Whose water is it anyway? Water management, knowledge, and equity in Northeast Brazil

Maria Carmen Lemos

Water management has historically posed exceptional challenges of equity and justice to policymakers around the world. Lately, the potential exacerbation of water scarcity and water related disasters in the wake of global climate change has upped the stakes for the vulnerable poor who are expected to endure the brunt of its negative consequences (Kates 2000, Adger et al. 2003). Because they are less able to mitigate and adapt to the negative consequences of water regime change, less developed countries have become the focus of attention and the locus of policy experiments that seek simultaneously to improve short-term water management efficiency and to promote long-term sustainability and adaptability.

Increasingly, albeit slowly, water management has moved from a mostly technical and elite-dominated affair to a process where decentralization, privatization, and stakeholder participation have become prevalent goals (Gleick 2000, Ribot 2002). This new paradigm of water management has sought to design and implement institutions that are democratic, economically viable, responsive to future change, and that lead to long-term sustainability. Efforts to implement water management reform are going on in places as diverse as Chile, South Africa, Mexico, and Brazil with different levels of breadth, commitment, and

achievement (Wester, Merrey, and deLange 2003, Bauer 2004, Brannstrom, Clarke, and Newport 2004, Lemos and Oliveira 2004). Water management reforms—in accord with the Dublin Statement of 1992[2] —have been heavily promoted by organizations such as the World Bank, the Organisation for Economic Cooperation and Development, and the United Nations.

Water management reforms have ranged from the privatization of water supply and basic sanitation to the implementation of full-fledged water markets. Two aspects of this effort speak directly to equity issues. The first is a push to reframe water as a common good with economic value, i.e. a good for which users should pay. While water tariffs to recover operational and management costs of water supply and basic sanitation have been conventionally applied to consumers for generations, the new paradigm focuses on bulk water charging, sparking a debate among users, policymakers and a broad range of stakeholders, especially environmental non-governmental organizations (NGOs). In principle, if users are made to pay for a good that they have customarily been able to access free of charge, they will be more likely to conserve it. However, the manner in which pricing schemes are negotiated, set, and implemented has a profound impact on the equity of distribution, access, and costs for different classes of users.[3]

The second aspect of water management with deep equity implications, and the focus of this chapter, is the push for the creation of participatory

institutions such as stakeholder councils in decision arenas that were previously dominated by the possessors of technical expertise. A common assumption behind the expectation of successful stakeholders' councils is that participation *matters* both in terms of outcomes and processes. That is, stakeholders' involvement contributes to solving the problems that brought them together and promotes desired practices such as democratization, transparency, and accountability in the context of policymaking. Yet, empirical evidence on the ability of stakeholder partnerships to reach these goals has been mixed (Leach, Pelkey, and Sabatier 2002, Manor 2005).

Scholars have identified a variety of reasons behind such failures ranging from the insincerity of some participatory schemes—for example, participation that is meant to 'legitimize' certain policies in the eyes of funding agencies— to the unequal organization of stakeholder groups and the difficulty of including a representative array of stakeholders in the councils (Mohan and Stokke 2000, McEwan 2003, Wester, Merrey, and deLange 2003, Abers and Keck 2005). These problems have appeared in the case of water councils, where members have not participated effectively, key social groups—especially the poor—are not effectively represented, and councils are unable to define and carry out agendas for action (see for example Wester, Merrey and deLange 2003, Lemos and Oliveira 2004, Formiga-Johnsson and Kemper 2005). Equity implications of stakeholder involvement include tradeoffs between different users (large vs.

small, upstream vs. downstream, public and private, current vs. future users), uses (e.g. irrigation, shrimp farming, recreation, water supply, etc), and type of problem (pollution vs. scarcity).

At its best, stakeholder involvement may increase the level of equitable allocation, democratization, accountability, and transparency of water management. At its worst, it may threaten resource sustainability and equitable distribution by allowing a few elite actors to "capture" the decision-making process at the expense of other stakeholders. In this process, the use of technoscientific information has the potential to shape both policy outcome and policy process.

On the one hand, knowledge can contribute to more effective management by informing stakeholders about system capacity and fluctuations, potential disruptions to resource availability (e.g. drought or flooding), implications of intra- and inter-basin water transfers, long term availability, and intergeneration implications of different levels of resource use (i.e. climate change impact scenarios). It can also inform stakeholders about the implications of water quality for current use and future sustainability of water resources and support decisions regarding water zoning plans and pricing schemes. Moreover, the ability to transfer knowledge and adopt innovation is an essential factor in building adaptive capacity to climate variability and change (Smit, Burton et al. 2000). In this sense, knowledge can potentially improve effectiveness and democratize

decision-making since better-informed stakeholders can make better-informed decisions.

On the other hand, if controlled by a few actors seeking to bolster their position vis-à-vis other stakeholders, knowledge can insulate decisions and exacerbate power imbalances between those with access to knowledge and those without that access (Lemos 2003). In such cases, knowledge can have critical implications for the "elite capture" of the decision-making processes, which in turn can affect issues of equity and justice in water management. Here, the difference between democratization and insulation rests on the rules of engagement of stakeholders and the practices regarding the availability and accessibility of knowledge.

In this chapter, I argue that while the emergence of a new paradigm of water management in Brazil including the creation of stakeholder river basin councils has opened the door for broader societal participation, it is the availability and accessibility of knowledge that has the highest potential to make this participation effective. In other words, although formal institutional rules are a necessary condition for participation, they are by no means sufficient to foster effective participation, both in terms of outcome (i.e. more efficient and equitable management) and process (i.e. more democratic, transparent, and accountable decision-making). Moreover, in the context of Brazil's dysfunctional insulated policymaking—in which water agencies' decisions may be grounded

simultaneously in technical criteria and vulnerable to political interference—the control of knowledge production and knowledge use has had deep implications for the equitable distribution of resources.

I discuss an experience of technoscientific knowledge use in water negotiation and allocation using data collected in the context of ongoing field research in the Lower Jaguaribe Banabuiú River Valley (LJBV) in Ceará, Northeast Brazil.[1] In this valley, a water user's commission (Comissão de Usuários) has been actively negotiating reservoir water allocation for the past ten years. To support water allocation meetings, the Water Resources Management Company (Companhia de Gestão dos Recursos Hídricos—COGERH)—Ceará state water management agency—routinely puts together reservoir scenarios to inform different groups of stakeholders (including water users) of the projected availability of water for upcoming seasons. Once a year, stakeholders and COGERH técnicos meet and based on the scenarios, they: a) debate different potential amounts of water volume, water loss (e.g. through evaporation), and discharge and their consequences for short and mid-term water availability (which in turn depends on the likelihood of drought); b) negotiate between different kinds of uses and needs for the allocation of water resources; and, c) try to build consensus around the volume of water which will be available to be discharged from the valley's two main reservoirs.

The implications of the negotiated allocation process to the issues of the equity of water distribution in the Lower Jaguaribe Banabuiú River Valley are twofold. First, the extent to which different kinds of uses and interests (including intergenerational) are represented or not in the context of the users' commission has a profound effect on the level of equitable distribution of resources and sustainability of the system. While the current allocation model seems to be significantly more participatory than previous management schemes in Ceará (Lemos and Oliveira 2005), the level of inclusion and representation of stakeholders has recently been the subject of closer scrutiny (Ballestero 2004, Taddei 2005).

What new evidence shows is that despite more participation, the inclusion of non-elites—such as small farmers, rural workers and rainfed farmers—has been thwarted both in terms of representation (they are less represented) and influence (they exert less influence during the allocation meetings). Second, the extent to which the use of technical knowledge either democratizes or further insulates decision-making shapes the level of access of different stakeholders not only to effective decision-making but also to water. Here, despite the effort from local técnicos to improve communication and availability, there is evidence that a substantial number of stakeholders find technical information neither available nor accessible. Moreover, there is a widespread perception of técnicos as the most

powerful actors in the water management process, more powerful than either economic and political elites.

In the following sections, I will briefly examine these issues focusing on the equity implications of knowledge use in the context of Brazil's water reform. Sections two and three will respectively describe the patterns of technical information use in policymaking and the water management institutional environment in Brazil. Section four examines decision-making strategies, the use of technical knowledge in water management in Ceará, and their implications for equity issues. Finally, I conclude with a few preliminary findings and suggest new areas for further research.

Technocrats And Politicians: Policy Insulation and Accountability.

Historically, technical decision-making has dictated water management in Brazil. Especially in Northeast Brazil, but also in other regions, those trying to solve water-related problems provided privileged solutions that continuously upgraded increasingly complex infrastructure systems. This approach to water-related problems was firmly grounded in a technocratic and exclusionary decision model that often shaped policymaking in Brazil (Schmitter 1971). The technocratic tradition goes back to the 1930s when, as a consequence of the modernization of

the state, a strong bureaucracy emerged based on the multiplication and expansion of both public and private organizations. As I have argued elsewhere,

> While in the classic Weberian model politicians and bureaucrats play very distinct roles, that is, politicians make policy decisions and bureaucrats implement them, in Brazil, the line between politics and bureaucracy has been purposely blurred under the guise of improving "efficiency" in policy-making. The underlying assumption was that politicians, because of their vulnerability to electoral politics, might fall prey to special interests and clientelistic relationships, which, in turn, could lead to biased policy decisions. Bureaucrats, on the other hand, because they are bound by their expertise and, in principle, should have no political agenda, are much more qualified to make the 'best' policy decisions and implement them efficiently. (Lemos 2003, 109).

Hence, throughout Brazil's republican history, but especially in the 1960s and 1970s, political leadership (both democratically elected and authoritarian) attempted to insulate bureaucratic systems as a strategy to foment development. By singling out some agencies and providing them with financial and human resources unavailable to the bulk of the "common" bureaucracy, these leaders

expected insulated technocracies to perform at a higher level of competency than other sectors of the government. Insulated agencies attracted high quality professionals by offering market competitive wages and fringe benefits, by adopting strict meritocratic selection and promotion processes, and by "protecting" their decision-making from traditional political meddling. The technocracy differed from traditional bureaucracy to the extent that its performance depended on specific technical and professional expertise. Most importantly, they operated from decentralized agencies (public and mixed enterprises and autonomous entities) that were relatively protected from practices such as clientelism, nepotism, the spoils systems, and corruption (Nunes and Geddes 1987).

On the one hand, insulation contributes to effective implementation of policy because it preserves material and human resources, and the commitment necessary to implement reform (Geddes 1990). This, in turn, increases autonomy and hence state capacity. Still, "capacity-enhancing reforms…occur only when the political leaders who must initiate them can expect to benefit from the reforms enough to outweigh the cost of losing the electoral advantages provided by the distribution of patronage" (Geddes 1990, 218). Therefore, it is not surprising that the most encompassing period of bureaucratic insulation in Brazil coincides with that of authoritarian rule when the military and their appointed governors were not vulnerable to election results.

On the other hand, insulated technocracies operate virtually unchallenged. Technocratic decision-making may defy basic precepts of democracy by limiting the number of participants and policy alternatives and rendering technocrats unaccountable to elected officials and clients (Etzioni-Havely 1983). Not surprisingly, tensions between insulation and accountability have had a lasting, mostly negative, effect on Brazil's democracy and the equitable distribution of resources (Reis 1990). Even after the transition to democracy, many technocratic agencies were able to maintain their legitimacy by articulating their authority in terms of their technical expertise (Lemos 2003).

Yet the level of insulation achieved by technocratic agencies has varied significantly through geography and time. While a few federal agencies were able to protect their integrity for the most part (Nunes and Geddes 1987), other agencies, especially at lower scales of government, were subject to a combination of insulation and political meddling that mirrored the broader policymaking environment in Brazil. In other words, even within insulated agencies, the level of political meddling would vary with specific policy areas and through time. For example, within the same agency, some projects would be more insulated than others. The election of a new government could bring serious threat to levels of insulation even if the agency’s goals and technical cadre remained relatively untouched (Lemos 1998, Lemos and Oliveira 2004).

This pattern of dysfunctional insulated policymaking has historically shaped water management in Brazil. Decisions were both firmly grounded in the technocratic model and at the same time vulnerable to the interference of politics and outside actors whose agendas did not necessarily correspond with what técnicos had determined to be the "best possible solution" (Lemos 2003). In Northeast Brazil, for example, the implementation of the infamous "hydraulic solution"—that is, policies that favored the construction of reservoir and canals to store and transport water to deprived areas—was attractive because it simultaneously met technocrats' ideas of technical progress, provided politicians with the opportunity to accrue political capital (through both pork-and-barrel and clientelitic distribution of benefits), and met the interests of large contractors who stood to be retained as service providers. For example, in Ceará alone, some 7,000 reservoirs were built with public resources. While a few were massive public works projects planned to normalize water flows and redistribute water across the region, the majority were located on private property where public access and the benefits were limited for those who were the most vulnerable to water shortage (Garjulli 2001).

While, ideally, technical knowledge can allow for a more transparent and better-informed decision-making, in Ceará (and in other regions of Brazil), it insulated decisions and alienated stakeholders. Access to and use of knowledge in Ceará was not equal. It favored those with power relationships and institutions. As

technical analysis becomes more prominent than other informational input (including opinions and interests of non-technical sources), it may "squeeze out other forms of information, decision-making routines, and claims" (Healy and Ascher 1995, 13). Indeed, when trying to gain political advantage, groups may be tempted to exaggerate or distort information when that information serves to support the interests of one group over another.

Water Reform and Institutional Change

In the 1990s, the Brazilian government initiated a reform process that replaced the previous centralized, top down and sectoral system with a decentralized, participatory, and integrated model that adopts the river basin as the main unit of water management. While a few states started the reform as early as 1992, it was not until 1997 that the federal government enacted Law 9,433 also known as the "Water Law" (Lei da Águas). It instituted the National Policy for Water Resources and created the National System for the Management of Water Resources. It also created a National Water Agency (Agência Nacional de Água—ANA) that both oversees the application of the law and has jurisdiction over the management of interstate river basins.

Despite quite different rates of implementation across Brazil's twenty-six states and numerous river basins, the new legislation has "shaken up" water management nationally. The new legislation introduced management mechanisms

more in tune with the democratization of state-society relations following the demise of the Brazilian military dictatorship in the mid-198s. It was also more in accord with the new water management paradigm spelled out in the Dublin Principles. These included (with significant variations across states and river basins both in terms of institutional design and degree of success): a) the organization of management at the river basin level, overhauling a previous system that favored state and federal jurisdictions; b) the creation of specific regulation to protect water resources at the river basin level; c) the decentralization of decision-making and resources—the design of a new system of water use permits and charges and the creation of different scales of public participation—especially the organization of river basin-level councils and State and National Water Councils; d) the insertion of water resources management within a larger realm of environmental concerns that challenged the traditional supremacy of economic criteria in the management of water; and, e) the understanding of water as a public good but also an economic good—for many, the most debatable and controversial aspect of the new legislation.

One particularly novel aspect of the law has been the creation of basin level councils whose tri-part membership represents users, organized sectors of civil society and the state, although the proportion of each sector varies widely across states and river basins. River basin councils' responsibilities vary considerably across basins and include designing and implementing bulk water

permit and charging systems, approving river basin management and water zoning plans, and facilitating conflict resolution among users.

The Brazilian system, although based on national regulation, has followed a highly federalized model that has afforded much flexibility to states to design and implement institutions that better 'fit' the characteristics of their water resources and socio-political systems. Thus, different states have pursued different strategies and created different structures to manage their water resources. The state of Ceará, for example, created a separate Users Commission that works in parallel with the more "official" River Basin Committee. This has not only increased the opportunity for users' participation but also has been hailed as a model of successful river basin-level management (ANA 2002). CEIVAP, the federal committee created in the Paraíba do Sul River, in turn, has managed to implement a user-fee system that is funding the basin's operational agency (Formiga-Johnsson, Kumler, and Lemos 2006).

With 90% of its territory located within the Brazilian semi-arid and with an average rainfall of 400 mm in the hinterland and 1,200 mm in the coast, Ceará is among the driest and poorest states in Northeast Brazil (Lemos et al. 2002). Traditionally water policy and drought planning have been highly politicized and closely related to the region's infamous "drought industry," that is, the unscrupulous use of drought-relief funds for private gain. As mentioned earlier, in Ceará, part of the problem was an antiquated water management system that

traditionally had focused on infrastructure building and had often been used as political currency. The situation changed in the early 1990s when ahead of most Brazilian states and even before the federal government, the state of Ceará started to reform its water management. As part of a series of reform-oriented state administrations, (Tendler 1997) and in response to a long period of drought which threatened water supply to the capital city of Fortaleza, a concerted effort was directed to design a new set of institutions to manage the state's water resources (Lemos and Oliveira 2004). This included the hiring of expert consultants as well as the study of state-of-the-art management options being implemented in other parts of the world.

At about the same time, the government of Ceará approached the World Bank with a proposal for the Bank to finance new water infrastructure, including the construction of new reservoirs in areas not covered by the existing network (Kemper and Olson 2001). The Bank agreed but insisted on a few conditions. The first condition was that the state implement and use the instruments outlined in the new law, including the creation of river basin committees and the introduction of tariffs for all water users (including irrigation). The second condition was that the state create a water resources management company (Kemper and Olson 2001, 342). As a result, COGERH was created in 1993 with financing from the World Bank as an attempt to avoid the common pitfall of "paper laws," that is, reformist legislation doomed to failure because of lackluster or inadequate implementation.

COGERH's responsibilities include the monitoring and management of Ceará's water resources, maintenance and operation of the state's water infrastructure, and the implementation of the institutions of the new water resources law including the organization of users across the state's eleven river basins.

COGERH followed Brazil's traditional model of insulated technocracy in which political leadership purposefully insulated agencies—created under the guise of technical expertise, meritocratic hiring, and plenty of resources—from the maladies of the inefficient public sector associated with third world bureaucracies. However, in one aspect, COGERH was critically different from other 'technical' agencies: at the insistence of outside consultants, the agency included social scientists in addition to the usual makeup of engineers and hydrologists associated with water management agencies. Thus, "the combination of social and physical scientists within the agency allowed for the amalgamation of ideas and technologies that critically affected the way the network of technocrats and their supporters went about implementing water reform in the state" (Lemos and Oliveira 2004, 2127). In the mid-1990s, COGERH started to put together reservoir scenarios to support water management. These scenarios became a valuable tool in supporting stakeholders to negotiate the allocation of water resources among different users.

In this context, new ideas and technologies may work as a critically enabling tool. Indeed, in the case of COGERH, technical knowledge was

instrumental not only in informing the creation of many of the organizational schemes pursued by COGERH técnicos but also in inviting mobilization from users who perceived their participation as meaningful and effective. One particularly innovative aspect of COGERH's organization of management at the river basin level was the creation of Users' Commissions that—in addition to the more institutionalized river basin committee envisaged in the legislation—would be able to participate directly in water allocation decision-making. As mentioned earlier, the Commission meet periodically to evaluate and plan for water use at the river basin level and function in parallel to the river basin committee. It is also within the context of the Commission that technoscientific information has been used to inform water allocation decisions among different users, especially irrigated farmers, large agribusinesses, and water utilities. After ten years and an effective decrease in the level of water use and conflict (Formiga-Johnsson and Kemper 2005), the Ceará case is hailed as the model to be followed in Northeast Brazil, and possibly other semi-arid regions of the world.

Management, Equity, and Technical Knowledge

Similar to other areas of the world, water systems in Brazil pose significant challenges to policymakers in equity terms: (a) they are subject to multiple, sometimes contradictory uses, (b) a wide variety of users depend on water

resources at diverse levels of need, (c) management systems span different scales and many times have overlapping jurisdictions, and (d) resources themselves are subject to different levels of stress, scarcity, and depletion (Rayner et al. 2002). In the context of water scarcity prevalent in Northeast Brazil, several equity issues rest at the heart of water management:

i. *Conflict between different kinds of uses including irrigation, fisheries, water supply, basic sanitation, and industry*. Within these user categories, there is further conflict between large and small users. For example, in irrigation, there is a conflict between agribusiness, medium and small irrigation perimeters, and rainfed agriculture that relies on humid areas around reservoirs to plant. Although all these groups depend on reservoir water, their needs in terms of volume and timing of discharge vary (see next section).

ii. *Intrabasin transfer and resources distribution*. In Ceará since water is scarce and badly distributed (the Jaguaribe is the only "normalized" river in the state), the state built a complex system of reservoirs and canals to reallocate water in the region. For example, the capital city of Fortaleza, the largest consumer in the state, depends on transfers from the Jaguaribe to supply its residents and industrial users. The metropolitan basin of Fortaleza is also the biggest generator of

revenues from bulk water charges in the state, virtually financing the water management system in place—including COGERH. Thus while users from Lower Jaguaribe Banabuiú River Valley may resent the transfer to Fortaleza, the system would collapse without the funds it generates.

iii. *Water quality and environmental impacts*. In Ceará, declining water quality especially as a consequence of untreated sewage from urban areas and pollution from pesticides and shrimp farming has exacerbated concern over the future sustainability of the basin. However, the environmental implications of these changes have not been included in the state's policy agenda and its long-term effects are not known (Lemos and Oliveira 2004, Formiga-Johnsson and Kemper 2005). Another issue with potential important environmental and equity implications is groundwater use, which has been virtually unregulated in the past and has been mostly ignored in the new water management law.

iv. *Institutional design and fit.* The current institutional design, albeit more participatory, may still skew water distribution by allowing large users to request water permits outside the jurisdiction of the River Basin Committee or Users Commission. Currently, any user can obtain a permit (and pay for the bulk water) without the approval of either

council. Although, for the most part, conflict between permit holders and other users has not arisen, the lack of a requirement for prior approval in the formal institutional design has been a sore point with stakeholders (Lemos and Oliveira 2004). This situation puts large users at a clear advantage over small users.

Moreover, many of these issues crossover and overlap, adding complexity. For example, shrimp farmers in Ceará are not the largest consumers of water but are resented by other stakeholders because of the negative impacts of their farms on the environment (after usage, water is returned to the river untreated). Irrigation, in turn, albeit the highest consumer (47.1 %), is the most resistant to water charges (Formiga-Johnsson and Kemper 2005). Finally, despite the potential for inequity—since large users can apply for water permits outside the purview of the Committee and Users Commission—it is precisely these large paying users who finance the management system.

Reform, decentralization, and knowledge

Within the rather loose institutional framework of Brazil's water reform, policymakers are afforded greater degrees of freedom not only to create new institutions, but also to change the existing ones. Hence, "within the constraints imposed by particular technological or economic configurations, actors can

modify institutions to solve new problems, to facilitate network-based collective learning, or achieve increasing efficiency" (Clemens and Cook 1999, 451). This seems to be exactly what COGERH técnicos tried to do by opening the decision-making process at the river basin level, albeit with different levels of commitment and breadth of perspective.

Ideas and knowledge have played a pivotal role in this process of institutional building in Ceará. First, ideas—here defined as a cluster of beliefs affecting the design of strategies of action geared towards policy outcome—shaped the creation of the new water management structure by supporting the initiative of policymakers to push for decentralization and participation. As argued before, the inclusion of social scientists in COGERH and the creation of a specific department to organize users within the agency changed the dynamics of reform to an unprecedented level of participation in water allocation. Many of these técnicos have been active in reformist social movements and politics for years. Their belief systems and worldviews heavily influenced their actions (Lemos and Oliveira 2004).

In the Lower Jaguaribe-Banabuiú river basin, the implementation of participatory councils went further than the suggested framework of River Basin Committees to include the Users Commission to negotiate water allocation among different users directly. Técnicos specifically created the Commission independently of the "official" state structure to emphasize their autonomy vis-à-

vis the state (Lemos and Oliveira 2005). This agenda openly challenged a pattern of exclusionary and clientelist water policymaking prevalent in Ceará. In practical terms, these changes meant a substantial departure from the way water allocation was negotiated in the past. The ability of these técnicos to implement the most innovative aspects of the Ceará reform can be explained partly by their insertion into policy networks that were instrumental in overcoming the opposition of more conservative sectors of the state apparatus and their supporters in the water user community (Lemos and Oliveira 2004).

The Users Commission meets once a year (with smaller meetings happening in between) to negotiate bulk water allocation. A larger pool of stakeholders elects representatives from users, the state, and organized civil society to participate in the negotiated allocation process. Membership is broken down as follows: a) twenty-seven representatives from the municipal government (25%); b) eighteen representatives from the state and federal governments (17%); c) thirty-two representatives from civil society (30%); and d) thirty representatives from the sectors of water users (28%) (Taddei 2005).

Although there is some variation in the electoral process from year to year, there is evidence of active negotiation and bargaining between members to get a seat (Ballestero 2004, personal interviews). The level of representation within the Commission is often questioned on two fronts. The first front is that membership is biased towards those with greater resources (both material and social) who are

able not only to keep high rates of participation in User Commission meetings but also are able to mobilize the political and social capital that is necessary to be elected. For example, one explanation for the lower level of participation among the poor is their lack resources to travel to the preparatory and allocation meetings(Taddei 2005). Second, that representation is thwarted by the lack of accountability between members and the constituencies they are supposed to represent since both the level of previous consultation and reporting back to the constituency is low among members (Ballestero 2004, Taddei 2005).[4] Furthermore, although the meetings are public and therefore open to all, in case the Users Commission fails to reach consensus on water allocation, only "official" members can cast a vote.

In their annual meeting, técnicos from COGERH prepare a series of reservoir management scenarios that includes amount of available water, rates of evaporation, and other specific conditions affecting water availability. Commission members, led by these técnicos, debate alternative discharge scenarios based on water availability and users' needs. Not surprisingly, although state and society also have representatives in the Commission, users exert the biggest influence in the allocation decisions (Ballestero 2004). In this situation, there is the possibility that users' lower risk-averseness may bring the system to collapse, that is, in a "tragedy of the commons scenario," users will over-consume water at the expense of long-term sustainability. In addition, many believe that

because the current system does not take into account intergenerational environmental issues and the long-term sustainability of the river basin, the state needs to step in to protect the stake of both society and ecosystems. With the exception of a few attempts to bolster environmental education, the state's River Basin Committees and User Commissions have sidestepped the issue of environmental impact and not considered long-term water sustainability in terms of future consumption (Formiga-Johnsson and Kemper 2005).

To guarantee short-term sustainability and prepare for the eventuality of a multi-year drought, COGERH técnicos have attempted to include some safeguards in the negotiated allocation process. For example, users are allowed to decide reservoir discharge up to a predetermined level. During meetings, técnicos often use their influence to advocate decisions that are more conservative. Although there is a risk that direct user input in water allocation would lead to overuse, this has not so far been the case in the Jaguaribe/Banabuiú (Lemos and Oliveira 2004, Formiga-Johnsson and Kemper 2005). The reasons can be traced to existing conflicts along three dimensions: (a) the presence of multiple users with conflicting interests; (b) the fact that different amounts of water have to be released from the three major reservoirs to meet users' needs; and (c) the tradeoffs between users from the lowland and highlands of the basin.

Since human consumption is a priority, large users such as urban water supply companies will push for lower levels of discharge to ensure longer periods

of water availability. Water systems that depend on intrabasin transfer favor more conservative rates of release as well. Irrigated farmers, in turn, have an incentive to maximize water consumption as soon as possible to guarantee the viability of their economic activity in the short run. Yet they are divided by geography, since the conflict between users from the basin's lower and higher lands also helps to keep water discharge in check. Thus, for users in the lowlands, it is better that larger amounts of water are released each season to increase their planted area (the area around the reservoirs that is naturally irrigated as the level of water recedes). For users in the highlands, it is more advantageous that the level of the reservoirs remain higher so as to supply their irrigated farms as needed throughout the growing season. Similarly, irrigators' downstream push for more release while irrigators upstream push for less. Finally, the fact that técnicos build scenarios for the whole system, but water is released from different reservoirs within the basin, can affect users differently depending on their geographical location in the basin. Therefore, there is an incentive for some users to protect resources in their surrounding area as they negotiate the amounts discharged from specific reservoirs as part of the broader allocation system (Lemos and Oliveira 2004, 2129).

The main implication for equity of the negotiated allocation is the fact that a greater number of both large and small users are effectively participating in the process. However, the degree of democratization of decision-making and its

impact on equitable distribution of resources is far from straightforward. Whether there is a positive impact depends on one's point of view. On the one hand, participation can strengthen and legitimize the new water reform institutions, expand the array of stakeholders deliberating about water use and sustainability, and strengthen the capacity of reform-oriented policy networks to push for further reform (Lemos and Oliveira 2004). Moreover, instead of resorting to clientelism to push for the specific agendas, users now can participate in a much more transparent fashion. In consequence, the system has also grown substantially more accountable to stakeholders than in the past. In practical terms, this has meant that conflicts have been better addressed between different uses and between large and small users. The main implication of the use of technoscientific knowledge for equity is that this participation is more meaningful and effective because stakeholders are able to make better-informed decisions when they have access to this knowledge. Thus users, who would not have had a say in the past directly or indirectly, now have the opportunity to defend their interests using expert knowledge instead of only acquiescing to what "experts" have to say. New knowledge and technologies such as reservoir modeling not only provided for better informed decisions within the new management schemes but also for more active participation by users.

In the context of Ceará's Users Commissions, the advantages in this case are many. First, users are more likely to abide by the decisions at the river basin

level (at this point there is not an established enforcement system, so basically, social pressure is the only weapon the técnicos and other users have to enforce how much water is being used) since they have been directly involved in the decision-making process. Second, by making simplified reservoir models available to users, COGERH is not only enhancing knowledge about the river basin but also is crystallizing the idea of collective risk. While individual users may be willing to "free-ride", collective decision-making processes may be much more effective in curbing overuse. Third, information can play a critical role in the democratization of decision-making at the river basin level by training users to make decisions, and by dispelling the widespread distrust that has developed as a result of the traditional patterns of bureaucratic insulation.

On the other hand, effective participation does not necessarily mean equitable participation. In fact, especially a the local level, there is growing evidence that despite great progress in terms of increased participation, many stakeholders still perceive water management as an exclusionary process. Hence, although there is more room for users and representatives of organized groups to participate, many non-elite groups, such as smaller users or rural agricultural workers, still feel excluded from the process (Ballestero 2004, Taddei 2005). They have showed their discontent with the new model by fiercely resisting several aspects of its implementation—especially water charging—as well as

openly criticizing, and even sabotaging, its implementation (Formiga-Johnsson and Kemper 2005, Taddei 2005).

Similarly, within the negotiated allocation process, Taddei (2005) found that technical language and credentials are often used as an instrument of authority not just by COGERH técnicos but also by elite members over non-elite ones. In this case, technical discourse alienates and overpowers laymen. This contributes to skewing further the decision-making process toward non-elite participants (Lemos 2003).

These findings are consistent with data collected by a broad survey of Lower Jaguaribe River Basin Committee members carried out in 2004. Although they believe technical information is useful and helpful to their decision-making, they find it is neither widely available nor easily accessible and understandable. They also perceive power within the River Basin Committee as strongly skewed in favor of técnicos over other actors. For example, although 65.9 percent of the members report that technical information makes decision-making easier, only 22 percent perceive it as accessible and available to all members. Moreover, members surveyed pointed out that the main constraint to the democratization of decision-making within the Committee is the disparate level of knowledge between técnicos and general members. This constraint is more important than economic and political power disparities. Indeed, such findings suggest that the persistence of technocratic insulation maybe one of the biggest hurdles to

overcome in order to increase effective participation in river basin councils. They also show that despite the best intentions of reform-oriented técnicos, the dominance of technical expertise in water management in Brazil is a difficult pattern to break.

Concerning participation and democratization of decision-making, the glass is half-full when we compare the current system to the previously exclusionary, non-participatory model. Here the use of COGERH's modeling tools has provided for better-informed decisions and more "efficient" reservoir management. Yet the glass is half-empty when non-elite groups continue to feel alienated from meaningful participation. Such alienation can lead to lack of access to decision-making, and ultimately, to lack of access to water. In this case, technical information can further aggravate the situation by limiting access and by providing técnicos with an authoritative voice likely to dominate water allocation negotiations.

Concluding Remarks and Further Research

In the 1990s, Brazil's approach to water reform overhauled the country's old top-down, sectoral system by creating a new set of institutional arrangements that fostered societal participation, integration, and the reframing of water as a common good with economic value. These changes "shook up" water management in Brazil. They allowed for the introduction of unprecedented

management schemes with important equity implications. This study focuses on a few of these implications in particular, notably the roles that técnicos and technical knowledge played in the implementation of water reform. In this case, the change from the basic water management paradigm in Brazil provided actors and organizations with greater degrees of freedom both to create new institutions that better 'fit' their water resources and their users management needs, as well as to incorporate new technologies into the decision-making process.

The new system in Ceará adopted a jurisdiction for decision-making—the river basin—and created a number of organizations such as the Users Commissions which significantly decentralized decision-making about water allocation and stimulated user participation. In the context of these new institutions, technical knowledge may have played a critical role in producing better-informed decisions as well as users' heightened perception of efficacy.

Yet the effects of the use of technoscientific information in the democratization of decision-making at the river basin level are more complex. On the one hand, technical information may allow for more participation for water users, especially elites. On the other hand, it may contribute to the continuation of traditional patterns of non-elite exclusion. Further, it may reinforce the dominance of a technical discourse in water management. Advocates for the dominance of technical discourse argue that considering the possibility of excessive and wasteful consumption, there should be limits to users' discretionary powers in the

first place. Nonetheless, the Ceará case supports the argument that institutional change alone will not guarantee effective participation of stakeholders in water management. Beyond the creation of formal participatory organizations, the availability and accessibility of knowledge may play a crucial role in improving both policy outcomes (more efficient and equitable allocation of water) and policy process (more transparent, accountable, and democratic decision-making).

The role of técnicos and their personal belief systems and worldviews is critical in shaping policy choice and institutional adaptation. As a result, there is evidence—if not of democratic water management—of more equitable, transparent, and accountable systems when compared with the region's previously exclusionary, clientelistic approach to water management. The effective decrease in water resources consumption also indicates progress in intergenerational implications of water management. By the same token, the relative success of negotiated allocation and the use of techno-scientific knowledge in that success may signal the building of adaptive capacity which will be highly important to framing a response to the negative effects of climate variability and change. The failure to consider long-term environmental effects and regulate groundwater use, however, may pose further difficult challenges to future sustainability and the equitable distribution of resources.

The Ceará case offers but a glimpse of the broader implications of water reform to equitable water allocation among different users and generations. More

research is needed to understand these processes across different river basins, regions, and countries. So far our limited evidence suggests there may be significant trade-offs between efficiency and equity. In this context, knowledge can play an important role in illuminating these tradeoffs in support of better informed decision-makers. However since knowledge can also contribute to the persistence of insulated decision-making processes, understanding the kinds of institutional arrangements shaping its use is essential.

Notes

1. This on-going research is funded by grants from the National Science Foundation (Award #SES 0233961) and the National Oceanographic and Atmospheric Administration (Award #NA03OAR4310010). The study is also part of a broader effort to study water management in Brazil (Projeto Marca D'agua). In collaboration with researchers from Projeto Marca D'agua, a survey of approximately 650 river basin committee members from 18 different river basins has been carried out, including queries on scientific information use and public participation. In addition, ethnographic field research has been carried out in Ceará, Northeast Brazil where we interviewed water managers, river basin committee members and a few managers of the hydropower sector who are active participants in reservoir management. I want to thank Marcelo Flores and Ricardo Gutierrez for their assistance in collecting data in Ceará, and Rebecca Abers,

Lori Kumler, and Nate Engle for their suggestions on earlier versions of the manuscript. Finally, I would like to thank the editors of this book for their guidance and valuable comments.

2**.** The four Dublin Principles are: 1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment; 2. Water development and management should be based on a participatory approach involving users, planners and policy-makers at all levels; 3. Women play a central part in the provision, management and safeguarding of water; 4. Water has an economic value in all its competing uses and should be recognized as an economic good.

3. For an in-depth discussion of pricing schemes in the context of Brazil's water reform see Formiga, Kumler and Lemos (2006).

4. This finding is consistent with the results of the survey of the Lower Jaguaribe River Basin Committee members who also point to low levels of communication between representatives and represented both before and after User Committee meetings.

References

Abers, R., and M. Keck. 2005. "Águas Turbulentas: Instituições e Práticas Políticas na Reforma do Sistema de Gestão da Água no Brasil". In Desenho Institucional e Participação Política: Experiências no Brasil Contemporâneo, edited by M. A. Melo, C. W. Lubambo and D. B. Coêlho. Rio de Janeiro: Editora Vozes, pp.155-185.

Adger, N. W., S. Huq, K. Brown, D. Conway, and M. Hulme. 2003. "Adaptation to climate change in the developing world". Progress in Development studies 3 (3):179-95.

ANA. "A ANA e sua Missão: ser guardiã dos rios". Agencia Nacional de Água 2002 [cited. Available from http://www.ana.gov.br/folder/index.htm.

Ballestero, A. 2004. "Institutional adaptation and water reform in Ceará". Master's thesis, School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI.

Bauer, C. 2004. "Results of Chilean water markets: Empirical research since 1990". Water Resources Research 40 (W09S06):11 pages.

Brannstrom, C., J. Clarke, and M. Newport. 2004. "Civil society participation in the decentralisation of Brazil's water resources: Assessing participation in three states". Singapore Journal of Tropical Geography 25 (3):304-321.

Clemens, E. S., and J. M. Cook. 1999. "Politics and Institutionalism: Explaining Durability and Change". Annual Review of Sociology 25:441-66.

Etzioni-Havely, E. 1983. Bureaucracy and democracy: A political dilemma. Melbourne, Australia: Routledge & Kegan Paul.

Formiga-Johnsson, R. M., and K. E. Kemper. 2005. "Institutional and policy analysis of river basin management in the Jaguaribe river basin, Ceará, Brazil". In Policy Research Working Paper 3649. Washington, DC: World Bank.

Formiga-Johnsson, R. M., L. M. Kumler, and M. C. Lemos. 2006. "The politics of bulk water pricing in Brazil: lessons from the Paraíba do Sul basin". Water Policy in press.

Garjulli, R. 2001. "Oficina temática: gestão participativa dos recursos hídricos: relatório final". Aracaju, SE: PROAGUA/Agência Nacional de Agua.

Geddes, B. 1990. "Building "State" Autonomy in Brazil, 1930-1964". Comparative Politics 22 (2):217-236.

Gleick, P. H. 2000. "The changing water paradigm: A look at twenty-first century water resources development". Water International 25 (1):127-138.

Healy, R. G., and W. Ascher. 1995. "Knowledge in the policy process: Incorporating new environmental information in natural resources policymaking". Policy Sciences 28 (1):1-19.

Kates, R. W. 2000. "Cautionary Tales: Adaptation and the Global Poor". Climatic Change 45:5-17.

Kemper, K., and D. Olson. 2001. "Water Pricing: The Dynamics of Institutional Change in Mexico and Ceará, Brazil". In The Political Economy of Water Pricing Reforms, edited by A. Dinar. Boulder, CO: Netlibrary, pp.339-358.

Leach, W. D., N. W. Pelkey, and P. A. Sabatier. 2002. "Stakeholder Partnership as Collaborative Policymaking: Evaluation Criteria Applied to Watershed Management in California and Washington". Journal of Policy Analysis and Management 21 (4):645-670.

Lemos, M. C. 2003. "A Tale of Two Policies: the Politics of Seasonal Climate Forecast Use in Ceará, Brazil". Policy Sciences 32 (2):101-123.

Lemos, M. C., T. Finan, R. Fox, D. Nelson, and J. Tucker. 2002. "The Use of seasonal climate forecasting in policymaking: lessons from Northeast Brazil". Climatic Change 55 (4):479-507.

Lemos, M. C., and J. L. F. Oliveira. 2004. "Can Water Reform Survive Politics? Institutional Change and River Basin Management in Ceará, Northeast Brazil". World Development 32 (12):2121-2137.

———. 2005. "Water reform across the state/society divide: the case of Ceará, Brazil". International Journal of Water Resources Development 21 (1):93-107.

Lemos, M. C. d. M. 1998. "The Politics of Pollution Control in Brazil: State Actors and Social Movements Cleaning up Cubatão". World Development 26 (1):75-87.

Manor, J. 2005. "User Committees: A Potentiality Damaging Second Wave of Decentralization?" In Democratic Decentralization through a Natural Resources Lens, edited by J. C. Ribot and A. M. Larson. New York, NY: Routledge, pp.193-213.

McEwan, C. 2003. "'Bringing government to the people': women, local governance and community participation in South Africa". Geoforum 34 (4, November):469-81.

Mohan, G., and K. Stokke. 2000. "Participatory development and empowerment: the dangers of localism". Third World Quarterly 21 (2):247-68.

Nunes, E. d. O., and B. Geddes. 1987. "Dilemmas of State-led Modernization in Brazil". In State and Society in Brazil: Continuity and Change, edited by J. D. Wirth, E. d. O. Nunes and T. E. Bogenschild. Boulder, CO: Westview Press,

Rayner, S., D. Lach, H. Ingram, and M. Houck. 2002. "Weather forecasts are for wimps: Why water resource managers don't use climate forecasts". In Project Report. Silver Spring, MD: National Atmospheric and Oceanographic Administration--NOAA.

Reis, E. P. 1990. "Bureaucrats and politicians in current Brazilian politics". International Social Science Journal 42 (1):19-29.

Ribot, J. C. 2002. "Democratic decentralization of natural resources: Institutionalizing popular participation". Washington, D.C: World Resources Institute.

Schmitter, P. 1971. Interest Conflict and Political Change in Brazil. Stanford, CA: Stanford University Press.

Taddei, R. 2005. "Of clouds and streams, prophets and profits: The political semiotics of climate and water in the Brazilian Northeast". PhD dissertation, Graduate School of Arts and Sciences, Columbia University, New York, NY.

Tendler, J. 1997. Good Government in the Tropics. Baltimore, MD: The John Hopkins University Press.

Wester, P., D. J. Merrey, and M. deLange. 2003. "Boundaries of consent: Stakeholder representation in river basin management in Mexico and South Africa". World Development 31:797-812.