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Modeling the Institutional Framework Governing Land Use and Water Rights in the U.S.-Mexican Border Region

Sergio Peña and Cesar Fuentes

ABSTRACT

There are differences and similarities between planning systems in the United States and Mexico, as well as policy alternatives for land use and water management that allow border communities to improve their quality of life. This analysis supports the ongoing construction of a system dynamics model of border communities under the Border Plus Twenty Years (B+20) project. Here, the constitutional framework of land use planning is analyzed by examining the role and function of each level of government. As well, water management schemes in both countries are detailed. Understanding the water rights system is important for identifying the obstacles to sustainable border policies that would enhance the quality of life of border residents.

Modelado del Marco Institucional Gobernando el Uso del Suelo y los Derechos del Agua en la Región Fronteriza México-Estados Unidos

Sergio Peña y César Fuentes

RESUMEN

Existen diferencias y similitudes entre los sistemas de planeación en México y los Estados Unidos así como alternativas de políticas para el uso del suelo y la administración del agua que permiten a las comunidades fronterizas mejorar su calidad de vida. Este análisis apoya la creación continua de un modelo de sistema de dinámicas de las comunidades fronterizas dentro del proyecto Frontera Más Veinte Años (F+20). En este trabajo se analiza el marco constitucional de la planeación del uso del suelo al examinar el papel y la función de cada nivel de gobierno. De igual manera, se detallan los esquemas de la administración del agua de ambos países. Es importante comprender el marco jurídico del agua para identificar los obstáculos de las políticas de una frontera sustentable que podrían incrementar la calidad de vida de los residentes de la frontera.

LEGAL FRAMEWORK FOR LAND USE PLANNING IN THE U.S.-MEXICAN BORDER REGION

Land use is the “glue that ties together the environment and the economy” (Herzog 2000), thus land use planning is relevant. The legal planning framework in both the United States and Mexico must be understood before coordinated urban planning policies can

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be designed. The topic itself poses a great challenge because of the differences between the two countries, not only in the degree of development but also in governments and legal traditions. Whereas the United States has had more than two centuries of democracy, Mexico has just begun to experience true democracy. As well, the legal system of the United States is based on case law or common law, while Mexico's system is based on civil law.

In Herzog's (2000) model, land use decisions have important effects on the built environment (which encompasses housing and economic, among other, activities) and how urban systems operate and grow. At the same time, the built environment—a product of human action—affects the natural environment (including air, water, and other natural resources). The impact of human action on the natural environment along the border in both countries is referred to as “transborder spillover” (Herzog 2000; Blatter and Norris 2000). This spillover is a focus of attention for policymakers in both countries, particularly since the North American Free Trade Agreement (NAFTA) was signed in 1993. Policies designed to manage or minimize transborder spillovers—such as air pollution and untreated sewage discharges into rivers and oceans—must incorporate a land use component. Therefore, it is important to understand the institutional framework and identify the actors or levels of government that have the legal jurisdiction to make decisions about land use.

The Institutional Framework of Land Use

To understand the complexity of managing urban areas that extend beyond national boundaries, one must understand the legal framework of land use decisions in both Mexico and the United States. The most important elements of this are the constitutional framework and the roles of the federal government, the state, and local communities. As will be demonstrated, land use planning in the United States has followed an incremental legalistic model where the judicial system, through legal cases, helped clarify property rights issues. Mexico followed the clientelistic-discretionary approach where the social and political context and the interests of the ruling political party shaped planning.

The constitution is the most important legal document from which all laws and regulations are derived and which every federal, state, or municipal governmental unit must follow. The constitution defines the sphere of action and constraints on government by granting certain inalienable rights to every citizen, such as freedom of speech and freedom of religion, both of which are granted by the Mexican and U.S. constitutions. Land use regulations are also framed by the constitution. Two questions emerge about land use decisions: Which level of government has the jurisdiction and *a priori* legal standing to regulate land uses? And, what kind of constitutional powers are granted to government to regulate land uses?

In the United States, local governments have jurisdiction over land uses. This right is recognized in the 10th Amendment to the U.S. Constitution, which states “the powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.” Notably, this amendment only recognizes two units of government—the federal and the state—and is silent about local units of government such as counties or cities, where most land use decisions are made. This issue was clarified in 1868 in *Merriam v. Moody’s Executors*, which set forth what is commonly known as Dillon’s rule.¹ The rule gives authority to local governments to exercise powers indispensable for accomplishing its governing function.

Similar to the 10th Amendment to the U.S. Constitution, Article 24 of the Mexican Constitution declares that powers not explicitly assigned to federal agencies are reserved to the state. But unlike the U.S. Constitution, Article 73, Section XXXIX-C of the Mexican Constitution states that Congress has the power to legislate issues regarding urban settlements. Making use of this authority, the Mexican Congress in 1976 passed the first law for urban settlements, known as Ley General de Asentamientos Humanos (LGAH). This law is the first general law on urban planning. According to Azuela (1989), urban planning is an issue of coordination among the three levels of government. Additionally, a 1983 reform of Article 115 of the Mexican Constitution signaled a landmark change for urban planning and land use decisions. This reform was part of a strategy to promote decentralization policies; it gave more responsibilities to local governments in the context of the 1980s’ economic

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crisis (Rodríguez 1997) and government fiscal crisis (Peña and Cordova 2001). In Section V of the same article, the constitution gives power to the municipalities to regulate land uses.

Of the constitutional powers granted to governments to regulate land uses, two are the most important: police power and eminent domain. Police power gives governments legal authority to pass laws and regulations to protect their communities. Eminent domain is the legal power to take land for a legitimate public purpose. From this perspective, a land use regulation is justified as an act to pursue a legitimate public interest or social function. The state, through police power and eminent domain, tries to balance the public and private interest. For example, a law could be designed to regulate the use of a public good, such as air, to protect the rights of people to breathe or enjoy clean air.

The U.S. Constitution's 10th Amendment grants police power to local governments to pass laws that ensure "the comfort, safety, morals, health, and prosperity of its citizens..." (Black 1991). This power also allows local governments to regulate land use and impose public control on private property, including actions to ensure comfort, safety, and public health.

U.S. governments are further bound by the 5th and 14th Amendments. The 5th Amendment, often known as the "taking clause," recognizes that "no person...[shall] be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation." The 14th Amendment requires that no property be taken without due process of law; furthermore, every person is entitled to equal protection under the law. A fundamental difference between police power and eminent domain is the clause with respect to just compensation. If property value is affected by police power, owners are not entitled to compensation; under eminent domain, they are entitled to compensation. In cases such as *Pennsylvania Coal Co. v. Mahon* in 1922 and *Lucas v. South Carolina Coastal Council* in 1992 (Duerksen and Roddewig 1994), the courts had to determine whether an action by government using police power could be considered, for all practical purposes, to be a taking. The court agreed in *Pennsylvania Coal Co.* that government regulation claiming legitimate public purpose could go "too far" and, therefore, the action in question constituted

a taking. In *Lucas*, the regulation had denied “all reasonable uses” and, consequently, should be considered a taking, thus entitling the affected parties to compensation.

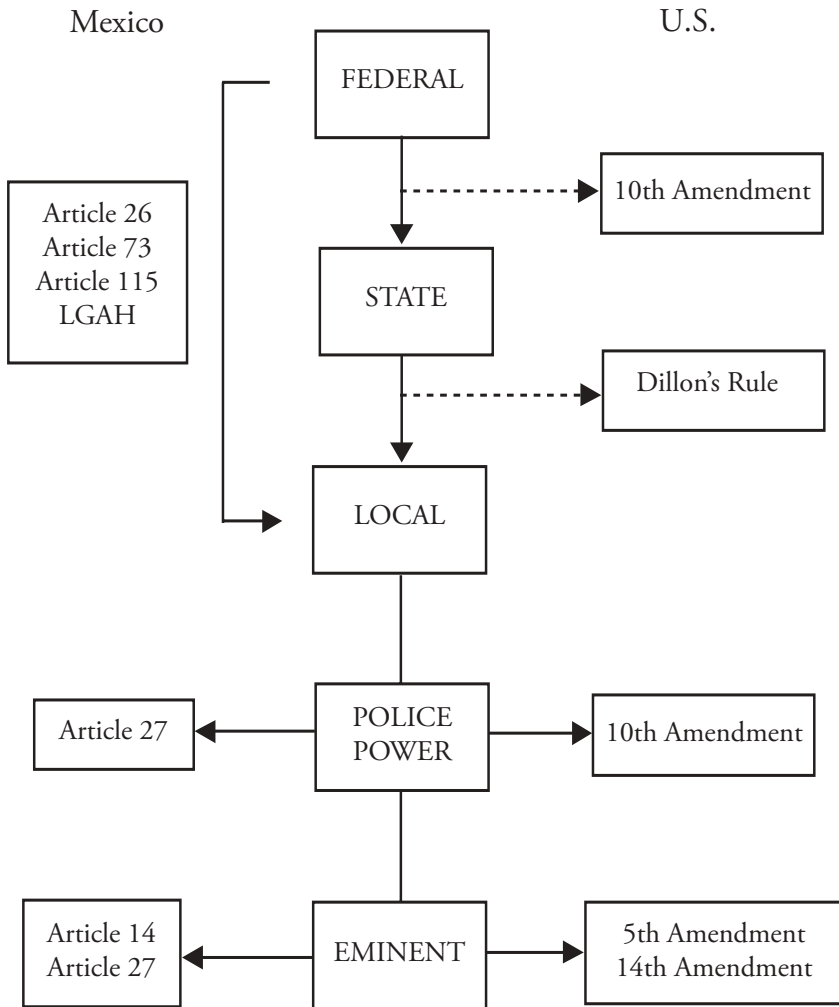
Article 27 of the Mexican Constitution explicitly deals with the topic of property rights. In general terms, this article states that land and waters within the national territory belong to the nation and the nation has the right to transfer land to individuals to create private property. Furthermore, the article recognizes the nation’s right of public domain to take away land for a public purpose after compensating the affected party. The third paragraph of Article 27 states that, “at all times the nation has the right to impose on private property the type of tenure that the public interest dictates, as well as to regulate for the social benefit to improve living conditions of the rural and urban population...” In brief, Article 27 gives the federal government power to control and regulate land to foster the public interest. The power to take or confiscate land can be exercised by executive decree or through a federal agency. As examples, the confiscation of oil companies’ property in 1938 was achieved through a decree by President Lazaro Cardenas, while agrarian reform, which confiscated large landholdings, was carried out by a federal agency. Similar to the 14th Amendment of the U.S. Constitution, Article 14 of the Mexican Constitution establishes that no person can be deprived of life and property without a trial following due process and based on existing laws prior to the act.

From the constitutional point of view, both countries share similar principles of land uses. The interpretation and application of the laws with respect to police power and eminent domain are what differentiate the two legal systems. In the United States, the judicial system defines the planning profession’s actions concerning land uses when a controversy arises about government use of police power or eminent domain. The judicial branch decides whether an action constitutes a legitimate public interest. For example, in 1926 the U.S. Supreme Court in *Village of Euclid v. Amber Realty Co.* upheld zoning as a proper exercise of police power, thus making zoning a widely used urban-planning technique. In a 1978 case, *Penn Central Transportation Company v. City of New York*, the court recognized protection of historical landmarks as a valid use of police power and denied the principle of “highest and best use of property.” As these

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cases help demonstrate, the judicial system in the United States has played a fundamental role in defining the sphere of action of land use planners (Blaesser and Weinstein 1989; Levy 1997; Duerkesen and Roddewig 1994).

Figure 1. Constitutional Framework of Land Use Planning



Source: Peña 2002

In Mexico, checks and balances between the three branches of government were absent for many years; the executive branch had overwhelming power compared to the legislative and judicial branches. Rodríguez (1997) claims the lack of checks and balances among the branches of government indicates a lack of horizontal decentralization in government. Furthermore, there was no clear separation between the ruling Institutionalized Revolutionary Party, known as PRI, and the executive, legislative, and judicial branches of government. Consequently, laws were interpreted and applied in a discretionary way with the objective of maintaining the political status quo. As a result, a “clientelistic-discretionary” decision model evolved whereby urban land decisions were made following political, rather than technical, influences (Azuela and Dahau 1993; Duhau 1998).

The situation has begun to change as more state governments and congressional seats have been captured by parties such as the National Action Party (in Spanish, PAN) and the Democratic Revolution Party (in Spanish, PRD). Checks and balances among the branches of government started to take root, particularly since PRI’s loss of the executive branch to PAN candidate Vicente Fox in July 2000. Today, the tendency is to create a more institutionalized model of planning where a necessary condition is a credible judicial system. The judiciary has recently begun to exercise its function in land use disputes. For example, in the state of Baja California in a landmark 1996 decision, the Supreme Court ordered the eviction of nearly 150 residents, most of them American, from Punta Banda for occupying land that had been illegally confiscated from its original owners by the Secretaría de la Reforma Agraria (Agrarian Reform Agency), and then subleased or subdivided.²

The Role of the Federal Government

The role the federal government plays in land use decisions in both countries could not be more different. In the United States, the conservative political position is that the best government is the least government. Following the founding of the country, states and local governments were empowered by the 10th Amendment to make decisions about land use. Although the U.S. federal government

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does not have an explicit constitutional mandate to establish national urban policy, it plays an important indirect role in how cities have been shaped by actively promoting home ownership through the Federal Housing Administration (FHA), giving tax advantages to home owners, and investing in infrastructure such as the interstate highway system through the Federal-Aid Highway Act of 1956 (Levy 1997). The government also set federal standards such as the 1990 Clean Air Act and the 1972 Clean Water Act, the requirements of which may be enhanced, but not diminished, by states and municipalities. The federal government uses grants and highway money to reward states that comply and punish those that do not.

In Mexico, a federalist system is recognized on paper in Article 40 of its constitution, but the federal government has a strong influence on planning decisions. Unlike the United States, Article 26 of the Mexican Constitution gives power to the executive branch through the federal government to create and coordinate national planning following democratic principles. Article 73, Section XXIX-C gives power to the federal government to create laws to coordinate urban policy among the three levels of government. Furthermore, it is through this concept of national planning that general laws are developed to deal with specific issues. LGAH provides the guidelines and concepts for urban planning and land uses at the national level. The LGAH addresses four themes:

- Concurrency among the plans of the different levels of government for the organization and regulation of cities
- Basic norms and regulations of land use planning
- General principles for the establishment of open space and land use regulation
- The basis upon which the population will participate in the planning process

Thus, the role of the U.S. federal government is indirect, through expenditures on infrastructure and fiscal incentives, while the Mexican federal government proactively sets national mandates for states and municipalities.

Legally, local communities cannot enter into formal binational agreements because the power to enter into such international agreements is reserved by the federal governments in both countries (according to Article 89 section X of the Mexican Constitution and Article I, Section 10 and the 10th Amendment of the U.S. Constitution). This constitutional impediment fosters the role of the federal government in planning issues along the border and limits inter-local agreements.

Border planning by the federal governments in Mexico and the United States has focused on issues such as water and boundaries, which are addressed by the International Boundary and Water Commission (IBWC). The IBWC, under this name and its original title, the International Boundary Commission (IBC), has been operating for more than a century, applying the boundary and water treaties between the two countries. The function and priorities of IBWC have been adapted to the new circumstances and context of the bilateral relationship. One of the first projects IBWC carried out was the demarcation of the international boundary. The Convention of March 1, 1889, established IBC to apply the rules set forth in the 1884 Convention dealing with the location of the border. Those rules were modified by the Banco Convention of March 20, 1905, to retain the Rio Grande and the Colorado River as the international boundary. Under the water treaty signed in 1944, dam projects became another priority for IBWC, and the commission took the first steps to address sanitation issues on the border.³

In recent years, the U.S. section of IBWC⁴ has pledged the incorporation of sustainable development and public participation as part of its mission statement, which “is to provide environmentally sensitive, timely, and fiscally responsible boundary, water, and environmental services along the United States and Mexico border region.” The commission provides “these services in an atmosphere of binational cooperation and in a manner responsive to public concerns and our stakeholders.”

Recently, there has been a shift in handling border issues from bilateral cooperation and coordination to binational co-management (Lara 2000) through the Border Environment Cooperation Commission (BECC) and the North American Development Bank (NADBank). BECC and NADBank are the result of a side agreement

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forged during the NAFTA negotiations to deal with the negative environmental impacts of free trade. The role and function of BECC is to certify projects, which can then receive financing from NADBank, and to provide technical support to local municipalities and stakeholders. BECC supports water supply, wastewater treatment, solid waste, and other related projects along the U.S.-Mexican border. The mandate was expanded in 2003 to include projects related to air quality, public transportation, clean and efficient energy, municipal planning and development, and water management.

Mumme and Brown (2002), who also use the Rodríguez (1997) typology, are correct in their assessment that border planning has moved from a highly centralized model where federal governments had a great deal of power to a model of “administrative deconcentration.” This allows the federal government to grant some administrative and planning function to a subunit (BECC, NADBank, and others) while at the same time maintain some degree of control through regulation and financial links.

The Role of the States

In Mexico, LGAH gives the states the authority to coordinate urban policy. That means LGAH addresses not only coordination among the three levels of government but also among states and municipalities. Article 115, Section VI of the constitution also discusses coordination among the different levels of government. According to Azuela (1989), the reforms made to Article 115 of the Mexican Constitution weaken the role of the states in urban planning matters and give the authority to regulate land uses directly to local governments.

The U.S. Constitution does not delegate powers to the federal government to legislate land uses, nor does it prohibit the states from using this power. Because of the 10th Amendment, states have the authority to legislate and develop statewide standards and guidelines for land uses and urban management policies within their jurisdictions. Two questions arise: Do states develop statewide land use plans? And, what has been the approach of states located along the U.S.-Mexican border?

Since the 1970s there have been efforts to pass statewide mandates and laws to deal with urban sprawl in places such as California, Florida, Oregon, Hawaii, Vermont, and Georgia (Kelly 1993). These efforts mainly focused on protecting environmentally sensitive ecosystems and reducing the fiscal burden of urban sprawl on local municipalities. According to Holcombe and Staley (2001), the “smart growth” movement has fostered strong intervention by the states in land use matters by imposing statewide mandates.

On the second question, the approach to statewide urban growth management strategies of U.S. border states varies. For example, California and Texas have taken different paths. California has been proactive in terms of growth management, and a Governor’s Office of Planning and Research assists local governments in complying with state laws. Texas has played a weaker role, allowing cities like Houston to take a *laissez-faire* approach in land use decisions. Notably, lack of subdivision restrictions allows the rise of unplanned communities in border counties known as *colonias*.

In November 1998, Arizona voters rejected an initiative to set statewide growth management standards, instead approving Proposition 303, known as the “Growing Smarter Act,” where state funds are used every year to buy or lease land for open space. Proposition 303 gives local communities the power to adopt their own growth management policies.

New Mexico uses a mixed approach. For example, Santa Fe, a city considered a strong advocate of urban growth management, imposes strict building codes to maintain the character of the community and city. Other communities, like Doña Ana County, have lax controls on subdivisions and a significant number of *colonias*. Innovative projects include the one approved by the 2002 state legislature to create a water bank and market mechanisms to allocate the scarce water resources of the lower Pecos River basin. This decision could have significant implications for land use issues.

Coordination of Border Initiatives

From above, inferences can be made about the difficulty of coordinating border initiatives. The large number of political jurisdictions and the different approaches to setting urban policy complicate the

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management of urban growth on the U.S.-Mexican border. The border extends for more than 3,000 kilometers (approximately 1,952 miles) from the Gulf of Mexico to the Pacific coast, and is shared by 10 states (four in the United States and six in Mexico) and 64 municipalities (39 in Mexico and 25 in the United States).

In Mexico, general laws such as LGAH allow some coordination among the border states. The watershed councils, or *consejos de cuenca*, in Mexico are an example of this interstate coordination. The watershed councils are coordinated by the Comisión Nacional del Agua (National Water Commission, CNA in Spanish). Some authors propose using this interstate planning model for managing the Rio Grande and Colorado Rivers “to serve the many users of hydrologic resources, to establish hydrologic infrastructure, and to preserve water resources” (Brown and Mumme 2000).

In the United States, where the federal government is limited in land use planning and there are no national laws such as the Mexican LGAH, coordination initiatives must come from states, local governments, and specific federal programs. Examples of interstate coordination are few, but one is the Western Governors’ Association, whose mission calls for the advancement of the role of western states in the federal arena. Specific border issues, however, are neither an issue nor a priority. The Border XXI Program, when it existed, and the Border Governors’ Conference are two examples of efforts to develop coordinated initiatives for border states in both countries. Unfortunately, neither program addresses urban planning or land use coordination issues *per se*.

The objective of the Border XXI Program was to promote sustainable development along the border through public participation, capacity building, decentralized environmental management, and interagency cooperation. The program included nine binational work groups to identify needs and programs in the areas of air, water, solid waste, pollution, contingency and emergency planning, cooperative enforcement and compliance, environmental information resources, natural resources, and environmental health. Note the lack of a land use planning or urban growth management focus.

The Border Governors’ Conference focuses on economic development and promoting the welfare of both countries. There are also neighboring state commissions such as the Arizona-Mexico

Commission, whose mission is “to improve the economic well-being and quality of life for the citizens of the Arizona-Mexico region by promoting a strong, cooperative relationship with Mexico.” An important goal of this commission is to develop indicators of well-being and quality of life to help assess the impact of NAFTA on the economies of Sonora and Arizona.

Texas and California have placed more attention on border issues because two halves of the biggest binational twin city pairs, San Diego, Calif.-Tijuana, B.C., and El Paso, Tex.-Ciudad Juárez, Chih., are located in these states. In California, the San Diego Association of Governments (SANDAG), through its Committee on Binational Regional Opportunities (COBRO) is proactive on border planning issues in the San Diego-Tijuana area. In Texas, the Rio Grande Council of Government (RGCOG) was created to promote intergovernmental cooperation. Unlike SANDAG, however, RGCOG does not have an entity resembling a border committee.

This brief analysis of state initiatives on land use coordination corroborates Herzog's (2000) assessment that land use policies are the least coordinated, in a binational sense, in the U.S.-Mexican border region.

The Role of the Municipalities

Although Mexico and the United States have explicitly adopted a federal and republican form of government, their practices have been quite different with respect to land use policies. A key difference is that local communities in the United States play a strong role in land use and urban growth management. In contrast, municipalities in Mexico have had a weaker role in managing urban growth. For many years, Mexican planning practice followed the clientelistic-discretionary model (Azuela and Duhau 1993), although this has begun to change. Progress has been made by municipalities, mainly those governed by PAN. Ciudad Juárez now has the Municipal Institute of Planning and Research (IMIP), and the Municipal Planning Institute (IMPLAN) exists in Tijuana, as does a similar entity in León, Guanajuato. In addition, reforms to Article 115 increased the role of municipal planning through the Comité de

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Planeación para el Desarrollo Municipal (Municipal Development Planning Committees, or COPLADEMUN in Spanish) (Rodríguez 1997).

Another important difference is that in Mexico, LGAH sets forth municipal planning standards under a one-size-fits-all approach. In contrast, municipal land use planning in the United States often is a custom-made or negotiated practice between market and community values—between the “growth machine” (Molotch 1976) and environmental advocates or coalitions. The way local officials are elected to city government is another key difference between the two systems. In the United States, city council members are generally elected directly by specific constituencies within a district or area, and they can be reelected; this system allows citizens to vote out a council member whose decision-making goes against their interests. In Mexico, council, *or cabildo*, members are elected as part of a party slate. As a result, the council reflects the proportion that each party obtained in the election and voting patterns are based on party lines and interests rather than constituencies or district base.

What are the advantages and disadvantages of one approach versus the other? The approach in the United States offers many opportunities for communities to experiment with different land use techniques adopted according to local goals such as promoting, curbing, or financing growth. Impact fees, urban boundary, building permit moratoria, and development agreements have been used to manage urban sprawl and ease the financial burden on local communities. There are also land use regulations to promote higher density and mixed-used development (Schiffman 1989).

Giving local communities the power to choose the appropriate land use regulations for themselves allows them to adopt policies according to their preferences and economic circumstances. The main disadvantage is that ecosystems do not necessarily follow political boundaries, so some coordination among communities is needed to prevent damage to the environment resulting from isolated decisions. The fundamental issues are who should control coordination and what the mechanisms should be. As explained in the previous section, one approach has been to pass statewide legislation. At the same time, the federal government's role has generally been limited to setting standards such as those of the Endangered Species Act,

Clean Water Act, and Clean Air Act, which communities must meet to receive federal funds. In Mexico, the federal government assumed the role of coordinating and facilitating federal urban policy through LGAH. This would give BECC a niche to perform a facilitator role and overcome the legal restrictions of establishing inter-local agreements between border communities.

RIGHTS AND ADMINISTRATION IN MEXICO AND THE UNITED STATES

Water Management Scheme

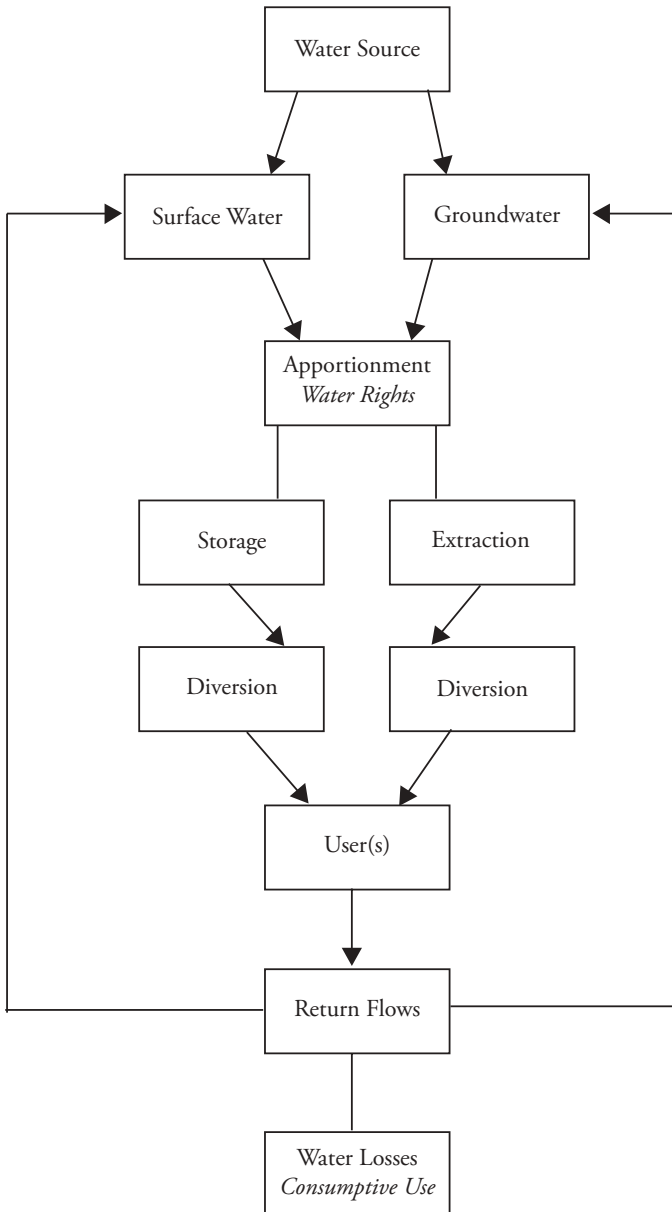
Figure 2 shows a conceptual framework based on the basic thermodynamic principle that matter is neither created nor destroyed. As Pearce and Turner (1990) point out, the environment becomes a supplier of services as well as a receptacle of waste in the sense that water taken out of the environment must be returned to the environment.

In the figure, it is assumed that the water cycle begins at a source that could be surface water or groundwater. Surface water flows in a defined channel, whereas groundwater can be stationary or follow a current. As needs arise, surface water can be captured, stored, and diverted to wherever it is used. On the other hand, groundwater has to be extracted or pumped from the ground and used on site or diverted through piping systems.

The core issue in water management is how the resource will be allocated among different users. The apportionment aspect of water shifts the discussion from the purely technical-engineering arena into the economic, social, and political context, where property rights play an important role. The property rights system determines how rationally and efficiently the resource is used.

When water has been used for domestic, agricultural, or industrial purposes, the quality of the water may be altered. Waste water, raw sewage, or water mixed with chemical substances can be hazardous to health. An important dimension of water regulation involves developing and implementing policies that ensure water

Figure 2. Water Management Scheme



Source: Authors

releases can meet certain standards that will not be harmful to humans or do irreparable damage to the environment. Finally, there is the issue of water lost to evaporation and evapotranspiration.

The Constitutional Role: Power Delegation

The constitution is the fundamental document that establishes the basic laws that regulate any society, and any law must derive from or be based on the constitution. The constitutions of Mexico and the United States address water rights and who has the legal power to regulate and legislate those rights differently.

The two countries could not be more different with regard to the powers that their constitutions assign to the federal governments. This reflects what Mumme (1982) refers to as “the dominant policy modes”—on the one hand a centralized political system and on the other hand a decentralized system that diffuses power. In fact, the U.S. Constitution makes only one reference to water issues, in Article I Section 8, whereas in Mexico Article 27 dedicates considerable time to water rights.

According to the U.S. Constitution, Congress shall have the power to make “Rules concerning Captures on Land and Water,” thus turning over authority to legislate water issues to the legislative branch of government. Article 27 in the Mexican Constitution gives the executive and legislative branches that same power. The Mexican Constitution states that all land and waters within the national territory belong to the nation, which at all times has the right to regulate private property on behalf of the public interest. Furthermore, the federal executive can regulate the extraction and exploitation of underground water on behalf of the public interest. Historically, the executive has had more power, although this has changed recently and a true check-and-balance system is developing among the branches of government.

The judicial branch of government has a contrasting role. According to Goldfarb (1988), the common law system in the United States gives to the judicial branch an active role through case law; litigation plays an important role in defining water rights. In contrast, the Mexican judicial system, which is based on civil law,

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determines whether some laws or acts of government are constitutionally legal, thus assigning the Mexican judicial system a more passive role.

Power Distribution among Government Levels

Article 124 in the Mexican Constitution and the 10th Amendment of the U.S. Constitution are important starting points to understanding the role each level of government plays in water rights. Both constitutions share a basic principle or rule of power delegation: Rights not explicitly assigned to the federal government or denied to the states are reserved to the states or the people.

The U.S. Constitution in Article 1 Section 8 gives Congress the power to legislate the capture of water; however, it does not explicitly delegate to Congress the power to legislate water diversion and apportionment. Based on the 10th Amendment, the power to legislate those issues belongs to the states. There are, however, tracts of federal land where states must account for the fact that the federal government is a stakeholder in water issues, specifically in national parks, national forests, on Indian reservations, and the like. According to Goldfarb (1988), the U.S. Supreme Court has decided that “the federal government is presumed to have reserved enough unappropriated water (surface or ground) to accomplish the purposes...” This matter is particularly important in western states with semi-arid and arid climates where federal land holdings are substantially large.

The Mexican Constitution is more explicit about the role of the federal government in water issues. It grants a great deal of power to the federal government—more precisely to the executive—compared to the power delegated to the states. Article 27 paragraph 5 is specific about which watersheds are considered national waters and, consequently, fall within federal jurisdiction. The following criteria are used to determine what qualifies as national water:

- Ocean water, according to international law
- If the water stream flows into the sea
- If the water stream crosses two nations
- If the water stream crosses two or more states

- If the water stream serves as a boundary of the states or nations
- Underground, as determined by the law

Furthermore, the Mexican Constitution in the same article recognizes that the landholder can appropriate groundwater but the federal executive can regulate or ban the extraction whenever the public interest requires it. Other types of water not considered in the article are deemed an integral part of property, but if the water source or aquifer is located in two or more properties, the water is considered to be of public interest and subject to state law. Therefore, states have limited power on water policy and administration because most of the watershed ecosystems extend beyond the artificial political boundaries of the states.

The above discussion demonstrates that the Mexican Constitution grants a great deal of power to the federal government and very little to the states; in the United States it is the opposite.

Mexico chose to centralize administrative decisions within the federal government to avoid the cumbersome legal problem of letting states deal with water appropriation whenever the watershed is shared by two or more states. In other words, the Mexican system of water rights can be described with the analogy of the “benevolent dictator” that economists often used to describe a non-market method of rationally allocating resources. The United States, by granting power to the states to deal with water issues, has generated a great amount of conflict between states, especially in the dry west. Interstate conflicts over water rights in the United States have been solved through three methods: interstate compacts, congressional allocation, and litigation between states in the U.S. Supreme Court under the international rule of “equitable apportionment” (Goldfarb 1988).

Power Distribution and International Waters

The United States and Mexico have considerable hydrologic resources involving both groundwater and surface water, such as the Colorado River and the Río Bravo/Rio Grande. Thus, it is important

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to understand how two countries with completely different legal systems have been able to craft an institutional framework to manage water allocation between themselves.

A constitutional principle that both countries share is a ban that prevents states from entering into treaties with a foreign power or government, thus preventing a state on either side of the border from crafting a transborder treaty. Article I Section 10 of the U.S. Constitution states that “No State shall, without the consent of Congress...enter into any Agreement or Compact with another state, or with a foreign Power...” The Mexican Constitution in its Article 89-X sets forth that the President directs foreign policy and engages in international treaties that are then ratified by the Senate.

The Mexican Constitution is even more explicit about surface water and groundwater. Article 27 paragraph 5 considers rivers whose watersheds cross two nations or serve as an international limit to contain federal waters. Furthermore, the right to regulate use of underground water is reserved for the federal executive.

In contrast, the U.S. Constitution does not provide standards like Mexico’s to determine the jurisdiction of the federal government on water. According to Goldfarb (1988), U.S. policy on international waters is made through treaties and uses “customary international law” to interpret them. The federal sphere of jurisdiction is bounded by what is agreed upon within international treaties; anything else becomes state jurisdiction.

The 1944 water treaty serves as a framework to determine the U.S. federal role and jurisdiction on water issues in the U.S.-Mexican border region. The main characteristic of the treaty is that it primarily deals with allocation of surface waters of the Río Bravo/Rio Grande, Colorado River, and Tijuana River. Section V of Article 24a gives IBWC authority over groundwater issues “to initiate and carry on investigations and develop plans for the works which are to be constructed or established in accordance with the provisions of this and other treaties or agreements in force between the two Governments dealing with boundaries and international waters.” Finally, IBWC Minute 242, signed on August 30, 1973,⁵ limits the pumping of groundwater within five miles of the Arizona-Sonora boundary and requires both countries to consult prior to undertaking any project involving surface water or groundwater.

Administration of Water Rights

The administration and management of water rights along the U.S.-Mexican border for efficiency and sustainability must address two substantially different property systems. The Ley de Aguas Nacionales (National Water Law), approved by the Mexican Congress in December 1992, is the regulatory instrument derived from Article 27 of the Mexican Constitution and sets the standards and procedures for distributing water rights. It also appoints CNA as the agency that administers the rights. In contrast, the U.S. system has neither a national comprehensive law nor a specific federal agency in charge of administering water rights; the administration of water rights falls to the state jurisdiction.

Article 27 of the Mexican Constitution states that "...property of land and waters within the boundaries of the national territory, originally belong to the Nation, which has the right to transfer its domain to individuals creating the private property." Furthermore, the National Water Law in Chapter II deals specifically with concessions and allocation. Article 20 establishes that the use and benefit of national waters by individuals or corporations will be made through concessions by CNA. Finally, the use and benefit can be revoked whenever the public interest requires it or when the concessionary fails to follow the rules.

In the United States, a water right is the same as any property and therefore is protected under the 5th Amendment (Goldfarb 1988). The holder of the right is entitled only to the "usufructuary right"—that is, the waterbody (lake, river, etc.) cannot be privately owned but is instead "owned by the state as trustee for its citizens" (Goldfarb 1988).

Table 1 presents the different types of water rights in the four border states on the U.S. side. The system of rights differentiates between surface water and groundwater.

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Table 1. Water Rights Diversion in the U.S. Border States

	Surface	Groundwater
Absolute ownership		Texas
Reasonable use		Arizona
Correlative rights		California
Prior appropriation	Arizona New Mexico Texas (after 1913)	New Mexico
Riparian	California Texas	

Source: Authors

As Table 1 shows, different U.S. border states practice different water rights doctrines. Absolute ownership does not impose any constraints on diverting water. Some authors say that the owner with the “biggest pump wins.” Prior appropriation operates under “first in time, first in right” as well as “use it or lose it,” which means that to continue claiming the right the owner must have a beneficial use for the resource. Correlative rights mean that in times of shortage “fair and just proportion” among the users is applied. Reasonable use of groundwater is similar to absolute ownership and follows two rules: waste is prohibited, and water must be used on land overlying the aquifer and can be transported only if it does not affect other owners (Golfarb 1988; Mumme 1982; Harris, et al. 1990). Riparian rights are mainly applied to surface water and are widely used in the eastern United States where water is not as scarce as in western states, which rely more on groundwater. This is a significant issue. In order to have riparian rights, property must be adjacent to the stream or one of its tributaries.

A fundamental difference between the two property rights systems is the transfer of the right. In the United States, water is treated as a property and the right can be sold and purchased like any other commodity. However in Mexico, water rights from national waters are concessions. If the owner fails to comply with

the terms of the concession, it can be revoked.⁶ For example, Article 27d of the Mexican water law states that the concession can be terminated if rights are transferred in violation of the law. This presents a major problem in establishing alternative water policies such as a binational water bank at the U.S.-Mexican border.

Furthermore, the different laws and water rights systems of the border states make matters more complicated. Border states in the United States apply a combination of water rights to deal with surface water and groundwater. The two most widely used systems are inefficient in the sense that the water is not allocated to its highest and best use. "First in time, first in right" does not allocate water to the best use, nor does "use it or lose it" promote conservation or a rational use of the resource. This has caused some states to establish regulations that promote conservation rather than a more efficient allocation method involving the reasonable use doctrine or correlative rights.

It is important to emphasize that Article 3 of the 1944 treaty assigns some priorities among users of international waters. It reads, "In matters in which the Commission may be called upon to make provision for the joint use of international waters, the following order of preferences shall serve as a guide: 1) domestic and municipal uses, 2) agriculture and stock raising, 3) electric power, 4) other industrial uses, 5) navigation, 6) fishing and hunting and 7) any other beneficial uses which may be determined by the Commission."

Water Quality and Protection

Water quality and water pollution are areas where the federal governments in both countries have the most active role. The right of governments to regulate issues affecting water quality is based on police power. This refers to the rights of governments to impose regulations and laws to protect the safety, morals, public health, and welfare of its citizens. Regulation of water releases or uses can protect water quality, and thus, the public health and welfare of the people.

In the United States, environmental protection and conservation were in the forefront of the 1970s political agenda after several events, including the oil embargo in Arab countries and discoveries

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such as the toxic pollution at Love Canal, a former chemical landfill in Niagara Falls, N.Y., that became a 15-acre neighborhood (SUNY Buffalo 2001). Since then, the federal government has been active in passing legislation to protect the environment. A number of federal mandates directly or indirectly relate to water, including the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Wild and Scenic Rivers Act, and the Clean Water Act. A key characteristic of environmental policy in the United States is that the federal government sets environmental standards and state and local governments are free to implement policies and comply with the federal mandate. The U.S. Environmental Protection Agency (EPA) supervises compliance or non-compliance and provides technical and financial assistance to local governments (Goldfarb 1988).

In Mexico, two constitutional articles address water pollution prevention. The 1987 constitutional reforms to Article 27 incorporated concepts such as conservation, restoration, and ecological balance. Article 73-XXIX-G empowered Congress to pass legislation to coordinate policy at all levels of government to protect, conserve, restore, and balance the environment. This created the most comprehensive environmental law, called the *Ley General del Equilibrio Ecológico y la Protección al Ambiente* (General Law of Ecological Balance and Environmental Protection, in Spanish LGEEPA) (Gonzalez and Montelongo 1999). Environmental policy was put at the top, to the level of a state department, under the *Secretaría de Medio Ambiente y Recursos Naturales* (SEMARNAT).

With regard to environmental policy on the U.S.-Mexican border, IBWC Minute 261, titled "Recommendations for the Solution to the Border Sanitation Problems," undertaken in 1979, was the first formal agreement protecting the border environment.⁷ In 1983, the Agreement on Cooperation for the Protection and Improvement of the Environment and Transboundary Problems, known as the La Paz Agreement, set the basis for the protection and preservation of the environment, as well as for cooperation among the different binational institutions. Since then, task forces have been established involving different departments and agencies on both sides of the border, such as EPA and SEMARNAT.

In 1990, Presidents George H. W. Bush and Carlos Salinas de Gortari met and made border environmental conditions a top priority. As a result, both countries agreed to develop a comprehensive plan, the Integrated Border Environmental Plan (IBEP). The purpose of the plan was to foster environmental coordination and cooperation between the two countries. The Border XXI Programs were the continuation of these cooperative efforts and attempts to promote and include public participation in the design stage of the plans. Another binational agency, BECC, was created to deal with the environmental effects on the border resulting from the economic integration of Mexico and the United States. BECC's mandate includes drinking water as well as sanitation.

In spite of efforts to address sanitation problems on the U.S.-Mexican border, water pollution continues to be a serious threat not only to the physical environment but to public health. According to Herzog (2000), environmental problems are linked to land use decisions. This means any environmental policy enacted on the border also must consider land use decisions.

Legal issues constrain the coordination of environmental policies and land use decisions. For example, both federal governments gave IBWC the legal authority to address sanitation problems related to water outflows that end up in rivers or the ocean. IBWC, however, does not have jurisdictional authority over land use decisions. In the United States, land use decisions are a local matter, according to the 5th and 10th Amendments. In Mexico, Article 115 gives local governments authority to regulate land uses; however, the constitution also allows the federal and state governments to have some input on the issue, as set forth in Article 73-XXIXC. BECC, in this regard, has an advantage and could play an important role, especially since its mandate has been expanded to offer technical assistance to communities on projects related to air quality, public transportation, municipal planning, and water management. A key difference between BECC and IBWC is that IBWC projects are a result of a treaty and therefore resources are allocated from the federal government. BECC projects have to be funded either through its operating budget, NADBank, or grants from EPA, SEMARNAT, or others.

WATER MANAGEMENT AND POLICY OPTIONS ON THE U.S.-MEXICAN BORDER

Recent controversy over the water debt Mexico owes the United States has captured media attention. Under Article 4 of the 1944 water treaty, the United States is entitled to “one-third of the flow reaching the main channel of the Rio Grande (Río Bravo) from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vacas Arroyo, provided that this third shall not be less, as an average amount in cycles of five consecutive years, than 350,000 acre-feet (431,721,000 cubic meters) annually.” Due to severe drought, Mexico did not deliver the water in a timely fashion as the treaty required and the amount of water “debt” reached 1,541,268 acre-feet on June 22, 2002. According to IBWC, the “debt” as of September 2004 is about half (741,012 acre feet) of what it used to be in June 2002. The water debt has become an issue that makes the U.S.-Mexican relationship difficult. The issue became politicized when Mexican politicians saw the opportunity to win voters by adopting nationalistic defensive positions. Meanwhile, Texas politicians used the issue to win votes by arguing that Mexico was hoarding water.

Over the past three decades, economic growth led by the maquiladora industry went hand in hand with population growth in border municipalities. The population in border communities has increased rapidly since 1970, particularly in cities such as Tijuana, where the population more than quadrupled in 30 years from approximately 277,000 in 1970 to nearly 1.2 million in 2000. In Ciudad Juárez, the population tripled in 30 years from more than 407,000 in 1970 to more than 1.2 million in 2000.⁸ This population growth has made it difficult for communities such as Ciudad Juárez to provide basic services like drinking water without also seriously depleting the source aquifer. This situation raises new cross-border issues because of the lack of an institutional framework for dealing with groundwater pumping (except for some restrictions imposed by IBWC Minute 242, as explained earlier). Also, El Paso and Ciudad Juárez have moved their attention to surface water as an

alternative water supply source, creating fierce competition not only among different water uses, but also creating competition and litigation between states such as Texas and New Mexico.

Circumstances and context have changed from the time when the southwest United States was open to settlement and when Mexico and the United States signed the 1944 water treaty, which is the current institutional framework for water allocation between the two countries. An important question is, What policy alternatives exist that would make possible an institutional framework to allocate water in a more efficient and sustainable way? Three policy alternatives, advocated by different scholars, are evaluated in the remainder of this chapter. The first option is a null alternative of taking no action; the second option is to create binational watershed councils (Brown and Mumme 2000); the third option involves creating water banks, which are advocated by economists and have been approved as a pilot project by the New Mexico legislature to allocate waters from the Pecos River.

Evaluation Criteria

The evaluation criteria developed by Ostrom, et al. (1993) can be used to analyze the advantages and disadvantages of bilateral and binational approaches to environmental management on the U.S.-Mexican border. The institutional evaluation criteria developed by the authors is divided into two broad categories: overall performance criteria and intermediate performance criteria.

The overall performance criteria for evaluation of institutions include economic efficiency, equity, accountability, and adaptability. The intermediate performance criteria refer to the cost of service and include transformation costs and transaction costs (coordination, information, and strategic).

Economic Efficiency

Economic efficiency of water delivery and management is when regulation and policy in both countries could achieve an environmental balance to ensure the basic function of the environment as a “resource supplier” and “waste assimilator” (Pearce and Turner

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1990). Thus, border institutions whose functions relate to resources management should be judged on how well they reach the ideal state of environmental equilibrium.

In evaluating the three policy alternatives, the null alternative of taking no action in either Mexico or the United States is assigned a low ranking because the probability that the environment can continue to be a resource supplier and waste assimilator is low. Furthermore, the western United States' property rights systems currently in use, such as prior appropriation and absolute rights, are wasteful. The first operates under "use it or lose it," and the second, "the biggest pump wins" (Goldfarb 1988); this means water is not put to its highest and best use. As a consequence, water-saving technologies and crops are discouraged. In Mexico, however, there exists a centralized management system that could easily make changes to water rights and allocation. The key problem is the lack of financial resources to improve not only irrigation ditches but the leaky and wasteful urban water delivery systems.

In theory, water banks would be a way to allocate the resource to its highest and best use through market mechanisms. The ultimate outcome of a water bank is that the market will price the water based on its marginal costs, and that those users who value the resource more will pay those willing to sell. For example, urban users purchase rights from agricultural users and this will encourage farmers to implement water-saving technologies because they could make money selling crops and water. According to the New Mexico Legislature, the water bank is "... a water management strategy that speeds up the temporary transfer of water from those willing to lease it to those willing to pay to use it" (New Mexico Legislature 2001).

Table 2. Economic Efficiency

Economic Efficiency	Null Alternative	Watershed Council	Water Banks
U.S.	Low	Medium	High
Mexico	Low	Medium	?

Source: Authors

In the United States, a water bank may be a good strategy to achieve economic efficiency because water rights are defined as property and can be transferable. However, Mexican water rights are defined as concessions and are not tradable, thus making the possibility of a water bank unlikely.

Watershed councils, according to Brown and Mumme (2000), are regional institutional mechanisms that manage water resources in Mexico, and they could be applied in a binational regional context. The key to understanding the economic efficiency of watershed councils is management coordination—instead of a fragmented coordination where the same watershed could have several managers each representing the interest of his constituency and overlooking the whole system, a council would be a mechanism where policy-making can happen in a more comprehensive and holistic way. In other words, economic efficiency of resource allocation can be achieved through an administrative regional institution that reduces transaction costs (in the form of coordination, information gathering, and sharing) as well as strategic costs.

Equity

Equity can be approached using the concepts of *pareto optimum* and *pareto superior*, which are used in economics to evaluate welfare policy. A *pareto optimum* is defined as a situation where the welfare of a water user cannot be improved without making other water users worse off. A *pareto superior* can be achieved when the welfare of the water user is improved in such a way that the marginal benefit is greater than the marginal costs of the affected party, and compensation could take place, thus transforming the situation into a positive sum game.

Under the null hypothesis, the United States scores low in the equity criterion using the *pareto optimum* and *pareto superior* concepts. Under the current water rights system that prevails in the Western states, the burden of scarcity or drought is not shared equitably. For example, under the prior appropriation system, priority is given to the senior appropriators under “first in time, first in right.” When rationing is required, the first users to be shut down are the junior appropriators or later claimants (Goldfarb 1988). The pro-

Table 3. Equity

Equity	Null Alternative	Watershed Council	Water Banks
U.S.	Low	Medium	High
Mexico	Medium	Medium	High

Source: Authors

portional principle in Mexico is applied to manage scarcity during drought; that is, all water users share the drought burden equally in a way similar way to the riparian rights system. Although closer to a *pareto optimum* outcome, it is far from *pareto superior*.

The watershed council strategy is assigned a medium grade because equity will be approached in the same fashion as in Mexico, and users will share a proportional burden. It is unclear whether a watershed council would involve changes in the water right system or simply institutional changes among agencies (Brown and Mumme 2000).

Water banks will deliver the most equitable outcome, given that, theoretically, a *pareto superior* situation could be reached. For example, agricultural users willing to sell their water rights to urban dwellers implicitly are incurring an opportunity cost (farming); however, benefits (recreational amenities, nice landscaping, healthier communities) to urban dwellers outweigh the private costs (forgone income for the farmer) as well as the social costs (employment losses and multiplier effects) associated with discontinuing farming. If the price is set right, everyone, in theory, should be better off.

Accountability

Accountability requires a system where all users (agriculture, domestic, environment/ecosystem) have equal rights and claims to the resource and the administrator allocates those resources in the most transparent way. Table 4 shows the evaluation given to each alternative with regard to accountability.

Table 4. Accountability

Accountability	Null Alternative	Watershed Council	Water Banks
U.S.	Medium	High	?
Mexico	Low	High	?

Source: Authors

In the null alternative, the United States certainly has taken bigger steps in making policy decisions more transparent, as well as in incorporating democratic principles in its planning approach. In contrast, for many years Mexico lagged behind in accountability and policymaking by following a top-down model. Furthermore, the judicial system gives the United States a venue to challenge government actions. For example, IBWC is often sued by state water quality boards and environmentalists for violating EPA water outflow standards of treatment plants such as the binational wastewater treatment plant in San Diego.

Under the null alternative, water managers are often accountable only to their own constituencies, including water districts, federal governments (as in the case of IBWC) (Peña 2004), or urban dwellers (as in the case of water utilities boards). Since fish and native plants cannot speak for themselves, the ecosystem is often overlooked. The fragmented and clashing interests of water users are unified and made more transparent under the watershed alternative. This approach could help maintain healthier ecosystems, thus making it the best option for accountability.

Transparency or accountability issues are quite different from those in the political or public arena under a market situation. In a market where perfect competition exists, buyers and sellers are well-informed of prices and quantities available. Neither buyer nor seller can change the prices, and entry and exit into the market is free. Also, buyers and sellers are rational actors seeking to maximize the market's benefit. On the other hand, there are markets where a seller exercises great power (monopoly) and by controlling quantity can manipulate both prices and buyers. In summary, as Table 5 shows,

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transparency improves as the water market bears a closer resemblance to perfect competition. In this situation, Mexico is the country that shows room for improvement.

Adaptability

Adaptability (Table 5) is the institution's ability to transform its function to the changing context of the U.S.-Mexican relationship on border issues. The null alternative offers the best outcome for adapting and transforming to the changing context; the watershed council option is the least adaptable.

The null alternative is ranked higher for several reasons. Time is a good criterion for testing the flexibility of the present institutional arrangements for managing water. The Treaty of Guadalupe Hidalgo between the United States and Mexico in 1848 established the actual boundary between the two countries and the 1944 water treaty provided the current framework for allocating water between them. This combination of treaties has proven flexible enough and has allowed the two countries to work out their differences in a civilized and peaceful way (Peña 2004). The property rights system has avoided a massive rebellion of water users, although it has not prevented scarcity or environmental deterioration.

Watershed councils are ranked lowest because they will require a substantial institutional change at all levels of government—mostly in the United States. It will also be difficult to assess the degree of flexibility that this alternative offers. Furthermore, given the fact that several actors will be involved or considered, it will be difficult to reach consensus or change institutional culture (as Brown and Mumme [2000] recognize). Mexico has been practicing this option, so adopting this approach as a binational model would be relatively

Table 5. Adaptability

Adaptability	Null Alternative	Watershed Council	Water Banks
U.S.	High	Low	Medium
Mexico	High	Low	Medium

Source: Authors

easy. In addition, the strong power that the Mexican federal government has over water issues, compared to the United States, may facilitate the operation of the councils.

A water bank or water market would operate under the assumption that any changes in water demand will cause a shift to supply those needs. For example, if water demand increases among domestic or urban users due to changes in the population income,⁹ there will be a shift of supply from non-domestic to domestic water users. However, flexibility and adaptability depends on how well the market works to allocate water, as shown in Table 6.

Intermediate Performance

Intermediate performance criteria refer to the cost of service, including transformation costs and transaction costs (coordination, information, and strategic). According to Ostrom, et al. (1993) transformation costs are the costs involved in turning stakeholders' preferences and willingness to pay into concrete demand packages, a financing mechanism, monitoring, regulation, and enforcement. Transaction costs (Table 6) in a simple market exchange between a buyer and a seller are normally low.¹⁰ However, in situations where the number of actors and the type increase, the transaction costs grow as well. From this discussion three types of transaction costs are identified: coordination costs,¹¹ information costs,¹² and strategic costs¹³ (Ostrom, et al. 1993).

Transformation costs in this context are those involved in transforming the resource from its source (water) and allocating it among users (including domestic and agricultural, among others) who put it to a beneficial use. The transformation costs in the United States are extremely high due to the fact that the decentralized system

Table 6. Transformation Costs

Transformation Costs	Null Alternative	Watershed Council	Water Banks
U.S.	High	High	Low
Mexico	Medium	High	Low

Source: Authors

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allows for a greater number of entities (such as federal and state agencies, regional boards, and water districts) that provide fertile ground for a high amount of litigation between states, users, agencies, and others. In Mexico, the centralized system allows CNA to coordinate water allocation, thus significantly reducing transformation costs. The total budget of IBWC and its Mexican counterpart, Comisión Internacional de Límites y Aguas (CILA), could be used as a proxy of transformation costs to allocate water between Mexico and the United States, plus whatever BECC, EPA, SEMARNAT, and other agencies contribute.

The watershed council alternative would have the highest transformation costs because in addition to the aforementioned transformation costs are those of several new binational regional agencies in each watershed along the U.S.-Mexican border. This alternative could have lower transformation costs only if some agencies disappear. In that case, coordination costs would be lower; however, this alternative is highly unfeasible politically.

Water banks' or markets' transformation costs depend on the cost to gather information or the degree of power that some buyers or sellers will have. As has been stated, if information is scarce and powerful players could affect supply and demand, the transformation cost would be higher. In summary, the transformation costs depend on the degree of imperfection in the water market, which in theory could be very low.

CONCLUSION

This chapter, which focused on the institutional analysis of land use and water, may prompt the questions: What is the relationship between land use and water? And, what is the importance of the institutional framework for modeling purposes?

Herzog (2000) provides an excellent answer to the first question by stating that land use is the "glue" that puts together the built environment and the natural environment. In other words, public policy decisions regarding the way a society builds and organizes the urban environment will have an effect on natural resources. This implies that any policy regarding the management of natural resources, such as water, needs to go in tandem with urban policy.

Land use policy is, perhaps, the most widely used planning tool to shape the urban environment, so the effects of poor land use policy are likely to be reflected in the natural environment in the form of negative externalities.

The Paso del Norte region faces a dual problem concerning water—quantity and quality. This chapter demonstrated that the current institutional framework, to a great extent, is part of the problem but also can be part of the solution. For example, on one hand poor land use decisions have an effect on water quality, on the other hand an obsolete property rights system that discourages more efficient practices and allocation contributes to the problem of water scarcity.

El Paso and Ciudad Juárez taken together are one of the largest binational conurbations in the world with a population of nearly 2 million people. It is imperative to not only coordinate land use policy but also reform the institutional mechanisms that govern water rights and allocation. This chapter identified the legal constraints that interfered with land use coordination and discussed alternative institutional arrangements (binational watershed councils and water banks) to allocate resources in a more efficient and effective way to deal with water scarcity. It is the authors' intention that future discussions of models promoted by the Southwest Consortium for Environmental Research and Policy (SCERP) would take into consideration not only the technical aspects but also the institutional and policy aspects.

Regarding the second question of why institutional analysis is important from a modeling perspective in general and for the Border Plus Twenty Years (B+20) model in particular, an institutional analysis offers alternative scenarios that can be explored in the model. The institutional analysis brings the model into reality; that is, the modeling process moves from being a simple scientific curiosity of particular interest for researchers into a tool that can be helpful for public policy. Although, B+20 does not include water banks explicitly as a module, this does not mean the implications of implementing certain land use decisions or shifting property rights regimes cannot be explored. This can be accomplished by adjusting the parameters within the model to be able to explore alternative policies. The B+20 model offers ways to adjust levels of variables to

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explore the implications of changing certain policies, including, for example, increasing the price of water, paving roads, and connecting each household to the sewer system.

ENDNOTES

¹ "...[A] municipal corporation possesses and can exercise the following powers and no others: First, those granted in express words; second, those necessarily implied or necessarily incident to the powers expressly granted; third, those absolutely essential to the declared objects and purposes of the corporation—not simply convenient, but indispensable..." *Merriam v. Moody's Executors*, 25 Iowa 163, 170 (1868) in Black (1991).

² In 1996, Mexico's Supreme Court ruled in favor of the plaintiffs, arguing that the Agrarian Reform Secretary's confiscation of 100 hectares of land in 1973 to create Ejido Colonia Estebán Cantú was illegal. Since 1973, the land had been subdivided and leased by the *ejido* people to Americans, who built their homes. With the eviction order, many risk losing their investment and it is unclear whether they are entitled to compensation.

³ The treaty of February 3, 1944, for the "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande" distributed the waters in the international segment of the Rio Grande from Fort Quitman, Texas, to the Gulf of Mexico. This treaty also authorized the two countries to construct, operate, and maintain dams on the main channel of the Rio Grande. The 1944 treaty changed the name of the International Boundary Commission to the International Boundary and Water Commission (IBWC), and in Article 3, the two governments entrusted IBWC to give preferential attention to the solution of all border sanitation problems (IBWC No Date).

⁴ IBWC has a Mexican section, the Comisión Internacional de Límites y Aguas (CILA).

⁵ “Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River.” Both the United States and Mexico approved the Minute on August 30, 1973. For a discussion of groundwater issues, see Mumme 1982 and 1988.

⁶ A concession can be revoked if: 1) the term of the concession expires and it is not renewed; 2) the volume diverted exceeds the allotment; 3) fees are not paid; 4) the work’s agreed-to terms have not been executed; 5) there is a transfer of rights in violation of the national water law; 6) the exploitation, use, benefit, or return flows are in violation; 7) the concession is not exploited during three years; 8) the public interest requires it; and 9) a court overturns or cancels the right.

⁷ This minute, signed September 24, 1979, was the result of a request made to IBWC and CILA by Presidents Jimmy Carter and Lopez Portillo to deal with sanitation issues on the U.S.-Mexican border (see Bustamante 1999).

⁸ Data come from Lorey 1993 and <http://www.inegi.gob.mx/estadistica/espanol/economia/feconomia.html>.

⁹ Water, according to different studies, is price-inelastic but income-elastic. Thus, consumer consumption patterns change very little when the price of water is increased. However, the consumption patterns of the consumer change substantially when personal income increases.

¹⁰ This idea is derived from the Coase theorem, which states that in the absence of transaction costs, resources would be allocated to the highest bidder.

¹¹ Coordination costs are the sum of the costs of the time, capital, lawyers, and personnel invested in monitoring and enforcing water rights.

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¹² Ostrom, et al. (1993) define information costs as the sum of the costs of searching for and organizing information, and the costs of errors resulting from a lack of or an ineffective blend of knowledge about time and place variables and general scientific principles.

¹³ Strategic costs are the increased transformation costs produced when individuals use asymmetric distribution of information, power, or other resources to obtain benefits at the cost of others (Ostrom, et al. 1993).

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