and consider broader water-sector reforms. It is in this particular environment characterized by economy-wide reforms that the central government constituted the committees to look into issues such as water pricing and private-sector participation and the state governments went for options such as autonomous corporations and private-sector participation.[61] It is naïve to expect that these changes will have an immediate and straightforward impact. However, they are certainly complementing the micro-level changes such as the IMT and also paving the way for further institutional changes downstream (e.g., the proposal to compensate farmers for non-delivery of water made by the Planning Commission).

The revival of interest on many policies that were considered once as anathema or impractical (e.g., irrigation privatization, volumetric water allocation, water rights, and moving water into the concurrent list) indicates the changing balance in the policy debate. This is certainly a positive development and augurs well for the prospects of more substantive reforms in the future. From another perspective, the economic and trade liberalization policies initiated since 1991 have also produced significant scale economies in terms of their synergetic effects on water sector reforms. Since water-sector reforms form part of an economy-wide reform, the political economy costs of the former became a small proportion of the latter.[62] Meanwhile, international lending agencies (e.g., World Bank and Asian Development Bank) and research and technical organizations, e.g., International Water Management Institute (IWMI) and Food and Agriculture Organization (FAO) also have considerable influence on the nature and direction of water sector reforms. For instance, most of the organizational reforms, including the promotion of basin-based organizations observed in states such as Andhra Pradesh, Tamil Nadu, Orissa, and Uttar Pradesh, were introduced under different World Bank-funded projects. Similarly, the IMT processes in Andhra Pradesh and Madhya Pradesh were shaped, to a greater extent, by previous research on the incentive aspects of matching grants as well as on the organizational aspects of multi-tiered arrangements for linking water user groups.

The transaction cost and political economy-based explanations apply not only to the general institutional changes observed at the macro level but also to the specific institutional changes occurring at the state and local levels. For instance, groundwater markets have emerged as the private costs of their creation/emergence are lower than their private benefits to individual farmers. This does not mean that they are free from social costs such as the implicit/illegal sales of power, violation of the proportional sharing principle, and aquifer depletion (Saleth 1994b).

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[61]These changes in the case of Andhra Pradesh, Karnataka, and Maharashtra also have an ulterior motive as they use these unconventional means of financing water projects so as to establish their control over water resources in the Krishna basin before the tribunal award comes for renegotiation.

[62]This fact clearly underlines the transaction cost implications and strategic significance of timing and packaging the water-sector reform so as to make it coincide with and form part of a larger economy-wide reform program.

But, these costs have not entered into the transaction cost calculus because they are *perceived* by the state to be lower than the economic and political costs of creating the institutions necessary for regulating them. But, this reckoning cannot remain this way for long as the transaction cost calculus of groundwater markets may get reversed with new developments. We also note, while passing, that all the water-related local conventions and contracts that we have discussed earlier are also amenable for transaction cost-based explanations, though the calculus in these cases involves mostly private costs and benefits. Certainly, the net social costs of groundwater markets in terms of depletion effects and ecological and equity consequences are far higher than the net private benefits, especially in the hydro-geologically sensitive areas. Yet, these markets escape regulation because both the economic costs of creating an effective regulatory regime as well as the political costs of undertaking such regulation are still higher in the reckoning of the policy groups and political leaders.

The irrigation management transfer program implemented both in Andhra Pradesh and Madhya Pradesh also has a perfect explanation within our institutional transaction cost framework. While there are committed change agents on all sides—the state, bureaucracy, donors, research/training organizations, and the people, the actual forces for change have their origin in the changing political-economy realities of these states. The heavy fiscal burden of irrigation subsidy has convinced the state, the bureaucracy, and the donors of the need for transferring the irrigation system to farmer groups. The economic threats of an increasing productivity loss from the poorly-maintained irrigation system—documented well by research organizations[63] and personally experienced often by farmers—have convinced them of the key role that farmers, as a group, have to play in improving farm-productivity and system efficiency. Though it is seldom recognized explicitly, the political groups have also viewed the program as an opportunity to build their grassroots organizations and local groups found them as an additional avenue for assuming social status and power. Since the program is viewed as a logical part of the process of decentralization centered on the *panchayat* system (particularly in Madhya Pradesh), it is also perceived to have considerable political mileage for ruling parties, especially during the election years.[64] Thus, from the perspective of all stakeholders, the transaction costs were reckoned to be far lower than the opportunity costs (i.e., the foregone potential benefits) of not implementing this program in the particular institutional environment which characterized these states when the program was actually implemented.

While the Indian water sector is gradually coming out of the bureaucratic grip and myopic political considerations, it has not yet fully matured to be influenced mainly by economic and technical forces. Unfortunately, the divisive role of political factors is likely to increase, especially on the issue of inter-state water sharing, as most rivers in India are shared by two or more states. As the basin resources are fully appropriated, additional claims will be politically more acrimonious unless institutional arrangements are created to catalyze negotiated settlements and mutual agreements. But, the issue has become complicated by the proposed 'Garland Scheme' for linking rivers, especially

[63]International best practices and research-based knowledge produced by organizations such as IWMI have also played a catalytic role in reducing the transaction costs of irrigation management transfer programs, especially in Andhra Pradesh and Madhya Pradesh.

[64]The irrigation-management program in Madhya Pradesh was quicker and smoother than in Andhra Pradesh in view of the facilitative role of the decentralization process that was implemented before the transfer program. This is evidence for the advantage of sequencing two different but operationally related reform components in terms of the favorable effects of the earlier program on the transaction costs (especially its implementation cost component) of the latter program.

when the central government lacks the legal powers and political will to implement the scheme, though it has the technical and financial arrangements to complete most of the feasibility studies for various links. It is in this political vacuum and indecisive environment that the Supreme Court has been invoked to ask the government to report on the feasibility and prospects of this scheme. This legal injunction has, in fact, reduced the political transaction costs for the scheme, which is one of the long-term but somewhat tricky options for India to address its water-shortage problems.[65]

Concluding Remarks

Based on the Institutional Analysis and Development framework and the Institutional Transaction Cost theory, this paper has developed a new research paradigm and methodological framework useful for a strategic analysis of the structure, performance, and change in water institutions. This research paradigm underlines the strategic roles that factors both internal and external to the water sector and water institutions play in minimizing transaction costs and maximizing the prospects for institutional reforms within the water sector. Understandably, the nature and importance of these factors can vary by the level of analysis (macro and micro), water sources (groundwater and surface water), or water sub-sectors (irrigation and urban/rural water supply). Similarly, the relevant transaction costs, the groups reckoning these costs, and the groups undertaking the changes can all change considerably by context. However, the basic framework proposed in this paper can be generalizable with suitable adjustments to a wide variety of contexts and situations.

Despite our selective and eclectic review of the Indian water institutional structure and the indirect and tentative way of evaluating its performance, our attempt does leave a few interesting observations with considerable implications for both institutional economics theory and water-sector-reform strategies. The present structure of water institutions in India, as reviewed in terms of some of their major institutional components and aspects, shows that it is far from the system that is required for the country to meet its water challenges at present and in the future. This observation is reinforced further by the substandard performance of water institutions, as evaluated indirectly in terms of the overall physical, financial, and economic performance of the water sector. However, there are notable reform initiatives to strengthen the water institutional structure and improve its performance. These initiatives, undertaken especially since 1991, provide observational evidence for the fact that reform benefits (or, opportunity costs of inaction) are exceeding the corresponding economic and political transaction costs. But, the fact that institutional changes are uniform neither across institutional components nor across water sub-sectors suggests that both the opportunity and transaction costs vary across institutional and sectoral contexts.

The nature, extent, and coverage of institutional reform clearly provide evidence for the powerful effects that exogenous factors (e.g.,

[65]The issue of whether this Scheme is sensible on economic, environmental, and political terms requires a separate and exclusive analysis. Neither the present occasion nor the space here is appropriate to do justice for such an analysis.

economic liberalization policies, political forces, international financial and research institutions, and natural calamities) have on the opportunity and transaction costs of institutional change within the water sector. Notably, the initiatives undertaken initially involved only the easier transaction cost-wise and ceremonial options (e.g., declaration of water policy, constituting committees, and marginal legal amendments). However, those undertaken in recent years involved politically difficult and substantive options (e.g., administrative reforms, basin organizations, irrigation management transfer, and reliance on autonomous corporations and the private sector). But, India is yet to move to the stage of embarking on real reforms (e.g., review of centre-state relation in the water sector, declaration of an exclusive water law, creation of water rights system at various levels, and administrative reforms for water sub-sectoral coordination, staff resizing, and balanced functional specialization). Understandably, these reform options involve heavy economic and political transactions costs. Although these costs are lower than the potential performance benefits, the differential weights assigned by political leaders often distort the transaction cost calculus.

While India has to go a long way to set right its water institutional structure, from the perspective of a stage-based process of institutional change, the changes observed so far do signify that India is on the threshold of ushering in the substantive phase of institutional reform.[66] This observation is based on four reasons. First, although the observed changes are slow, partial, and inadequate, their direction and thrust are on desired lines. Second, the nature and tenor of these changes—both already observed and those proposed in an approved reform blueprint (World Bank 1998)—indicate a clear commitment of the central and state governments to move ahead with the process of institutional change. This commitment is likely to be strengthened further by additional pressures from factors both endogenous and exogenous to the water sector. Third, as the already initiated reforms begin to yield benefits, strengthen pro-reform constituencies, and reduce the technical and political costs of transacting additional reforms, the incentive balance within the institutional transaction cost framework is likely to move toward further reforms. Finally, but, more importantly, since the path dependency properties of institutional change will ensure that it is costlier to return rather than to go ahead in the reform path, further reforms are more likely to be undertaken. Although the reform process can be delayed, it can neither be stopped nor reversed.

While the prospects for undertaking higher-level reforms are brighter for India, there is an indispensable need for a clear and long-term strategy for reform implementation. In this respect, some of the key insights from cross-country analyses of water institutional reforms (e.g., Saleth and Dinar 2000 and 2004) can be used both for reform design and implementation. These involve the issues of timing to strategically exploit the synergy effects from exogenous factors, scale-related effects of institutional inter-linkages (e.g., links between WUAs and pricing policy and WUAs and volumetric allocation), and institutional sequencing and packaging (e.g., undertaking easier reforms first and implementing related programs together). As the transaction cost declines and political balance improves as we move on the institutional change continuum, it is prudent to pursue a logically linked sequential

[66]As per the theory of institutional change proposed by Saleth and Dinar (2004), the change process involves circularity with four distinct stages, each with different dimensions of time and configuration of drivers. These stages are marked by mind change in terms of perceptional convergence among stakeholders as induced by both objective and subjective factors, procedural and ceremonial changes, actual and substantive changes, and the realization of actual performance benefits. From another perspective, the first stage is where the demand for institutional change emerges, and the second and third stages are where the supply of institutional changes occurs.

reform strategy wherein water sub-sectors and institutional components are prioritized in terms of their performance impact, facilitative roles for downstream reforms, and political acceptability. Since such a strategy can exploit better the synergies from both institutional inter-linkages and exogenous factors with proper timing, packaging, and sequencing, it has a better chance of success, that too, with the least social cost and political opposition.

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