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I. Introduction

Water management provides a critical lens onto the development process.¹ For the last several centuries, improvements in clean water and sanitation have contributed to better health and increased life expectancies. Currently, however, developing countries seem unable to make much progress in bringing these benefits of development to significant sectors of their citizens. Water coverage is incomplete and water is of uneven quality. Just as serious, however, are the environmental impacts of water extraction, untreated sewage disposal, and the depletion of water sources through excessive withdrawals and pollution.

To resolve this, the World Bank and other development organizations strongly encourage decentralization and privatization of water and sanitation services, which is said to produce more efficient service delivery by local authorities or private companies, while generating a more efficient and equitable allocation as well (Thobani 1997; Mumme and Brown 2002; Larson 2002; World Bank 1996). Opponents of privatization, however, argue that issues of equity, transparency, and stakeholder participation are lacking as governments adopt a private-sector-type business approach, without consultation with water users, and without appropriate mechanisms for public participation in decision-making (WWAP 2003, p 30).

In this research report, we present a framework for the analysis of the social appropriation of water based upon the concept of the **New Culture of Water**. Using that framework, we review the Mexican water sector in light of a set of original case studies. Although privatization might have some role to play in improving the performance of certain functions of water management agencies, it has clearly not proved superior to the public agencies we review. More importantly, however, the privatization solution has proved incapable of tackling the very serious problems of environmental destruction and the over-exploitation of finite water sources that plague the country. Our review of water management in Mexico, therefore, sheds light on some of the contradictions of a development process that is far from sustainable.

II. The analytical framework: The New Culture of Water

A. *The New Culture of Water*

The concept of a *New Culture of Water* (NCW) grew out of a major Spanish social movement opposed to the national water policy of the José Maria Aznar government (1999-2004) that proposed an ambitious infrastructure program to build large dams and other public works that would facilitate the large-scale transfer of water from the relatively well-endowed watersheds of northeastern Spain to the semi-arid south.² The NCW offers a

¹ Not long ago, “development” was one of the major discourses organizing academic work on international affairs. Now, “globalization” seems to have displaced it in the titles of books, articles, and even university research centers interested in processes of social and economic change. Discussing water in the context of development, reinforces its role as a *sin qua non* for the progressive improvement of human welfare and people’s capabilities.

² Its significance in political and social analysis and action was recognized in 2003, when one of its founding members, Pedro Arrojo-Agudo of the University of Zaragoza, was awarded the prestigious Goldman Prize for

dramatic contrast with the conventional approach to water management that takes water demand for granted and promotes supply-side solutions through large public works programs. According to the NCW, large infrastructure projects reflect a vision of water service that ignores the social and environmental impact of water extraction and enriches specific industrial and political sectors of the society. The alternative vision of the NCW starts from an integrated sustainable development model that evaluates policy proposals affecting the social appropriation of water in terms of limited water availability, social justice considerations, and an appreciation of the multiple environmental values of water.

Because of the deleterious environmental, social, and intergenerational justice impacts of trans-basin water transfers and aquifer depletion, the NCW suggests that regional development must be designed to take into account the availability of water in its own watershed. An essential feature of the NCW, therefore, is the emphasis on the demand side of water management, including a clear view of the impact of agriculture and other competing, non-domestic uses on resource availability. Going beyond the traditional supply-focused strategies, however, requires serious reconsideration of basic concepts such as demand itself – which is usually conceptualized as an independent variable that the water manager must simply satisfy. Redefining that concept as a variable dependent on multiple institutional factors, especially price, opens up a vista with multiple alternative solutions (Jiménez-Torrecilla and Martínez-Gil 2003).

Alternative strategies such as modernizing the physical infrastructure of water distribution networks in cities – which currently lose at least one-third of the water (US and European data) that passes through them – and improving systems for domestic and industrial water use, could increase availability much less expensively than mega-projects while also contributing to ecosystem conservation and rehabilitation. Similarly, agriculture is a very inefficient user, with estimates of losses of more than half the water it employs; modernizing irrigation systems and implementing new production technologies could also free up significant amounts of water at less cost than mega-projects, with important gains for costs and productivity. In Spain, even desalinizing sea water and aggressive sewage water treatment and recycling would be cheaper than transferring rivers across watershed boundaries, at the expense of estuaries, deltas, wetlands, biodiversity, and the people living in and using those ecosystems (Jiménez-Torrecilla and Martínez-Gil 2003).

Because water is a regionally-limited resource, the NCW also clarifies the need to make a social as well as an economic and ecological assessment of the best use of water. For example, many NCW advocates in Spain are especially critical of water-intensive agricultural practices in semiarid regions. This social assessment begins with the guarantee of a minimum “human right” to consumption, which generally includes a tap inside of the house. Guarantees of socially-necessary consumption, however, do not trump the overriding requirement to protect environmental values in the watershed. In summarizing its basic principles, the NCW defines, in order of priority, four fundamental functions of water in the environment:

- 1) Water for life – a basic lifeline of clean water as a human right for individual and collective well-being, that must not be denied by any society, and especially not by using the pretext of financial stringency;

environmental activism in Europe. One of the first policy shifts of the Rodríguez-Zapatero government that succeeded the Aznar administration (1999-2004) was to declare a moratorium on the implementation of the National Water Plan.

- 2) Water for ecosystem sustainability;
- 3) Water for activities of general social interest, including but not limited to urban services, health, sanitation, and social cohesion, assuring their uniform availability to all groups in the society; and
- 4) Water for economic growth and development (Arrojo 2005^a).

For the first three functions, the NCW erects an unconditional platform on which to build the foundation for equity and social cohesion, which must be promoted by the State, using “criteria of maximum socio-economic efficiency”. In this regard, it does not balk from advocating the application of appropriate models for water fees based on increasing block rates that are socially redistributive; instead of accepting the inevitability of present practice that is bureaucratic and inefficient to justify privatization, this paradigm calls for rising to the challenge of a “profound reform of public service,” based on the principles of “transparency, a healthy competitive environment of information and explicit comparisons with other operators (using benchmarking), and, in sum, participatory management” (Arrojo 2005^a).

The NCW makes it clear that the last function, that of the productive uses of water, represents the greatest demand for water. As such, it is also the key to the heightening problems of scarcity, contamination, and overexploitation of rivers and aquifers. While it is essential to recognize that these uses are the legitimate right of individuals in their efforts to improve their standards of living, society has an obligation to ensure that this last use not become illegitimate or even illegal, exceeding the capacity of the ecosystems to replace these sources through natural processes and/or discharging effluents that are contaminating the environment; to avoid these problems, society must ensure the development of strict guidelines and the full application of the weight of the State in their application .

The NCW provides a framework to assess the social appropriation of water in which urban water management agencies are important actors, even though they do not fill the entire stage. The NCW does not, however, adequately integrate the role of the public sector in regulation of water management and urban public service agencies in its analytical framework. Although its emphasis on demand management is fundamental, and its central concern with protecting watersheds is evident, this work does not consider how the public sector will ensure that each agency will contribute to its overall objectives. The NCW does not take a position on privatization, for example, except to insist that decisions on financing strategies should be made in a socially inclusive way. The market, without a doubt, opens up incentives for efficiency that can generate interesting improvements in the distribution and productive use of water, whether in the agricultural, industrial, or urban service sectors. Nevertheless, it is no less certain that market dynamics are blind and inefficient when it comes to the management of environmental issues, social issues, ethical issues, as well as those of inter-territorial equity. For those reasons, looking at the market as a “new magic wand” that guarantees a turn toward the New Culture of Water might be an error. Privatization and the regulation of water management –be it private or public, therefore, are issues requiring careful study and consideration (Arrojo 2005; Jiménez-Torrecilla and Martínez-Gil 2003).

The NCW uses the term culture to signify the need for a paradigm shift. In this framework, water is not simply a factor of production, but has great value in the whole panoply of social, economic and recreational spaces, as integral parts of living cultural landscapes, and as a critical component of ecosystem infrastructure. It requires changes not

only in government and policy, but also in society as a whole (Jiménez-Torrecilla and Martínez-Gil 2003).

B. Integrated Water Resource Management and the NCW

Although the product of a process of intellectual development independent from the New Culture of Water, *Integrated Water Resources Management* (IWRM) can be thought of as an administrative parallel to the philosophical underpinnings of the NCW. There is broad agreement among experts in public administration that an IWRM approach is needed to integrate the needs of the multiplicity of users, the ecosystem requirements, and the imperatives of social and economic justice in an increasingly complex political environment of water management. Two fundamental principles for this reorganization are also broadly agreed upon: 1) the need for objectivity and impartiality in the administrative bodies, together with an adequate base of information and technical expertise, in the decision-making process; and 2) the overriding inclusion of the requirements of the ecosystems and, in particular, of the availability of water in evaluating the administrative decisions for the allocation of the resources.³

Two additional elements are generally included in the institutional package for a minimally effective management system. The first, a strong and generally accepted system of property rights, is prerequisite for a sound institutional framework to permit the management scheme to function; the property rights system must be clear on the ownership and transferability of water use rights and ensure that the users themselves have an active role in resource (water) allocation and the operation of the necessary infrastructure. Finally, there is a broad consensus that a system of hydrological planning that privileges integrated management and efficient use of water resources must be implemented with broad participation and be guided by readily understood indicators that clearly identify the principal problems and bottlenecks between supply and demand of water for different uses. Such a system must effectively facilitate the coordination and management functions of the public sector with the productive and social needs of the consumers, generating incentives that maximize the long-term economic, social and environmental benefits that accrue from water use.

C. Framework of Analysis

The Mexican water management situation is different from Spain's in many ways, including a greater reliance on groundwater, and the lack of a coordinated social movement promoting a New Culture of Water. However, the Spanish view suggests a framework of analysis that contextualizes and reinforces the importance of governance issues in urban water management systems, regardless of whether those systems are public or private. These are summarized in Table 1. To apply this framework to a study of urban water management agencies, we gathered information in the following seven categories:

³ The analysis offered in this and the next paragraphs has become standard in the specialized literature in recent years. Testimony to this is the fact that an international organization, the International Water Resource Management Institute, was created as part of the Consultative Group on International Agricultural Research, to study these matters and the World Bank has created a "Water Resources Management Group" with its own sector strategy document (2004). One of the most cogent statements of the directions for change summarized in the text can be found in Ballesteros, *et al.* (2005), where four case studies in Latin America are examined.

Water management strategies in urban Mexico

- a) Administrative and managerial functions
- b) The effectiveness and efficacy of water delivery, including leakage and quality
- c) The capacity of balancing demand and supply in distinct social sectors
- d) The structure of fees, subsidies, spending, and investment
- e) The implications of the system in terms of income distribution
- f) Environmental impact in source areas, including the state of the aquifer
- g) Sewage treatment and downstream impact

Table 1: Framework for contextualizing the performance of urban water management agencies

WATER SOURCES	WATER WITHDRAWALS	URBAN WATER MANAGEMENT AGENCIES	SEWAGE TREATMENT AND DISPOSAL
<ul style="list-style-type: none"> *Environmental impacts of water extraction *Social impacts of water extraction *Limited withdrawal possibilities *Consideration of alternative water sources, such as desalination, rain-water harvesting, and wastewater recycling 	<ul style="list-style-type: none"> *Control and coordination of withdrawals *Other uses and users of water, especially agriculture 	<ul style="list-style-type: none"> *Technical and management efficiency *Demand management strategies *Social assessments of best use of water *Equity and social sufficiency in water delivery *Equity in tariff structures *Conservation incentives from tariff structure 	<ul style="list-style-type: none"> *Reconsideration of technological models of mixing grey-black and domestic-industrial effluents *Environmental impact in discharge areas *Appropriate re-use of treated water

III. Water management: The state of the debate⁴

During the 1990s, as Latin American countries frequently failed to provide growing urban populations with water and sanitation services, the World Bank, the IMF, the Inter-American Development Bank, and other international financial institutions promoted various forms of privatization in the water sector; they were joined by the Global Water Partnership to convene three World Water Fora further intensifying the pressures for privatization of urban water management. The argument justifying this new approach rests on several propositions about water, the state, and the private sector. Historically, slightly different propositions about these actors justified a model of water provisioning in which public sector water provisioning agencies were perceived as the best solution to market failures. This section reviews those propositions, highlights the most important points in contention, and places the debate in the context of the New Culture of Water.

A. The case for privatization

First, advocates of privatization hold that water is a precious and limited good that is becoming increasingly scarce as populations – and demand – grow. Furthermore, the approach holds that the market provides the best way to allocate a scarce resource. If water consumers paid the full price of production – perhaps including environmental externalities – water would be more efficiently distributed and conserved. Taken together, this leads to the idea that it is best to sell water in order to save it.⁵

A second proposition blames the failure of the public sector to provide reliable water and sanitation services on its presumed inability to operate efficiently, to maintain infrastructure, and to generate the capital needed for infrastructure investment. Specific problems confronting public sector providers are said to include (Idelovitch and Ringskog 1995):

- 1) Low physical efficiency due to lack of maintenance, technical and operational problems such that as much as forty or fifty percent of water is lost through leaking pipes, especially in irrigated agriculture.
- 2) Low financial efficiency, due to lack of metering, poor consumer records, and ineffective billing procedures. These create distortions in charging for water, fail to generate the data needed for planning, and create an inability to recover costs or make investments in improved service or reduced environmental and health impact.
- 3) Tariffs that fail to reflect the true economic cost of future water supplies.
- 4) Excess staff, often protected by public sector unions.
- 5) Political intervention, political appointments, inability to attract talented managers, and lack of qualified technical staff.

The state supposedly lacks resources for infrastructure extensions. Mired in politics and the rent-seeking behavior of bureaucrats, it is unable to create the managerial innovations and

⁴ The ample literature on the heated debate about privatization is well summarized in the following references: Bakker, 2003; Balanyá, 2005; Barlow and Clarke, 2002; Hall, et al. 2001; World Bank, 2001.

⁵ The preamble of the European Water Framework Directive, for example states that ‘water is not a commercial product like any other but, rather a heritage which must be protected, defended and treated as such.’ The document then obliges member states to achieve full cost pricing of water by 2010. For an evaluation of the Directive and a discussion of its development, see Kaika, 2003 and Page 2005.

technical capacity necessary to overcome the physical, financial, and personnel inefficiencies plaguing the water sector.⁶

The third proposition contrasts the inefficient state with an efficient private sector. Private sector actors are implicitly presented as apolitical agents isolated from political pressures. They are thought to be entrepreneurial and innovative, adopting the most appropriate technologies, best business practices, and leanest labor practices to increase efficiencies and recover costs. It is assumed that the private sector does not pursue rent-seeking strategies through government manipulation; nor is the private sector thought to be vulnerable to pressures from politicians. In addition, the defense of private sector management strongly emphasizes the relatively facile access that the private sector has to capital markets, assuring its ready ability to generate capital for long-term, infrastructure investments in water service improvements.

Thus, privatizers believe the state should substantially withdraw from public provision of water services. Instead, private sector actors should provide such services through a variety of mechanisms. These include service contracts, management contracts, lease arrangements, concessions, build-own-operate-transfer arrangements, joint ownership, mixed companies, and – rarely – outright sale. The state, meanwhile, should take on a regulatory and monitoring function, oversee the sector, provide guidance, and protect the rate payer from monopolistic behavior. Where a formal regulatory body is lacking, contract regulation becomes necessary.

Whatever the specific form of privatization, increasing private sector participation in the water sector has the following objectives:

- 1) To increase the population supplied with water and sewerage
- 2) To expand sewage treatment to decrease health and environmental impacts
- 3) To provide better quality of service
- 4) To improve operating efficiency
- 5) To finance the system without public subsidies or guarantees

B. Counter arguments

A counter argument against the push toward privatization holds that water is not commercial and that commodification is essentially theft of a common good. Privatization organizes access to water on the basis of ability to pay. Some opponents of privatization insist that access to clean water for basic needs is a fundamental human right for which governments have the primary responsibility for ensuring that all people have equal access to water on a nonprofit basis. They reject the idea that water is best represented as a human *need*, which allows the private sector to provide the resource through the market on a for-profit basis.

As opponents of privatization argue, when water becomes a commodity sold to the highest bidder, water goes to those who can afford it, and this can only serve to deepen existing inequalities. Shutting off the water taps of the poor becomes acceptable and

⁶ A similar set of assumptions about the character of the state leads to recommendations for decentralization. This is thought to improve service delivery by empowering local governments, which are thought to be more accountable to local people, more responsive to their needs, more agile, and somewhat better able to enact innovations in management. Furthermore, decentralized water agencies might have a greater degree of autonomy from other local government responsibilities and be better able to facilitate the transfer of water management functions to private sector operators.

necessary – despite the human suffering and violent protest this generates. Thus, although efficiencies, in terms of leakage and cost recovery, might go up under privatization, affordability, access, and welfare of the poor might go down. In addition, privatization is often hypocritical in its implementation. Although domestic use comprises a small percentage of overall water consumption, privatization tends to fall most heavily on urban domestic users, with urban institutional and industrial interests less affected and agriculture often left out. In this case water allocations are frozen by history and the market allocates scarcity mainly among urban consumers, to the detriment of the poor.

Furthermore, although the environmental concerns of excess water withdrawal and pollution are used to justify a full-cost pricing market approach, privatization does not resolve environmental problems. Reserving water for wetlands, estuaries, and future users is difficult to incorporate in pricing schemes, especially when governments withdraw from the sector and public accountability, participation, and oversight is diminished.

Finally, critics say privatization puts power in the hands of distant and unaccountable institutions far removed from local communities and governments. They express a particular distrust of transnational and Northern-based corporations that do not have any particular allegiance to specific cities and regions in the global South. In contrast to promoters of privatization, critics are generally skeptical of the inherent efficiency of the private sector. Talk of public-private partnerships, for example, underestimates the kinds of strategies private firms adopt to maximize profits. Firms' strategies can include political collusion, kick-backs, and abuses of the monopoly powers gained through poorly-written contracts and limited oversight by state regulators.

Others have noted the continued need for the state to serve as regulator, arbiter and guarantor in a context of privatization. Privatization requires structures of transparency and accountability which, paradoxically, require strong and effective central state authorities (Tendler 1997). This approach suggests that the state's failures in governance are not evaded through privatization, and thus alternatives that strengthen and reform the state require greater attention.

C. Privatization in the New Culture of Water

There are a number of parallels between the privatization debates and the New Culture of Water. For example, both approaches emphasize the goal of water conservation, the need to make decisions about how to allocate water, the importance of technical efficiency (reduction of leaks), and the possibility of conservation incentives (demand management) from well-designed tariff structures. On the other hand, the NCW is much more explicit about environmental issues and the livelihood impacts of water withdrawals and water pollution.

Privatization is neither precluded nor promoted in the NCW framework. Instead, the NCW identifies the need to consider social, ecological, and economic assessment of the best use of water. It considers a human right to water, but interprets this as a minimum consumption under socially-acceptable conditions, within the limits of regional water availability. Ideally, public decisions about privatization should follow public debate about the social, ecological, and economic aspects of water allocation. Thus, it recognizes that the market potentially generates incentives for water conservation, but suggests that cross-subsidies and equitable tariff schedules would have to consider a minimum human right to water consumption.

Furthermore, the NCW framework places the urban water management agencies, most frequently the arena of privatizations of various kinds, within a larger framework. This suggests that the privatization debate, which focuses mainly on service delivery issues while minimizing environmental and livelihood issues, provides a rather limited view of the goals for water management reform.

IV. Water management in Mexico

A. Mexico in a Latin American context

Public provision of water services in Latin America are not of notably high quality. In the accompanying table (Table 2 – see appendix) we offer some very general figures on the prevailing situation in the region, using country data and the specific situation in the urban areas; the countries are organized in ascending order of their per capita incomes. It is very clear from a cursory examination of the information that the situation varies greatly among the countries and, as expected, there is a higher quality of service in the urban areas. Furthermore, as might be surmised, there is a significant statistical relationship between the level of national income and service coverage in the region: the Spearman's rank correlation is .64 and .62 for potable water and sewage respectively at the national level (significant at the .01 confidence level; the data for the urban areas are not statistically significant).

Countries throughout Latin America are experimenting with decentralized water management, and privatized systems are often the focus of surprisingly intense debate while failing to produce the expected service delivery improvements. Throughout the region, the public provision of these services by local government units is common; Chile is the outstanding exception to this pattern, with all water service privatized at the national level as part of the dramatic economic reforms that were promulgated during the 1980s.⁷ Only a few countries have offered concessions to private sector companies, and most of these are quite recent, reflecting pressures from the international financial institutions, (e.g., the International Monetary Fund, the World Bank, and the Inter-American Development Bank, basically through conditionality clauses in their loans), for the transfer of public services to transnational corporations; Argentina and Bolivia have both been in the news because of public discontent with the practices of the foreign companies that were awarded the contracts. In October 2004, a national referendum in Uruguay modified the constitution to prohibit any privatization of water service.⁸ In contrast, private provision of water services in Colombia has proceeded without notable internal problems and international notoriety; this may be due in large measure to the effective system of regulation which assures effective participation of representatives of the companies, the government and the public in all hearings.

⁷ See Dourojeanni, 2000 and Bauer, 2004, for a review of the Chilean experience.

⁸ On the Argentine experience, see Loftus and McDonald, 2001 and Eustache and Trujillo, 2003; on Uruguay, see Grosse, Thimmel and Taks, 2004; on Bolivia, see Olivera, 2005 and Warner and Moreyra, 2004; on the general subject see the excellent article by Bakker, 2003, the book by von Weizsäcker, et al., 2005, and the case studies in Balanyá, et al. 2005.

As should be expected for one of the countries with a high per capita income, Mexico is among the better serviced countries. (Table 2– see appendix) Although the census data are not comparable with the regional sources, they show the considerable improvement in coverage of water and sewage services during the past half century (Table 3 – see appendix); while urban Mexico has grown rapidly, water services provision has increased even faster, assuring increasing levels of coverage. Although the information by cities in Mexico, published by the National Water Commission (CNA for its initials in Spanish), shows relatively high levels of coverage, it also documents dramatic variations in water supply as well as large differences in the operating efficiency (both physical and commercial) of the water agencies in a sample of cities for which data are available. (Table 4 – see appendix); in this table, we have ordered the cities by the available per capita water supplies. Just as striking is the information on operating costs, which indicate a range from about one peso per cubic meter to more than seven pesos reflecting not only local efficiencies but also the striking differences related to water availability, water quality and the topographical and other physical factors that influence agency costs; similarly, there are striking differences among cities in the number of workers per thousand water contracts, ranging from about 3.3 to almost 11 in one instance. Not surprisingly, we found no statistical test that would enable us to describe agency performance in a more systematic way; most troubling is the qualitative observation that those agencies with the largest staffs, in relative terms, are not the most efficient in either delivering water to their customers or in assuring a less wasteful process of distribution and treatment.⁹

Today, there is a general crisis facing Latin American societies with regard to the administration of their water resources. Throughout the region, one country after another is following the example of Chile, which profoundly reorganized its water sector in 1981. As mentioned above, Mexico has been moving along the same path since creating the CNA in 1989 and enacting the *Ley de Aguas Nacionales* in 1992, which was then amended in 2004. Mexico's reform process has been profoundly influenced by the Integrated Water Resource Management approach, with a strong central agency ostensibly (but ineffectively) coordinating the sector.

B. The institutional history of urban water services in Mexico

Mexico's National Water Commission, the CNA, was created in 1989, as a specialized agency to centralize all matters regarding water management. The broad mandate charges it not only with dealing with issues of managing the nation's water resources but also for maintaining adequate records of available supplies and the quality of water; it is primarily responsible for administering the allocation of water to all users, public and private, and assuring correct functioning of the local agencies directly charged with the management of water services to consumers and the regional councils charged with the management of the water basins and irrigation districts. Under the Mexican constitution as amended (Article 27), virtually all water is property of the nation and the federal authorities are charged with

⁹ Unfortunately, most of the published material on urban water management in Mexico is widely dispersed in journals related to natural resource management and public administration. There have been an increasing number of theses and dissertations on the subject in recent years, but most of these are not readily available, as there is no central service that makes them available as is the case for other countries. Some of these publications examine conditions in the cities where we undertook case studies and will be cited in those instances; those of a more general nature will be mentioned in the analytical sections, as is appropriate.

distributing it among claimants; this gives the Commission broad authority to manage all sources, including surface supplies and underground aquifers. It coordinates activities with other federal agencies responsible water use, like the Federal Electricity Commission that operates hydroelectric facilities and the Ministry of Agriculture that develops plans for rural production.¹⁰

In the area of urban water management, the CNA's principal responsibility is to assure the delivery of adequate supplies of water for the population and for productive activities. This includes not only the planning, construction, and operation of infrastructure for the extraction, transport and delivery of water, but also the negotiation of considerable inter-basin transfers in a number of cases where local supplies are inadequate for burgeoning urban populations and rapidly growing productive sectors. Ironically, this system of centralized control of management of water resources is supposed to facilitate the smooth operation of a highly decentralized structure in which almost 2,500 local water agencies operate at the county level; responsibility for local level administration of water services is relatively new, dating to modifications in the Constitution in 1983. We will return to this issue of intergovernmental relations in later sections of the paper and in the concluding analysis.

This analysis of the urban water management system in Mexico started from the widely accepted premise that the system is very badly managed and presents enormous problems because of lack of accurate information, uncertainty about the conditions of the aquifers from which water is drawn, absence of technical and administrative skills to define and implement basic management functions, and, most seriously, an inaccurate definition of the proper scope of action of the water sector in Mexico. The country's present problems with urban water management have a long history that merits some mention, since it strongly influences the current structure of service and the serious problems that have yet to be adequately faced. Until 1983, central government ministries were responsible for all water allocation and distribution; these services were variously administered by district offices of these organizations; many irrigated farms and large industrial users were issued permits to drill and operate their own wells or directly draw water from surface sources.

With the 1983 constitutional reform, responsibility for drinking water and sewage was transferred to the states and municipalities. Although firmly grounded in the conviction that the system had to be decentralized, political and financial exigencies did not permit this ambitious change to be accompanied by the transfer of financial resources or technical capacities to ensure that the services could be administered well. On the contrary, contemporaneous reforms in the tax system reduced the financial autonomy of local and state governments, while the technical cadre that had operated the system until that point did not support the transfer of functions to these new operators and continued to guide decisions in directions that assured effective control by the central government organizations and, in some cases, in coordination with state government offices. Thus, although generally recognized as a good idea, effective decentralization was systematically

¹⁰ Although this is not the place to go into details about Mexico's irrigation infrastructure, it is worthy of mention that the country is one of the temperate countries with the highest proportion of irrigated to total arable land in the world, at almost 25%; there are about 6 million hectares of land capable of being irrigated of a total of about 25 million hectares under cultivation. Considerable portions of this infrastructure are not well maintained and others are not used for a large variety of institutional reasons; in fact, many of these obstacles are the result of conflicts among federal agencies or between jurisdictions that are unable to resolve their differences.

thwarted by bureaucratic and political groups fearful for the loss of influence in the evolving governmental structure and by individuals concerned about their personal fortunes in the face of important changes in the geographic and political balance of power (Castro 1995).

The unwieldiness and ineffectiveness of the water management system remained on the political agenda with the election of a new president and change in administrations in 1988. The CNA emerged as a national regulatory body, with a mission to promote decentralization by offering water agencies a greater degree of autonomy from other local government responsibilities and promoting the transfer of as many functions as possible or even whole systems, to private sector operators, thereby contributing to reduce the overwhelming financial pressures facing the sector. A key element of this new structure involved a commitment to reduce the financial dependency of the water sector on the government budget by charging for water services, setting fees sufficiently high to cover the real costs of operating the systems so as to confer the local organizations with an increasing measure of autonomy. To implement this mandate, structural reforms endowed some of the new local water agencies with greater legitimacy, creating their own boards of directors and administrative councils with power to set tariffs and approve investment programs, as well as independent authority to negotiate contracts with third parties (private enterprise); one important change, which has yet to be widely accepted, is the power to cut off or at least restrict service to customers who are not current in their payments.¹¹ These new directions in the domestic policy formulation can be directly traced to a concerted effort by the international financial institutions (IFI's),¹² but most especially the World Bank and the Inter American Development Bank, to implement new policy framework for public service provision in developing countries, more consistent with the neoliberal "Washington Consensus" that was dominant at the time.¹³

By the end of the XX century, the reform program for the water sector was still far from being implemented. Independently of the CNA's ability to actually advance on the many dimensions for institutional reform and modernization, it seems clear that there are two different types of obstacles facing the water sector. On the state and local levels, both state coordinating and technical assistance organizations and operating agencies lack the financial resources, technical capacity and the political mandate to undertake the thorough-going structural reforms required to improve service. On the federal level, there is a profound political debate –that has not been permitted to surface as an open discussion in the national arena– about the structure of political control and operating responsibilities for water services in Mexico. There are serious disagreements about the exercise of individual and collective rights to water, including a history of illegal, de facto, expropriations of

¹¹ These reforms were all contingent on political concessions by local politicians who had to renounce control over appointments and budgetary allocations as well as on enabling legislation by state legislatures, many of which were reluctant to cede their authority for fixing tariffs and staffing.

¹² These include the International Monetary Fund, which does not generally offer financial aid for specific projects, the World Bank, the InterAmerican Development Bank, and other regional banks, of which the Asian Development Bank has been particularly active in the area of water services. The North American Development Bank, together with its sister organization, the Border Environmental Cooperation Commission, has also financed numerous drinking water systems, along with drainage lines and sewage treatment plants.

¹³ Consult, for example, the description of the Washington Consensus by one of its creators (Williamson, 1999), or a more critical view by one of its most authoritative critics (Stiglitz, 2002). For a critical analysis of the privatization of water services, see Balanyá, et al. (2005), Barlow and Clarke (2002), and the authoritative website on the subject: www.psir.org/reportsindex.asp

access to water from indigenous and other community groups; these problems are exacerbated by a long history of official concessions, transfer of permits for wells and surface water rights among individuals, and illegal appropriation of water by different groups. A second matter affecting the national water context is the controversy about the ability of the public sector to assure the adequate provision of drinking water and sewage treatment facilities, given the penury of public financing and the lack of expertise; while the IFI's have weighed in quite strongly in this regard, in both Mexico and elsewhere, to push for the privatization of public services in general, and water, in particular, in Mexico, the CNA has been a strong advocate of this position from its very beginnings (CNA 2003; IADB 2003; Roemer 1997; Warner and Moreyra 2004).

In addition to these institutional obstacles, there are philosophical disagreements about the operational mandates that have become sources of conflicts in the implementation of the modernization and decentralization agenda. Most academic observers of the process are in agreement that, in spite of legislative mandates and frequent declarations of commitments to stakeholder participation, the CNA's approach does not offer any effective opportunities for local level participation in decision-making. Just as serious, the Commission's engineering approach does not include a serious evaluation of the environmental impacts of its decisions or provide criteria to deny or challenge petitions for concessions for water rights that often exceed water availability in each water basin.¹⁴

C. Sectoral and fragmented, despite centralization

Mexico's reform process has been profoundly influenced by the IWRM approach. In spite of the far-reaching institutional reforms, however, the country, like most others in the region, is still plagued by a water resource management system that is characterized by a fundamentally sectoral approach; that is, each of the different categories of users – agriculture, hydroelectricity and urban-industrial– is guided by its own set of guidelines and overseen by separate agencies whose criteria for fixing operational standards and allocating water among competing claimants differ. This system has generated numerous local crises and there is a growing consensus that it is assuming national proportions, as regions and users encroach on each other, taking water from each other and delivering discharges that are violating historical pacts while compromising environmental integrity, human health, and social peace. The resulting mix of growing scarcity and spreading of negative externalities, along with increasingly predatory and unethical competition among users, is producing intensifying conflicts and inefficient uses of the resource as well as worrisome degrees of environmental degradation.

The institutional reforms enacted in Chile, and subsequently in Brazil and Mexico, were conceived to try to overcome the obstacles imposed by obsolete administrative structures. The idea of creating a single regulatory agency would be able to overcome the partial visions that local and sectoral agencies bring to their planning processes; it was paramount in the thinking of those trying to implement this modern approach to resource

¹⁴ There are a number of serious evaluations of citizen participation in the various processes involved in national, regional and local water planning. Starting from different vantage points, and using different criteria, they generally agree that the CNA does not consider participation to be a relevant consideration in program design and implementation (Wester, 2003; Castro et al., 2004; Vera Cartas, 2005). Similarly, although considerations with regard to environmental protection and ecosystem conservation are an important part of the discourse, they are not part of the operational thinking of the people charged with policy design and implementation (Castro et al., 2004).

management; if it was to work, it would require a strong central agency endowed with autonomy and cutting edge technical capabilities that could be made operational. Even more difficult, however, is the requirement to construct social consensus among the stakeholders –users committed to accepting mediation procedures that are virtually unknown in Mexican political arenas; this requires developing open processes of participation and dialogue, an element of institutional change that was not explicitly considered in the institutional reform process.

Urban water management in Mexico, in particular, is being subjected to pressures from all sectors of society. From a budgetary and administrative vantage point, the system is in crisis, with growing subsidies required to provide inadequate service that systematically discriminates against the poor and rural sectors of society. From a public health perspective, water quality is creating epidemiological problems, because the quality of water delivered to the population is either unsuitable for safe consumption or because the agencies are unable to convince their clients that its quality is acceptable; as a result, in spite of low personal income levels, Mexico is now the second only to Italy in its consumption of privately supplied bottled water in the world. Its urban infrastructure is antiquated and insufficient; many public works departments and water service agencies do not have a reasonable idea of the way in which their systems have been constructed and lack the basic analytical tools and machinery to begin to correct the situation. In many parts of the country, they are simply incapable of dealing with the strong seasonal variations in water flows, resulting from storms and drought, with repetitive cycles of destruction affecting primarily the poorest segments in society during periods that are euphemistically labeled ‘natural’ disasters. From an environmental point of view, most of the aquifers supplying urban areas are overexploited, leading to dangerous levels of depletion and the growing concentration of noxious minerals and agroindustrial and industrial residues that pose innumerable public health and ecological problems; uncontrolled and untreated effluent discharges are further exacerbating the problems, poisoning people and ecosystems and occasioning further problems as the waters are reused in agricultural and industrial production or, even worse, for consumption by Mexico’s poorest social groups. It is no wonder that Mexico’s leading specialists foresee the possibility of a greater intensity of social outbreaks in the coming years because of this situation.¹⁵

D. A diagnosis of urban water management in Mexico

There is general agreement in Mexico that the water management system is in crisis. Since its creation, the CNA has repeatedly maintained that one its principal foci of has been to promote the improvement of service standards by developing a regulatory structure and by improving the quality of the operating agencies. As part of this process, it continues to collaborate closely with the International Financial Institutions (IFI’s) which have been allocating increasing amounts of financial assistance to upgrade the agencies and to build infrastructure. A complex set of institutional mechanisms have been developed to finance new infrastructure and upgrade existing water systems, some of which provide additional

¹⁵ Perhaps the recent appearance of a book describing the depth of the water management crisis in the central part of Mexico – including the Mexico City and Toluca valleys – is symptomatic of the way in which present-day conflicts have been carefully cultivated over past years as politicians successfully postponed the “day of reckoning” by drawing water from other watersheds to satisfy burgeoning urban-industrial demands without regard to the social and environmental consequences (Perló y González, 2005).

incentives for creating opportunities for private concessions. In addition to these loans from the IFI's, there have been a considerable number of technical assistance missions and outside consultants conducting evaluations and providing recommendations to the CNA and to state and local water agencies; an overriding characteristic of these visits has been their focus on providing the information and the preparatory organizational support that would facilitate the contracting out of various aspects of the management system to private firms. This study provides an overview of the present state of urban water service management in Mexico.

The bureaucracy charged with the management of the water sector is acutely aware of its deficiencies. Internal documents and professional evaluations by private consultants and the IFI's offer a continuing flow of studies providing supporting information that highlight these problems and recommend costly solutions. However, even a cursory review of the current state of affairs points to the historical tension between the idea that decentralization improves the efficiency of water provisioning and the idea that issues of equity, transparency, and participation hinder water management strategies. The technical staff and managers presently charged with operations often shrug off this tension as a product of the intrusion of political forces beyond their control that can only be confronted by further removing the daily operations from the view of the public. In order to deal with these issues, their preferred solution, as well as that of their advisors and financiers, is to either strengthen the autonomy of each operating agency or to pursue a radical strategy of privatization of individual segments of the operation or transferring the service by means of a concession to an outside operator. In this view, then, the state water commissions would be responsible for regulatory oversight and direct political negotiations with their legislatures and user groups, leaving the tasks of forging an efficient operating organization to a technocracy that can remain aloof from the political machinations that are the source of so much conflict and inefficiency.

Of the almost 2,500 Mexican water agencies charged with delivering services to (mostly urban) populations, more than 80% are small departments within municipal government agencies; they lack professional staff and are handicapped by a political system that does not allow local-level officials, who are chosen for a three-year term of office, to run for reelection; it is the exceptional unit where the technical and administrative personnel have the minimum training required to provide adequate service. Since its creation, the CNA has been particularly focused on transforming these agencies into more independent bodies, with professional staff and legal structures that would permit a greater measure of continuity and independence. As a result, there are now about 435 water agencies that have become semi-autonomous organizations, with differing degrees of administrative, financial, and political independence, to manage their tasks; although better prepared than most, many are still woefully unprepared for the challenges of adequately running their organizations and meeting the demands for bringing local service standards up to national objectives. There is a wide variety of managerial schemes presently being used as models for the organization and reorganization of public service providers in Mexico. This move towards professionalism and decentralization has preempted an ongoing concern about the coverage and quality of water and sewage services; the CNA belittles this problem, and local agencies attempt to deal with the situation in an ad hoc manner but it continues to resurface, generally in the form of social protest or outright confrontation between the local operators and the social groups in poorer neighborhoods or on the marginal fringes of the urban areas.

In selecting our case studies, and in diagnosing performance, we identified seven key components for analysis. We are particularly concerned to determine whether one organizational form or another –public or private ownership, centralized or decentralized management– has proved to be more effective in providing adequate service levels, measured with both quantitative and qualitative indicators. As mentioned earlier, the seven basic factors that are examined in the next part of this document, both on a national level and with the use of materials drawn from detailed case studies, include:

- a) Administrative and managerial functions
- b) The effectiveness and efficacy of water delivery, including leakage and quality
- c) The capacity of balancing demand and supply in distinct social sectors
- d) The structure of fees, subsidies, spending, and investment
- e) The implications of the system in terms of income distribution
- f) Environmental impact in source areas, including the state of the aquifer
- g) Sewage treatment and downstream impact

In summary, the study is designed to identify the ability of different organizational structures to manage urban water systems, assuring broad and quality service. It encompasses both measures of financial viability, within the tariff structures fixed by state and local governments to which they report, as well as the responsible management of the ecosystems from which they draw their water and to which they discharge the effluent streams. Information was drawn from the National Water Commission (CNA) and from individual studies conducted by water agencies and independent researchers.

V. Research method

The *new culture of water* perspective suggests that the scope of responsibility of water management must confront issues of demand management and source area protection in order to construct socially just –and socially acceptable– water management strategies. The analytical framework synthesizes these views; it holds that the *effectiveness* of water provisioning services is a function of the *institutional context* and the *scope of responsibility* of the managing authority. To evaluate Mexican urban water systems, we subjected the principal institutional and operating characteristics to an analysis guided by the NCW perspective. Thus, we framed our research in terms of the impacts of these systems on society, production and the environment.

The study involved the integration of materials from a wide variety of sources. The documentary materials were drawn from official sources, newspaper accounts, and academic analyses, including extensive field visits. Local interviews were conducted in water agencies, with officials from the state regulatory agencies, and the CNA, in addition to numerous people directly involved in the reorganization of the sector during the past decade. We selected six cities in which to conduct more detailed case studies on the basis of criteria that would facilitate some understanding of the impact of the varying institutional forms on the levels and quality of water service delivered to the population; the cities are: Aguascalientes, Cancún, León, Puebla, Saltillo, and San Luis Potosí. We were particularly interested in learning about the possibility and levels of public participation in influencing local standards, and the differential responsiveness of private and public management systems to social demands.

Information barriers: Our original intention was to produce an essay summarizing the water management situation in each city, an objective that proved unachievable because of the poverty of the available data and the secrecy with which the agencies jealously guard as much information as possible about their operations; this problem is so serious that their regular reports to the CNA on operational results and in-house evaluations are frequently unbelievable; in many cases, the discrepancies arise because the figures are estimates rather than being based on actual reports of physical or financial variables. In other cases, the agencies simply do not have the equipment or personnel to measure such basic information as real energy usage, water extractions or even the extent and condition of their infrastructure. The inability to produce coherent institutional histories or evaluations is also the result of the rapid turnover of personnel; even in the cases of those decentralized and 'autonomous' agencies that are not subject to the 3-year political cycles of local government, the plethora of technical, administrative and political problems resulting from attempts by dedicated civil servants to reorganize their structure and rationalize procedures frequently provokes such strong reactions that the well-intentioned reformers are rapidly replaced. Only when these innovators are backed by strong political leadership and an effective professional staff can they implement an institutional and administrative package that allows them to modernize the water service and attack some of the inherited problems of inadequate infrastructure, system design, and managerial inadequacies; although the CNA argues (2003) that these problems cannot be readily overcome without privatization of specific services or the whole system, there are notable examples of public agencies that have managed to implement effectively a wholesale modernization program: León, Monterrey and Tijuana are among the largest systems generally cited in this respect; although these agencies undoubtedly have the best information systems in Mexico, they have not been notably forthcoming with the detailed information that would be necessary to evaluate their performance in a detailed manner: their responses to requests for information in this study and from others has been to refer people to relatively unstructured and uninformative web pages.

The study did not analyze the costs of operating urban water systems, since responsibilities are widely dispersed among government agencies at all levels of government, without any systematic coordination. Although probably not by design, the present division of labor and lack of effective oversight has resulted in a structure in which the real costs of service cannot be readily determined. Further complicating the difficulty of estimating the true costs of water service, are the lack of consistent accounting procedures and standards, making any evaluation of the true cost of service virtually impossible. Among the more serious problems is the frequent use of water agencies as employment repositories for political appointees and for people being occupied as a result of political or union pressures; in some cases, the inclusion of non-service related functions in water agencies is a result of historical agreements that later administrations have found impossible to dislodge, such as the inclusion of a professional football team on the payroll in the case of Morelia.

In the following section, we integrate the results of our field studies with studies conducted by other analysts and by the agencies themselves to characterize the management of urban water services in Mexico. In each of the sections, we summarize findings, guided by the seven principal areas of concern suggested by the New Culture of Water perspective.

VI. A summarized analysis of urban water management services in Mexico

A. The administration and management of urban water services.

Urban water services in Mexico are delivered through a wide variety of administrative structure in different parts of the country. Although the most common organizational form is the provision of water services through a municipal department, most people in Mexico are served by semi-autonomous (public sector) organizations that have been granted some degree of independence by recent changes in state and municipal legislation; this institutional change was promoted and has been supported financially by the CNA since it was created (CNA 1989). This move towards decentralization contributed to giving the agencies a greater measure of stability and financial self-sufficiency as well as a firmer basis for obtaining financing for new investments, making their revenue streams directly available to guarantee repayment.

Serious efforts have been made at all levels of government to improve the administration of urban water services in Mexico. There has been an unending program of training courses, diagnostic evaluations, national seminars and technical assistance programs to implement a broad series of reforms designed to help the local agencies meet the challenge of providing increasing coverage and better quality water, while pushing for the improvement of financial indicators on the commercial side of the operation. National resources were constantly enriched with financial and technical assistance from the World Bank and the Inter-American Development Bank, organizations that were not only supporting modernization, but also private sector participation in contracts and operating concessions.

Perhaps the two most important programs to improve the delivery of water to users have been the elaboration of reliable lists of users and the installation of meters to measure usage and develop mechanisms to begin to control consumption. It is generally agreed that until the authorities have a better idea of where the water is being used and establishing tariffs that penalize large consumers for their excesses, they have little possibility of introducing mechanisms to rein in water usage; but such a process requires a previous step of macro-measurement that allows the water agencies to determine how much water they receive and process, a step that remarkably has not been implemented in more than 80 percent of the systems.

As might be expected, in the systems that we examined with care, four of the six agencies know with relative precision the volume of water they extract from their regular sources of supply. Developing complete registers of their users, however, has proved to be especially difficult, in part for an institutional obstacle that is particularly evident in the case of Cancún, because of its burgeoning urban growth: the company is prevented from invoicing water used in the large numbers of marginal communities on the periphery which occupy lands to which they do not have proper titles since the invoices themselves might constitute evidence of land ownership.^{16,17} In San Luis Potosí, the company faces problems

¹⁶ AguaKan, the Cancun water company managed by the Suez subsidiary Ondeo, distributes water to the marginal settlements under contract with the state water agency, although this water is distributed free of charge.

¹⁷ In several urban areas, this problem is posed by wealthy suburban developments that resist “regularizing” their connections to municipal services, availing themselves of their political and/or economic influence and

of defining total water consumption because the significant farming communities in its water district have presidential grants to use raw sewage for irrigation in addition to the underground water that they extract. In Puebla, administrative chaos is so serious that even the all-important hotel industry, on which the city depends for an important proportion of its economic activity, cannot obtain adequate water supplies through the public system, and therefore must resort to regular deliveries by tank trucks to assure their ability to operate; in this case, the anarchy led to its foreign partner, Veolia, resigning its contract in 2005 because of the system's inability to correct its long-standing structural problems.¹⁸

With the letting of concessions, the new companies usually make rapid strides in completing their customer rolls and improving collection procedures. This was the case in the first significant private concession made since the creation of the CNA: Aguascalientes (Caldera, 2004), as well as in the subsequent private sector contract in Saltillo.¹⁹ In both cases there were significant advances in service coverage and consistency in availability of water. By extending and repairing water lines and improving pumping equipment, controlling water pressures in the system and installing procedures for identifying leaks, the companies made substantial strides in improving the quality and quantity of water they deliver to customers. Similarly, in the case of the publicly managed company in León, a business oriented administration of the publicly owned company installed in the early 1990s has demonstrated that such advances are not necessarily limited to privately managed firms. In these four cases, as well as several others throughout the country, the agencies are finding it relatively easy to increase the proportion of households serviced effectively by extending their networks, by enforcing regulations for developers to create adequate networks within their subdivisions and by introducing relatively simple measures like dividing their networks into sectors and closely monitoring water pressure within these segments.

On a more mundane level, it seems surprising, given the emphasis on increasing efficiency, that the more routine aspects of the administrative structures of water service departments throughout the country have not been able to meet the challenge of effective accounting and managerial systems. Repeatedly in our interviews with service providers as well as with purveyors of software and services, it became evident that the inability to keep track of various essential parts of the operations continues to be a major obstacle to overcoming the inherited inertia of poor collection and payment mechanisms and an inability to generate analytical information to inform top management properly of performance indicators. Even more troublesome than the smaller systems that still maintain records manually, are the several large metropolitan areas that have introduced modern software systems that they are not able to properly maintain and update or modify with

the relative weakness of municipal governments, as is the case of Patzcuaro, a colonial tourist attraction that is home to groups historically accustomed to dominating a highly stratified local society.

¹⁸ Veolia had a management contract that in essence placed it at the center of responsibility for overall management of the system; it withdrew because of its inability to avoid excessive interference from local politicians who contravened basic management agreements.

¹⁹ The private sector contracts in Mexico City were conceived precisely for improving the customer rolls and raising collections, rather than for operating the system as a whole. In spite of substantial investments in upgrading the administrative systems, as a whole, the system is only able to collect about one-half of the water bills in a current fashion, and three-quarters of annual billing in a relatively current manner.

their own personnel; as a result, the software vendors have a great deal of influence over operations and often control the nature of the modifications that can be introduced.²⁰

One of the most important aspects of a public service agency is ensuring its responsiveness to public needs and demands. Here too, local systems are generally unprepared to face the challenges presented by the modernizing discourse from the highest levels of the political hierarchy: the promise of accountability and transparency. The agencies are unable to provide the national authorities (CNA) with the basic information about operating parameters, and in those cases where they have 'independent' boards of directors, we found that the information provided to these people was inadequate or even misleading, making it virtually impossible for them to provide effective oversight: in the case of evaluation of the new private administration in Saltillo requested by the Board of Directors and conducted by the highly regarded private water consultants from the region's private university, the problem became particularly absurd when the evaluating group produced a very expensive but totally inadequate report; even after the Board and the municipal partner requested considerable revision, the directors found themselves unable to either abrogate the contract for non-fulfillment or demand compliance with the original terms.²¹ In place of effective managing directors or avenues for public participation, a number of the better managed companies and their respective municipal governments are contracting with public opinion and survey research firms to measure public reactions to the changing institutional structures for water management; not surprisingly, these assessments turn out generally positive, as the new companies find it relatively easy to increase coverage and improve the quality of service, given the dismal record of service provided by the previous managers.

B. Efficiency and Efficacy in water service delivery.

Examining the efficiency and efficacy of water services involves a multidimensional evaluation of the process of water service delivery. Efficiency can be examined in terms of physical volumes of water delivered and treated as well as in economic terms. Efficacy is evaluated in terms of the ability of the system to respond to local and international standards in water service delivery.

Efficiency. On the whole, Mexico faces many difficulties in raising its record of physical efficiency in urban water service delivery. There is inadequate knowledge of innovative technological alternatives and insufficient funds for redesigning and replacing obsolete infrastructure networks and information is simply not available to even identify precisely where the problems are. There is a generalized perception that the quality of water delivered to consumers varies greatly, even within a single metropolitan area, with systematic biases against poor, when considering the volumes and quality of water delivered to the communities. Even more serious is the record of treating sewage effluents, since there are relatively few treatment plants, a large proportion of which are inoperative

²⁰ Not surprisingly, some of the larger municipal systems are using software designed and sold by the large international water companies, but without the capability to enter modify the 'source code' to adapt the programs to the specific needs of the city. In these cases, they depend on the good will and/or service contracts with the vendors to maintain their administrative processes, often without adequate training, especially for top management.

²¹ In an interview, the municipal controller reported that local government dare not strongly challenge the manager, appointed by its private counterpart, lest problems between the partners become too tense.

for technical and financial reasons or, more troublesome still, the lack of human resources to assure their correct operation.

There are a number of different sources of inefficiency in the delivery systems. Perhaps the most serious is the lack of widespread use of metering for bulk water extractions from aquifers or for volumes processed by the local water companies. Household or commercial deliveries also go unmeasured in a surprising number of regions, and even where (micro) meters have been installed, many are inoperative or not systematically read. As a result, the service providers simply do not know very much about water flows through their systems and are unable to keep track of the quality of the water they are supplying to their customers; outside the major metropolitan areas managed by decentralized agencies there are very few systems that even aspire to provide water of a bacteriological or mineral content in accord with international or even domestic standards. Another result of the absence of information and the social pressures on local decision makers to compensate for leakage and complaints of non-delivery is the installation of larger pumping systems that cannot correct the problems but significantly increase the costs of operation and end up actually increasing leakage because of the higher pressures.

Even more serious than the lack of information about water flows, is the dreadful state of design and repair of the water mains. In one city after another, we found a serious intermixing of materials used in the construction of the mains and reports of important volumes of uncontrolled leakages throughout the system. Most systems have not implemented technologies and networks to subdivide their areas into sectors so as to enable them to detect and control water flows as well as to assure and maintain pressurized systems.

To illustrate the practical consequences of these generalizations, a few references to the national data on water service will suffice. There were 526 water treatment plants in Mexico in 2003 (the last year for which data are published – CNA 2004), of which more than 10% of the plants were inoperative and only 35% of the installed capacity was reported to be in use. There were 1320 municipal sewage treatment plants of which 13% were out of service, with only about 67% of the installed capacity in service. When evaluating municipal service as a whole, we find that the volume of water estimated to be supplied by municipal water agencies –some 320,000 liters/second– less than one-fifth of the volume was even flowing through the plants, many of which do not operate adequately. These data cannot even begin to measure the proportions of water lost in the several stages between the points of extraction and delivery.

This information can only hint at the magnitude of the financial burden that this pattern of inefficiency represents. Throughout the country, Mexico's topography requires tremendous expenditures for moving water both horizontally and vertically, extracting it from greater depths from the nation's increasingly over-exploited aquifers and from ever increasing distances, as competition grows among users and conflicts intensify among uses. Since these costs are paid in large measure by local governments, where the tax systems are especially regressive, the inefficiencies suggested in this text impose a particularly disproportionate fiscal burden on the poorest social groups in Mexico.

Efficacy. Exacerbating the impacts of this pattern of inefficiency is the unequal way in which water services are delivered to the population. As is common in many other parts of the world, the infrastructure for urban water services are primarily oriented to serve the needs of established populations in and around the central core of urban areas. As cities

expand, new infrastructure to assure adequate delivery depends on the local resources that are allocated on the basis of highly contested political struggles for competing budgetary demands; historically, this process of urban water services expansion has systematically discriminated against the poorer communities, especially those “irregular” settlements on the urban fringes. As a result, there is a very unequal distribution of regular water service among social groups in urban areas.

A superficial review of the Mexican data on water provisioning suggests that this harsh judgment is unwarranted. In 2003, almost 90 percent (89.4%) of the urban population was reported to be connected to regular potable water service and 77.2 % were linked to sewage lines. Unfortunately, this optimistic picture is belied by a series of more detailed analyses of the characteristics of water service in different sectors within each urban area and among those areas. We discovered, for example, that the local water companies generally are not allowed to provide water connections to those housing units and neighborhoods (*colonias*) in which there were “irregular” settlements without formal titles to their lands; since a water invoice might be considered valid evidence of land ownership in some legal proceedings, the local water agencies have to be careful in assuring that their bills are issued in the name of the title holders. Students of urban settlements in Mexico estimate that this segment of the population represents as much as 35% of the population.

As a result, water service is generally “irregular” in areas where there are squatter settlements or disputes about land ownership; this means that the residents must depend on deliveries from tank trucks, either private or public, or even worse, by taking untreated water from local rivers, or irrigation and sewage canals. The cost of water supplied by the tankers is several times more than that delivered through the water mains.

But this description does not do justice to the magnitude of problems facing the people in these districts. Those without regular access to water generally are not served by sewage lines. As a result, the problems of quality of life are magnified. But in recent months (summer-autumn 2005), the significance of this lack of infrastructure was dramatically brought home by the differential impacts of the hurricanes on people in the affected areas. Although the effects of the storms was widespread, and initially affected people from all walks of life, the lasting effects and the depths of the destruction of generally far greater in the areas without sewage systems or storm drains; although particularly notable in Chiapas, the most serious human impacts in Cancún were also observed among the marginal communities settled along the edges of streams and on the fringes of urban areas.

C. The capacity of balancing demand and supply among distinct social user groups

As described above, the NCW and the IWRM approaches lead to an analytical focus on the way in which the various stakeholders are managing the allocation of water resources within watersheds and among them, in the case of areas that are beneficiaries or losers in the interbasin transfers. The institutional framework in place in Mexico makes it particularly difficult to administer this balance, since several agencies with markedly differing competencies are responsible for specific facets of the planning, allocation, conservation, and management process in each watershed. Although the CNA is generally accepted to be the institutional figurehead responsible for the regulation of the system (Dourojeanni, Jouralev, and Chavez 2002), an evaluation of its practical operation belies

this version. In fact, responsibilities for water resource management in Mexico are so dispersed that it is fair to say that any attempt to develop a reasonable diagnosis of hydraulic balances, and an approximation of the pressure points that would have to be controlled if the present patterns of overexploitation that characterizes virtually all underground water sources were to be brought into compliance with national standards.

All three of Mexico's major metropolitan areas are presently confronting varying degrees of crisis in their water supplies. Mexico City imports about 30% of its total consumption, although it is generally agreed that if adequate provision were made for capturing rain water and storing it or injecting it into the aqueous subsurface structures, the valley would be able to supply its own needs without resort to the massive water transfers that are the source of inter-regional problems. Monterrey's problems are more serious, since it is located in the semi-arid northern region, forcing the state water agency to import substantial volumes from neighboring watershed in adjoining states. Guadalajara, Mexico's third largest metropolis, faces even more complex problems because it must reconcile its needs with those of a number of other states, commercial agricultural interests, and rich industrial cities that depend on the same water resources; uncontrolled effluents from industrial parks where textile and chemical plants render surface water unusable, force the city to draw from the nation's largest lake, Chapala, in anticipation of approval for a dam to collect sewage waters for reuse in the metropolitan area,²² while nearby cities like Leon will increasingly depend on using water from the region's rivers for their own survival.

Some positive developments for confronting the imbalances were identified during our field studies. Two distinct innovations are being explored by local water agencies: the acquisition of water rights from rural producers with permits to extract water from aquifers and the transfer of concessions to use clean water to the cities in exchange for the use of treated residual effluents. Neither of these developments is proceeding smoothly, as best illustrated by the case of San Luis Potosi. An intermediate sized industrial city, centrally located on a principal access route to the United States, the local water agency offers an example of attempts at institutional and technical innovation. It is one of only a few that has successfully merged several municipal agencies into a single metropolitan company, responsible for urban water and sewage management (Interapas). In one of its first proposals for confronting the heightening crisis of supply in a semi-arid area, the administration proposed a seemingly straight-forward exchange of underground water rights for treated water from a new sewage system for the cooling system of the thermoelectric plant operated by the Federal Electricity Commission (CFE); the agreement suffered a tortured birth even after an acceptable price for the treated water was agreed upon, because the CFE stalled in implementing the agreement in response to administrative fears about the liability of the people making the decisions and the lack of sufficient information about possible minor technical problems associated with the arrangement. The program of letting concessions out to a private company to build sewage treatment plants in the San Luis Potosi area was also predicated on the assumption that the water authority would be able to oblige the local farming communities to accept the treated water for their irrigated fields; this assumption has proved illusory, because the farmers had previously negotiated a presidential decree granting them unlimited access to the untreated sewage water. This facet of the program was still the target of acrimonious conflict at the end of

²² Approval for this dam is being vigorously contested by local citizens' groups and national environmental organizations. They have been effective in stalling the project for several years.

2005, and is symptomatic of a widespread problem facing the water sector in Mexico: the inability of existing administrative structures to effectively manage water allocations because of the complex set of entitlements that have been distributed to competing claimants since the promulgation of the 1917 Constitution, or even some who have inherited water use rights that predate the Mexican Revolution.

These attempts by Interapas are a precursor of a wide variety of initiatives that are being designed and promoted throughout the country to attempt to confront the growing imbalances between supply and demand in all parts of urban Mexico. They might be more generally assembled under the broader rubric of the development of water markets. The CNA, together with the World Bank, has been pressing for more serious consideration of ways to institutionalize procedures for transferring water rights that, up to now, have been exchanged through a series of informal negotiations or purchases by local water agencies as well as by private parties.²³ They have convened seminars and technical panels to explain and train agency experts in the inner workings of the procedures that might be used to begin to negotiate the sharing of access to different water sources or the actual purchase of well rights; implicit in this process is the ultimate threat of the exercise of the powers of the state to exercise its rights of eminent domain, a drastic step that has frequently led to violent protest in the past.

D. The structure of fees, subsidies, spending, and investment

All of the people concerned with the urban water sector in Mexico are aware of the financial problems related to its operation. Less than one-half of the people connected to urban water services actually pay their bills, while many others are not even invoiced. Tariff structures reflect a wide variety of criteria for charging for the service, and although the principle of charging more (per cubic meter of water used) for higher consumption levels is widely accepted, less than one-third of the households with service have functioning water meters. For those households that pay their bills, most water service is billed at a flat fee for each water connection; in those few of areas where metering is effective and service is monitored, the unit costs of water increase markedly with increasing consumption (Table 5 – appendix I, page 40).²⁴

The CNA has developed a program for encouraging the local water agencies to pay for the water they extract from their aquifers and to improve their collection practices. Called Promagua, the program promises to return bulk water fees paid by the agencies to the federal government for their consumption if they develop programs to improve their infrastructure for distribution (reduce leakage and increase pressure in the lines) and install meters and develop effective measurement and billing systems. This program, strongly supported by the World Bank, is based on the assumption that consumers will begin to be more responsible about their use of the resource, if their bills more closely reflect the volume they consume.

²³ Perhaps the most widespread use of the purchase of rural water rights has occurred in the northern state of Sonora, where arid conditions has intensified pressures on the urban and state-wide water agencies to confront frontally the imbalances. One collaborator in this research, Nicolás Pineda, reported on the experiences in the Hermosillo metropolitan area in this regard (also see Pineda 1999).

²⁴ The table may be slightly deceiving, since virtually no residential consumer will fall into the upper levels of monthly consumption. Similarly, the minimum levels –suggesting higher unit costs for very low levels– are usually below the minimum threshold for household consumption, which is usually between 10 and 20 m³ per month.

In all of the water systems in Mexico heavy subsidies are required to finance their operation. In the best publicly-managed agencies, including Monterrey, León, and Tijuana, and in the privately administered systems, current revenues generally cover operating expenses and normal maintenance; in most other jurisdictions, even the day-to-day operations require regular injections of funds from municipal and state budgets to cover costs. Investment costs for extending the system and for major modernization projects are paid for from public investment, generally provided by the federal government. It is expected that the three private companies (Aguascalientes, Cancun, and Saltillo) should be able to absorb these costs as part of their long-term commitment to operate the systems; this assumption has generally not proven to be feasible.

Another major issue that is a matter of ongoing conflict for water service is the responsibility of private developers to provide the infrastructure for their new settlements. In general, it has always been assumed that the infrastructure serving low-cost housing for poorer groups would be paid for from public funds, in order to make the housing more accessible, but in recent years, as private builders have taken advantage of developing capital markets to expand into this market, the pressures on municipal government has resulted in ever smaller housing units (now sometimes as small as 45 m² or 400 ft²) with inadequate provision for basic urban services and open spaces. At the other end of the social spectrum, the political power of the wealthy is often effective in transferring responsibility for (high-quality) urban services to local government at the expense of other budgetary priorities; this was repeatedly commented upon in our interviews in Michoacan and Queretaro, although other respondents agreed that the practice was widespread.

E. The implications of the system in terms of income distribution

The considerations offered in other parts of this analysis make it clear that the present structure and functioning of the urban water management system in Mexico operates in a systematically regressive fashion. There are a number of different planes on which this process operates so that corrective measures can not be easily implemented. The first and most obvious is the monetary cost of obtaining adequate supplies of quality water for domestic needs. Although the tariff structures in those jurisdictions that have metered supplies are generally progressive, the poorest groups still pay a greater proportion of their incomes for water service than does the rest of the population. Because the settlement patterns in many Mexican cities has relegated lower income groups to the outer fringes, frequently in squatter settlements and often along the banks of drainage or irrigation canals, without the ready possibility of land titles. In these areas the local governments are hard pressed to extend the local infrastructure to provide regular service to these communities; as a result they are forced to resort to water delivered by water trucks – tankers that bring water in from generally unsupervised supply points; in some areas, and in some moments (especially around local elections) local authorities will contract for these services, but generally the people are forced to pay for them on their own, in unregulated markets where collusion often raises the prices far beyond the truckers' costs or the prices charged to more fortunate groups connected to the mains.²⁵

²⁵ Another source of inequity is the high charges for new connections reconections in the case of late payment of bills. These fees have gone up much faster than other costs as they are not as easily regulated and are less visible than the water rates themselves. We documented numerous reports of grievances in this regard in both Saltillo and Mexico City.

But the distributive impacts extend far beyond the problem of the high cost of the liquid. Since the quality of water also differs greatly among socio-economic groups, the use of substandard supplies leads to one of the major problems in Mexico: water borne disease, such as gastrointestinal illness, are the most common ailments, but the list of effects extends much further, to debilitating and life threatening problems such as cistercercosis, the result of untreated water being used for irrigation of fruits and vegetables or infecting the water supplies of animals that are subsequently slaughtered for human consumption. A related problem is the contamination of aquifers from natural causes (e.g., arsenic from geological formations that are drawn into the water supply as aquifers are overexploited) or anthropogenic sources (e.g., organochlorides from pesticides) that then are concentrated along the food chain, creating new sources for disease. While some of these processes are uniformly spread among the population (at least 20% of Mexico's milk supplies are tainted in this manner), it is the poorer segments, which are most vulnerable because of their poorer nutritional standards, and which ingest a disproportionate share of the contaminants, suffering the greatest effects from both the illness and the social and economic costs of treating their problems; of course, within each social group, it is the women who bear the heaviest burden from these problems because of their preponderant role as caretakers (Bennett 2005). Of course, the lack of water treatment facilities further aggravates the problems, distributing the induced epidemiological effects in a highly unequal fashion, both socially and geographically.

On another level, large proportions of the population with marginal service through institutional channels, who do not enjoy publicly provided infrastructure and regular sources of water, have no choice but to organize themselves to provide this vital input. Self-built and locally managed water systems are quite common in smaller towns and villages where municipal authorities are incapable of providing even minimum services.²⁶ In many of these groups, local boards are organized to provide water services by imposing connection fees and water use charges, administering the system as best they can; these systems, however, often further exacerbate local inequities and tensions, conditioning water supplies to exorbitant costs on outsiders and political or ethnic minorities.

But perhaps the greatest source of inequity derives from the highly regressive structure of local government finance and the way in which federal monies are distributed. Local revenues are generally derived from property taxes that are highly regressive in their application and value added taxes have the same distributive impact. Elite recruitment and apportionment systems during the election process exacerbate the problem by creating obligations for public expenditures and patronage to the wealthy and politically influential at the expense of the priorities of socially marginal groups.

The cumulative impact of these processes has created a national water management system that is inadequate and socially discriminatory. Although water is vital for existence, until it is provided in adequate quantities and of sufficient quality, the supply and effluent systems themselves will continue to be an additional source of profound inequalities.

²⁶ Recent initiatives to build small-scale and modular water treatment plants to provide a new source of safe water for productive purposes is still operating on too small a scale to be socially relevant.

F. Environmental impact in source areas, and the state of the aquifer

Another of the serious problems confronting Mexico as a whole is the rapid degradation and depletion of its aquifers. The approach of the NCW that establishes clear priorities on competing uses for the water and the lessons of IWRM that insists on the integrated consideration of all sources and all users in a single allocation system is clearly not possible in Mexico, where different public agencies are responsible for particular facets of the system, without any coordinating or regulatory body to oversee the process.

A notable example of the problems created in this process is the participatory network of councils that were created to manage watersheds throughout the country. These councils are supposed to be democratic bodies in which conflicting interests could be reconciled through negotiation or even by exchanging water rights, a sort of make-shift market based approach to local problem solving. These councils, like most other participatory institutions in Mexico, proved to be anything but democratic, becoming instead mechanisms for the vertical transmission of orders or for local land and water management for the benefit of the major economic, political, and bureaucratic interests in each region; even worse, at the national level, these bodies were defined to include only representatives of water users, and therefore could not be expected to include the substantial numbers of people living in the regions of the headwaters of the river systems or even above them, whose daily activities directly impact on the way in which water can become available in the lower reaches of the basin (Barkin 2001).

The CNA continues to focus on the problem of satisfying demand without regard to mechanisms for limiting use or making choices among alternative demands. Water use supervision is widely dispersed among all three levels of government, and reflects the long standing constituencies that have carefully protected their fiefdoms over the course of past decades. Contrary to prevailing opinion in administrative and political circles, it seems quite unrealistic to expect this large and technocratic bureaucracy to be able to make the necessary adjustments that would allow it to become an expert manager and neutral party in evaluating the best interests of the nation.

G. Sewage treatment and downstream impact

Although the CNA pays lip service to the need for sewage treatment facilities and the “polluter pays” principle, its approach to the problem suggests that the country is still far from finding viable solutions, given the magnitude of the task facing the nation. There are numerous examples of intervention by the agency that actually impede further progress towards a national solution. Our interviews and field research indicate that a single engineering paradigm dominates –based on an industrialized approach using activated sludge as a way of deactivating noxious biological activity. As a result, design solutions are generally based on the construction of self-contained water treatment plants that combine and concentrate domestic and industrial wastes into a single viscous effluent that often must be considered to be toxic. At present, only about 18% of residual waters from urban water supply companies pass through treatment plants, and it is officially reported that less than one-half of these are actually in operation because the responsible local authorities lack the financial means to pay their costs or the technical resources to assure their proper maintenance.

There are innumerable examples of plants that are under construction, that have already been let out for bid or which are in design phases that illustrate this tendency. In Saltillo, the spatial separation of residential areas from heavy industrial activity as well as the topography of the area would have lent itself particularly well to a project design that separated the different effluent flows using appropriate design technologies for each sewage source; instead a single system was contracted for, combining the two waste flows and leading to a process that will be more costly and less susceptible for recycling of the treated water because the combined facility is to be located at a lower altitude than would have been possible with alternative proposals; local experts consider that final design solution was strongly influenced by private sector pressures from the local industrial group that already operates a small water treatment plant and will probably be able to siphon off part of the water from the new system for use in its own installations and for resale to other industrialists. In Morelia, another large scale plant under construction will produce an effluent that is unsuitable for use in the irrigation district adjoining the plant which produces dairy products and produce for the metropolitan area; when questioned about the decision not to use a modular design so that some of the waste stream be siphoned off into smaller passive plants using anaerobic bacterial processes and/or to raise the standard of treatment so that the water could legally be used for irrigation, local social groups were brushed off as being uninformed of the complexities of the problems involved or told that the problem was the unwillingness of the local farmers to pay for the treated water, given that the present underground water sources they use is virtually costless.

Examples of opposition to innovative technologies and models of social organization abound. In the Villahermosa metropolitan area, the country's largest treatment plant using a technology of "artificial wetlands" was actively opposed by the CNA, which preferred a more traditional design based on chemical treatment of sludge; the alternative design (with lower construction costs than the alternative) was approved in a political process by the state government and that plant was built and is operating with costs for the first year almost 30% below original estimates; ironically, during the regional workshop convened by the CNA in preparation for the IV World Water Forum to be held in Mexico in March 2006, regional CNA officials participated in a tour to explain the innovative features of the plant along with state supporters, attributing the initiative to the "close collaboration" between local and national government agencies. A less fortunate outcome came from a proposal for using a pilot project design for treating residential effluent in the border town of Ojinaga, Chihuahua. In this case, agronomists had worked for several years with local citizen groups to plant some 300 hectares of trees resistant to the high salinity of the arid, desert-like conditions and build the drainage system required to transport sewage from the city to the new forest; the experiment produced an effluent that exceeded international standards for returning water to the Rio Grande (Bravo). Several years later, however, when bids were called for a full-sized treatment facility, the design was rejected by the international border commission (dominated by CNA) as being "too experimental."

Smaller plants for towns and suburban communities are also on the official agenda, as amendments to the national water law require their installation in the coming years. Here too, the technical bias in favor of technology that produce industrial sludge has virtually proscribed the use of "softer" technologies that are less expensive to build and can be operated by the communities themselves. One experience in the state of Oaxaca that employs innovative financing mechanisms and relies on a high degree of local participation in construction and operation overcame skepticism from regional CNA officials because of

the charismatic and technical capacities of the managers and strong political support from state government.²⁷ This experience offers some insight into the structure of official opposition to more innovative approaches, showing that mid-level technicians responsible for evaluating new proposals are reluctant to approve new approaches whose failure might endanger their own careers within the agency, and who don't perceive any personal or institutional benefit from approving solutions that are more efficient, more environmentally friendly or less costly; since the operating costs and technical efficiency of the plants once they are operational are not standards by which individual performance in the CNA is evaluated, the personnel have little incentive to join the battle to support proposals that would have to run the gauntlet of bureaucratic opposition and commercial lobbying from the traditional bevy of contractors committed to the tried and proven (albeit unsuitable and operationally ineffective) systems.

The CNA remains adamant in its opposition to technologies that are being supported by smaller international aid agencies as well as by environmentalists in other parts of the world. It has not made substantial financial or technical investments in appropriate modular, small-scale technologies that are more readily (self) financed by local communities and more suitable for the widely varying ecosystems that characterize the country. This opposition to new technologies is joined by the numerous farming communities growing fruits and vegetables for nearby urban areas, since the more expensive and complicated traditional approach has delayed construction of many sewage treatment plants. This rural constituency uses the untreated urban waste streams for irrigation, in direct contravention of national sanitary regulations, as a source of water and nutrients for their crops; in one particularly egregious example, the farmers actually financed the construction of the drainage system in Zamora, Michoacan, to channel the effluents directly to their strawberry fields; no less reprehensible from an epidemiological perspective, is the systematic management of residual waters from Mexico City in the neighboring state of Hidalgo, where they flow untreated into a large dam or directly into the fields where grains as well as fruits and vegetables are cultivated for sale in the capital city.

VII. Conclusion

We began this evaluation with the presentation of an analytical framework in which the new culture of water leads to an emphatic call for a regulatory structure that encompasses an integrated evaluation of the water system as a whole. In this context, there is general international agreement that any management scheme requires the holistic consideration of all of the available water resources, including the systems for ecosystem management to protect the environment and most especially the aquifers, as well all of the claimants of this water –domestic, industrial, agricultural and public service – including the environment itself as a legitimate, although voiceless, stakeholder. The field work was framed to respond to a growing concern in Mexico and elsewhere about the ability of different institutional models to adequately respond to the challenges of designing and operating urban water systems that could adequately respond to the challenges of assuring universal service within the constraints of protecting the ecosystems on which they presently depend and assure their availability for future generations.

²⁷ This experience was described in detail in one of the regional preparatory workshops, leading up to the World Water Forum mentioned in the text, held in autumn 2005 in Oaxaca.

The Mexican system is clearly unprepared to meet these challenges. In virtually every aspect of the operation of the system the research found that the institutions had not even formulated their responsibilities in such a way as to facilitate advances in meeting even short term goals. Technological and institutional assumptions are proving erroneous, the basic data needed for evaluation, accountability, and planning are missing, and inadequate systems of financial control and revenue collection further complicate the management tasks. We summarize those failings in these eight points:

- 1) On the whole, the national water system offers wide disparities in the volume and quality of water available to different social groups, with disturbing inequities that oblige the poor to pay substantially more for service, or to expend more effort to ensure access. Compounding this problem are the seriously deficient service standards that systematically penalize the poor on many different levels: because of inadequate water quality, they suffer disproportionately from water borne diseases that take a greater toll because of accompanying indices of malnutrition and low educational and cultural levels; because of discriminatory regulatory systems and unscrupulous market operators, they live in areas that are more difficult to service and for which administrative systems are unprepared to attend.
- 2) The information on which descriptions of the operation of the water management system in Mexico is based is seriously flawed. Basic concepts are not precisely defined and there are inadequate technical and institutional means for collecting and systematizing this information.
- 3) Many local water agencies lack basic metering systems. They do not know how much water they extract and process, and/or cannot estimate the volumes they deliver to their customers. Virtually no system can accurately describe effluent flows or total extractions from the aquifers, since several government organizations are charged with responsibility for supervision. Many wells have been drilled and operate without proper permits and most of those registered with the authorities are withdrawing volumes of water far above their authorized levels.
- 4) Financial controls are notably lax. In all but the largest systems, local record keeping and fee collection systems are based on manual record keeping without systems for determining compliance and commercial effectiveness. Local officials regularly intervene to condone debts for influential individuals or groups, and political pressure is easily applied to ensure service and side-track administrative efforts to collect outstanding bills.
- 5) Inadequate urban development programs and disorganization facilitate the proliferation of new residential developments without consideration for infrastructure needs or provision for basic urban services. Even in the wealthiest urban areas, these initiatives frequently proceed on the assumption that services will be delivered later in response to social and political pressures, regardless of the technical and environmental constraints.
- 6) Fiscal problems and cultural patterns have created a heritage of low levels of sewage treatment and the widespread use of effluents for irrigation in discharge areas. In some cases, the farmers themselves have built or improved the drainage systems that channel these waters to crops that benefit from the fertilizing benefits of the sludge, regardless of the public health consequences.
- 7) Regulatory and administrative vacuums place responsibility for the management of rainwater runoff in the purview of public works departments rather than with the

water management authorities. As a result, there is virtually no provision for urban storm sewer infrastructure in the country, with the result that seasonal rains regularly wreak havoc throughout the country, with very high material and social costs that are widely lamented and irresponsibly disregarded because they are categorized as “natural disasters.”

8) Similarly, responsibility for some environment management problems is located in other agencies –the Secretariats for the Environment and Agriculture– while urban development has been shifted to the local levels. As a result, the water agencies generally assume no responsibility for programs like rainwater harvesting, land and water conservation, aquifer monitoring, etc. that might prove to be environmentally, socially, or financially attractive alternatives to constructing new aqueducts or dams for local water supplies.

One central concern of students of urban water management is whether the advocates of varying models of privatization are correct in arguing that they can respond to the deficiencies that have become patently clear in evaluations of public sector operations. In this regard, our study has also raised serious misgivings about the possibilities of an easy solution. The enthusiasm of the international financial institutions to finance private sector solutions has proved misplaced in numerous examples around the world, including both developing and developed countries; some of the large international water management companies are reducing their plans for expansion and even withdrawing from difficult or sensitive areas, such as the case of Puebla in Mexico or Suez in other parts of Latin America.²⁸

In Mexico, only three cases of privatized management of entire water systems have emerged, although there are numerous instances of concessions to operate individual parts of the process, as is the case of fee collections and local maintenance Mexico City and sewage treatment plants in many other parts of the country. Although each of these cases reveals some important advances in the installation of modern management systems and technical innovations that improve operating efficiency, none have emerged as unquestioned successes in demonstrating the superiority of their approaches; numerous problems of contract violations in one case and institutional barriers to assuring universal service are aggravated by the systematic disregard for the long-term environmental questions related to assuring adequate service in a healthy relationship with the surrounding ecosystems. Similarly, in a few outstanding cases, public sector companies have proved able to implement important innovations that have transformed these areas into models of professional management; but all of these cases also present problems of serious disregard for the environmental damage occasioned by present operations and none have made adequate provision for remedial actions that might postpone or avoid an impending crisis. In contrast, in a few instances local citizen groups have implemented innovative solutions that do offer to confront the long-term environmental challenges of water management; they have done so in the face of staunch political opposition and point the way to new models of citizen participation in the design and implementation of new management

²⁸ Of course, there are also numerous examples of cities where their contracts have been cancelled. The spectacular public uprisings in Cochabamba and La Paz in Bolivia, the difficult history of privatized service in Buenos Aires, and the expulsion from Tucumán, Argentina, are a few of the more notable examples in Latin America.

models; the centralized Mexican political system, however, opposes efforts to consolidate these experiences or to reproduce these models.

Thus, our overview of the Mexican urban water management system does not offer any solace for politicians searching for ready solutions. We suggest that the country is aggravating its environmental crisis without building the necessary institutional or social framework within which it could begin to tackle the major tasks it faces in correcting existing problems and extending the system to provide service to the very large segments of society that are presently without.

Although our findings reflect the weaknesses of the public sector, there is no evidence that the private sector can better overcome these obstacles. In Mexico, the principal problem of water management is the lack of any group or authority that has assumed responsibility for the overall management of water resources and the absence of mechanisms for actively incorporating all of the stakeholders in the allocation process and the application of a wide range of technologies in the solution of the whole panoply of environmental, technical, and social challenges facing the nation.

The New Culture of Water shows the need for an integrated approach to water management, but Mexico lacks that. The centralized water authority that ostensibly oversees the sector from a systemic perspective, the CNA, is unable to fill this coordinating role. It lacks reliable information on the quantity of water available in aquifers and watersheds. Relying on faulty data reported by urban water management authorities, it cannot adequately estimate the quantity of water withdrawn by agricultural, industrial or urban users, nor does it have the authority to effectively control those withdrawals at a watershed level, or even to regulate the discharge of wastewater back into watersheds and aquifers.

Debates about the role of privatization in urban water management are fundamentally misguided because they are too narrow. Urban domestic water users make up a fraction of total water use; relatively wealthy farmers and industrial users are the main consumers of water. Furthermore, the emphasis on pricing and the profit motives of private firms cannot encompass the issues of the environment as a legitimate water user, nor can it serve the large impoverished urban dwellers who lack stable incomes or property titles. The private vs. public debate obscures the pressing need to govern a much larger, integrated system with urgent social welfare goals, difficult social problems that preclude straightforward market solutions, environmental limits, and the need for socially-inclusive decision-making about how to meet those goals and respect those limits.

VIII. Data Tables

**TABLE 2: LATIN AMERICA & CARIBBEAN:
Indicators of Potable Water and Sewage Networks: 2003**

Country	GNP/cap.	Population	Urban Pop	Urban Areas		National	
	(US\$/cap) 2003*	(000 inhabitants)	% Urban	Coverage -- %		Coverage -- %	
				Potable Water	Sewage	Potable Water	Sewage
Haiti	412	8, 326	37.6	48.8	45.7	46.0	26.4
Honduras	721	6, 941	55.5	93.8	93.9	80.9	70.2
Guyana	730	765	37.6	98.3	97.2	92.9	84.7
Nicaragua	820	5, 466	77.3	95.0	93.0	66.5	75.8
Bolivia	939	8, 808	64.0	93.1	82.3	73.5	63.5
Paraguay	1,235	5, 878	58.0	70.1	84.9	43.6	67.1
Guatemala	1,574	12, 347	40.6	98.8	94.7	80.3	79.5
El Salvador	1,760	6, 515	63.5	92.4	85.8	59.4	68.3
Ecuador	1,855	13, 003	64.3	81.5	70.5	70.3	58.0
Jamaica	2,055	2, 651	57.6	97.7	90.0	80.5	90.5
Dominican R.	2,120	8, 745	67.1	96.0	95.6	87.6	89.5
Colombia	2,352	44, 222	76.5	98.0	97.0	90.6	83.4
Peru	2,431	27, 167	73.9	86.8	89.5	75.4	73.7
Venezuela	2,470	25, 699	87.6	84.6	71.1	83.1	68.6
Dominica	2,877	79	72.0	100.0	86.0	92.7	77.9
Belize	3,125	256	48.4	100.0	70.9	90.9	48.3
Panama	3,466	3, 120	57.2	87.7	98.7	86.9	93.2
Costa Rica	3,935	4, 173	60.6	99.6	88.8	95.0	93.5
Brazil	4,182	178, 470	82.8	95.7	93.6	89.0	84.8
Cuba	4,274	11, 300	75.9	98.3	97.0	92.9	93.8
México	4,682	103, 457	75.0	94.5	87.0	86.5	72.5
Uruguay	4,953	3, 415	92.5	98.2	95.4	97.8	94.4
Chile	6,051	15, 805	86.6	99.1	93.3	94.2	93.4
Argentina	6,601	38, 428	88.6	84.7	88.5	78.6	83.9
Barbados	6,858	270	51.7	100.0	99.3	100.0	99.3

* Constant prices for 1995

Sources: 1) CEPIS: Centro Panamericano de Ingeniería Sanitaria y Ciencias del Ambiente. Web page: <http://www.cepis.ops-oms.org/> (Data for 2003). Location: "Portales"; "REPIDISCA"/ "Servicios de Información"/ "Indicadores Ambientales"

2) ECLAC, *Statistical Yearbook of Latin America and the Caribbean*, 2004.

TABLE 3: MEXICO: Evolution of Water and Sewage Coverage 1960-2000

	1960	1970	1980	1990	2000
Total population	34,923,129	48,222,238	66,365,920	81,249,645	97,483,412
Urban population*	14,382,000	23,828,000	37,584,000	49,345,000	59,419,766
% Urban population	41%	49%	57%	61%	61%
Households	6,409,096	8,367,400	12,074,609	16,035,233	22,268,916
Access to Water	2,069,981	5,056,167	8,533,164	12,729,987	18,973,116
% Access to Water	32%	49%	71%	77%	85%
Inside the house	1,505,003	3,210,795	6,022,847	8,072,518	12,427,656
% Inside the house	23%	38%	50%	50%	58%
Access to Sewage†	1,851,470	3,440,466	6,158,095	10,202,934	16,126,800
% Access Sewage†	29%	41%	51%	62%	75%

* Urban population refers to localities with 15,000 or more inhabitants.

† Connected to public network or with septic tank.

Sources: Instituto Nacional de Estadística, Geografía e Informática. *Censos de Población y Vivienda*. 1960, 1970, 1980, 1990, 2000. (Mexico City: INEGI) (On webpage: <http://www.inegi.gob.mx/est/contenidos/espanol/rutinas/ept.asp?t=mviv088&c=3406>) Updated and modified from Pineda, 1999, p. 172.

TABLE 4
Mexico, 2003: Basic Information

CITY	BASIC INFORMATION			EFFICIENCY		
	Rainfall	Water Supply	Revenue/Service	Physical	Commercial	Overall
	Mm/year	L/H/Day		%	%	%
Nat. Average		276		60	50	30
Cadereyta	591	189	714	74	100	74
Linares	591	201	763	74	100	74
León	597	204	1,855	55	98	54
Ecatepec	887	234		36	94	33
Monterrey	591	249	2,075	75		
Guamuchil	766	276	716	73	76	56
San Pedro	318	277		65	70	46
Ciudad Victoria	766	283	1,434	67	86	58
Cuahtémoc	418	285		56	85	48
Culiacan Rosales	766	285		65	92	60
Atlixco	1265	286		68	71	48
Los Mochis	766	297		69	94	65
Ciudad Mante	766	307	1,220	58	93	54
Guazave	766	308	2,466	58	84	48
Hidalgo	418	313		73	82	60
Mazatlán	766	315		69	56	65
Hermosillo	423	328	1,391	68	40	27
Querétaro	554	335	1,757	45	68	31
Heroica Nogales	423	338		74	39	29
Veracruz	1484	346		69	46	31
S.Miguel Allende	597	349		64	73	47
Xalapa-Enríquez	1484	365	939	40	72	28
Aguascalientes	450	370		42	92	38
Torreón	318	397	165	46	89	41
Ciudad Lerdo	500	415		37	75	28
Puerto Vallarta	821	415	2,669	65	100	65
Chihuahua	418	425	1,486	62	74	46
Ciudad Acuña	318	456	927	48	59	28
Albia	318	462		51	81	42
Gómez Palacio	500	485		39	74	29
Agua Prieta	423	488	1,209	67	52	35
Tepic	1061	512	534	51	65	33
Ciudad Obregón	423	635		57	54	31
Ciudad Juárez	418		1,705	75	69	51

Notes: Rainfall: Annual average for the state in which city is located (millimeters per year)

Water Supply: Total water available to population measured in liters per person per day

Revenues/service: Total income of water agency divided by number of service contracts

Efficiency: Physical: Water invoiced divided by total water supplied

Commercial: Water paid for divided by water invoiced

Overall: Physical times Commercial

Source: CNA. Apéndices, *Situación del subsector agua potable y alcantarillado y saneamiento a diciembre de 2003*. On web: <http://www.cna.gob.mx> .

TABLE 5: Tariff Structures in Mexico (ca. 2004)

Consumption (m ³ /month)	Cost	0	5	10	20	30	40	50	60	70	80	90	100
Well-managed cities													
Monterrey	Total	16	20	41	88	179	279	397	529	670	816	969	1128
	W/S \$/m ³	0.00	3.94	4.13	4.41	5.96	6.98	7.95	8.82	9.57	10.20	10.76	11.28
Leon	Total	48	48	54	157	245	357	468	608	741	911	1073	1234
	W/S \$/m ³	0.00	9.60	5.36	7.83	8.17	8.92	9.35	10.13	10.58	11.39	11.92	12.34
Tijuana	Total	36	37	73	174	462	793	1131	1585	1863	2130	2396	2662
	W/S \$/m ³	0.00	7.45	7.34	8.68	15.41	19.83	22.61	26.42	26.62	26.62	26.62	26.62
Mexicali	Total	25	34	48	75	120	241	374	607	704	801	897	994
	W/S \$/m ³	0.00	6.74	4.77	3.73	3.99	6.03	7.48	10.11	10.05	10.01	9.97	9.94
Tourist Cities													
Acapulco	Total	49	49	49	109	169	228	288	416	543	670	797	925
	W/S \$/m ³	0.00	9.80	4.90	5.44	5.62	5.71	5.76	6.93	7.75	8.38	8.86	9.25
Los Cabos	Total	64	64	64	64	64	100	125	150	343	392	441	490
	W/S \$/m ³	0.00	12.76	6.38	3.19	2.13	2.50	2.50	2.50	4.90	4.90	4.90	4.90
La Paz	Total	44	44	44	66	66	131	188	188	188	437	437	743
	Water \$/m ³	0.00	8.75	4.37	3.28	2.19	3.28	3.76	3.13	2.69	5.47	4.86	7.43
Puerto Vallarta	Total	86	86	86	86	86	134	170	206	244	282	321	360
	W/S \$/m ³	0.00	17.21	8.61	4.30	2.87	3.36	3.39	3.44	3.48	3.52	3.57	3.60
Mazatlan	Total	25	25	25	47	70	105	139	200	242	334	383	490
	W/S (residential) \$/m ³	0.00	4.96	2.48	2.35	2.33	2.63	2.78	3.34	3.46	4.18	4.26	4.90
Manzanillo	Total	46	46	46	69	103	153	192	260	304	740	833	925
	W/S (residential) \$/m ³	0.00	9.22	4.61	3.43	3.43	3.83	3.83	4.34	4.34	9.25	9.25	9.25
Cancun	Total	37	37	37	41	78	93	148	202	313	423	534	644
	W/S (working class) \$/m ³	0.00	7.40	3.70	2.03	2.59	2.32	2.95	3.37	4.47	5.29	5.93	6.44
Mid-size Cities													
Naucalpan	Total	99	99	99	99	99	101	102	104	340	342	344	606
	W/S (residential) \$/m ³	0.00	19.73	9.86	4.93	3.31	2.52	2.05	1.73	4.86	4.28	3.82	6.06
Atizapan	Total	59	176	176	204	265	265	265	270	270	295	295	295
	W/S (residential) \$/m ³	0.00	35.29	17.64	10.22	8.82	6.62	5.29	4.50	3.86	3.68	3.27	2.95
Toluca	Total	92	92	92	92	92	98	99	100	243	244	246	455
	W/S \$/m ³	0.00	18.35	9.18	4.59	3.06	2.44	1.98	1.67	3.46	3.05	2.73	4.55
Querétaro	Total	14	25	37	59	176	410	527	558	707	855	1004	1152
	Water (middle class) \$/m ³	0.00	5.03	3.66	2.97	5.87	10.25	10.53	9.30	10.10	10.69	11.15	11.52
Tlalnepantla	Total	45	45	90	188	282	380	475	619	722	825	1055	1172
	W/S (residential) \$/m ³	0.00	8.96	8.96	9.41	9.41	9.50	9.50	10.31	10.31	10.31	11.72	11.72
Saltillo	Total	32	32	32	78	129	196	263	347	432	524	624	725
	W/S (residential) \$/m ³	0.00	8.96	6.85	22.62	37.64	51.23	68.75	80.05	99.42	56.63	67.51	78.38
Huizquilucan	Total	45	45	45	52	106	180	265	380	512	694	807	957
	W/S (residential) \$/m ³	0.00	9.07	4.53	2.62	3.54	4.49	5.30	6.33	7.32	8.67	8.96	9.57

Notes: W&S: water and sewage

Sewage refers to a drainage system, not water treatment.

Residential refers to 'comfortable' homes

Source: Bal-Ondeo, through courtesy of Hugo Contreras, Director of Development

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