

# Water institutional reforms in Chile

Robert R. Hearne<sup>a</sup> and Guillermo Donoso<sup>b</sup>

<sup>a</sup>*Corresponding author. North Dakota State University, Fargo, North Dakota, USA.*

*Fax: 701-231-7400. E-mail: rhearne@ndsuxext.nodak.edu*

<sup>b</sup>*Ponificia Universidad Católica de Chile, Santiago, Chile*

Received 9 June 2004; accepted in revised form 19 August 2004

---

## Abstract

This paper provides a review of the recent institutional changes observed in the water sector in Chile. This review is then used to reflect the Chilean experience in the light of the results concerning institutional change found in existing literature on both institutional economics in general and water institutional economics in particular. These results relate to factors explaining institutional change and the role of endogenous institutional features, such as path dependency and institutional linkages during the reform process. Against a brief description of the main features of the water sector in Chile, the paper provides an overview of Chilean water management institutions and the reforms process ongoing since the 1980s. The factors that motivated institutional changes in Chile's water management include ideology, transactions costs, interest-group behavior and path dependency. While the already observed institutional changes, such as the transferable water rights, water markets and urban water reforms, are all significant, further reforms are delayed by the deliberate legislative process required for changes as a result of the 1980 Constitution. Future water reforms in Chile, therefore, depend on a very difficult process of political reforms needed to change the 1980 Constitution and the 1981 Water Code.

*Keywords:* Water institutions; Water resources management; Institutional reforms; Water markets; Water policy; Water law; Chile

---

## 1. Introduction and background

The water management policy in Chile has been noteworthy for its innovative adoption of market mechanisms for water allocation. Economic liberalization enacted during the military government of 1973–1989 included the 1981 National Water Code, which established transferable water use rights and facilitated water markets. Despite inter-sectoral conflicts, the paradigm of

secure property rights and limited governmental regulation has been maintained since 1981. An increased private sector participation in water supply and sanitation provision has further reduced the role of the state. The allocation of secure property rights has, in general, been beneficial to most sectors of the economy. The irrigation sector has invested in irrigation technology and expanded the production of permanent fruit crops. It has permitted the development of mining activities in areas characterized by water scarcity through the acquisition of water use rights from agriculture. The favorable business climate for water supply and sanitation companies has led to high levels of service coverage and increased investment in wastewater treatment. In some rivers with significant hydroelectric potential the incomplete specification of non-consumptive use rights has led to conflicts. In general, water markets have not become institutionalized. However, despite conflicts and concerns that the state needs greater power to regulate water for the public good, efforts to modify the 1981 Water Code have not gathered the requisite political support.

This paper provides a review of the recent institutional changes observed in the water sector in Chile. This review is then used to reflect the extent to which the institutional reforms observed in Chile conform to some of the results concerning institutional change found in existing literature on both institutional economics in general (e.g. North, 1990) and water institutional economics in particular (e.g. Saleth & Dinar, 2004). These results relate mainly to the factors explaining institutional change and the way endogenous institutional features such as path dependency and institutional linkages have influenced the reform process. From here on, the paper is organized as follows. The second section will present some key features of the water sector in Chile. The third section of the paper will present an overview of Chilean water management and institutional change observed since the 1980s. The fourth section will present the reasons for the occurrence of change and for the slowness of the change in the period since democratic rule. The fifth section will present a discussion of the successes and remaining challenges in the realm of water institutional reforms and change in Chile. The final section concludes by summarizing the main points and suggesting policy implications.

## **2. Key features of the Chilean water sector**

Chile's unique geography provides a variety of climatic conditions and a number of short river valleys running from the Andes to the Pacific Ocean. Two primary mountain ranges, the Andes and the Coastal Mountains span the length of central Chile and provide the limits to the coastal plain and the central valley. Precipitation ranges from near zero in the north to an annual 2,000 mm in the south (see Fig. 1). The rainy season is in winter and much of the precipitation is stored in the snowpack, which is favorably released to irrigation systems for crop production during spring and summer.

Water withdrawals in Chile average 2,000 m<sup>3</sup>/s. Of this almost 68% is used in non-consumptive hydroelectric generation. Despite a diversified economy, water use in Chile is dominated by irrigation, with 85% of consumptive water use. Industrial use of water is 7% of withdrawals, mining and potable water supply each accounting for a little more than 4% of total water use. Freshwater recreation is increasing, with interest in rafting, fishing and boating in lakes and reservoirs. Most of Chile's large commercial fishing activities are in ocean and coastal waters.

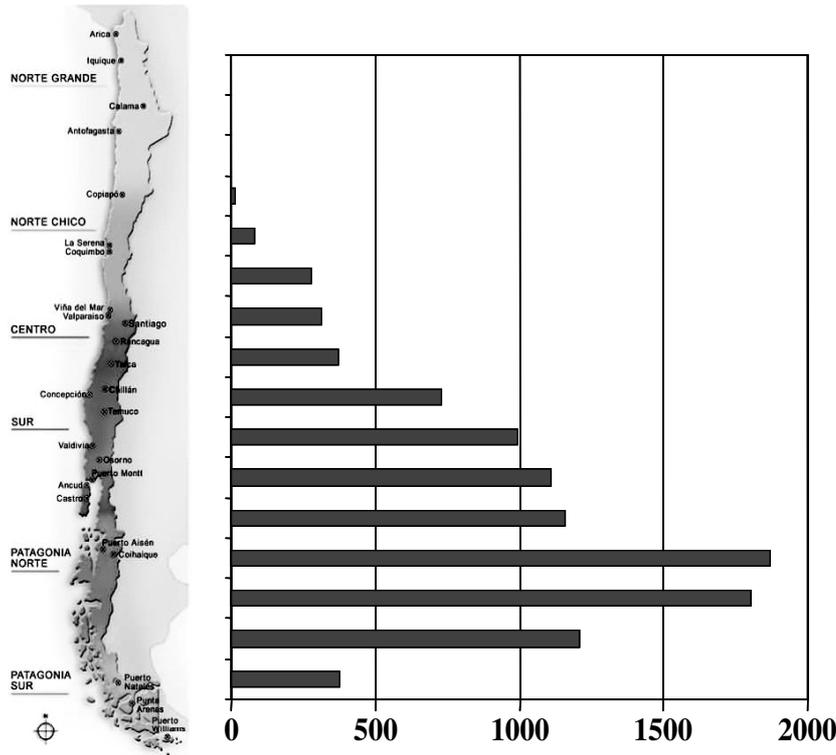


Fig. 1. Map of Chile and average rainfall (mm/yr).

In the northern Chile desert, approximately between 17° and 26° south latitude, the limited water resources sustain a few coastal cities, some specialized agriculture and a few large mining operations. This is the principal copper mining area in Chile. In north central Chile, between 26° and 33° south latitude, there is an adequate supply of water in a few river valleys for canal irrigation. Water storage reservoirs have been constructed to support these irrigation systems, especially in the Limarí Valley where three reservoirs have a storage capacity of 990 million m<sup>3</sup>. Central Chile, between 33° and 39° south latitude, contains the nation's principal urban and industrial areas, including Santiago with a population of 5,700,000. Irrigated crops include fruits, vineyards, basic grains, forage and vegetables. Industrial products include processed food, pulp and paper, chemicals, plastics and petroleum products. Also central Chile remains the region with the greatest hydroelectric generation capacity, especially in the Maule and BíoBío basins. Southern Chile, south of 39° south latitude, is humid, forested and scarcely populated. There is little irrigation in the area, which produces forest products, cereals, dairy and livestock, potatoes and sugar beets. Because of its cool water, clear lakes and coastal fjords, this area contains Chile's large aquaculture industry. In 2002, there were an estimated 400 marine and 185 freshwater salmon and trout farms in the region.

Chile has a high level of coverage of potable water and sewerage systems. This is perhaps facilitated by the 86% of Chile's population living in urban areas. In 2000, 99% of the urban

population and 72% of the rural population had access to improved potable water, and 96% of the urban population and 97% of the rural population had access to improved sanitation (WRI, 2003).

Irrigation in Chile was initially developed with private-sector investment. Over one million hectares of mostly small run-of-the-river systems were developed by private investors. In the 1930s, the government began to develop large water catchment and canal systems. Contracts to recover the capital costs of these projects were denominated in local currency, so that after inflation they became negligible. Thus the total irrigated area in Chile has remained stable in the last 50 years. Recent investments in pressurized irrigation technology have modified irrigation practices, but 91% of the irrigated area utilizes surface irrigation. The principal irrigated crops include cereals, fruits, forage crops, vegetables and vineyards (Instituto Nacional de Estadísticas, 1998; FAO, 2000).

Chile has 4,025 MW of hydroelectricity generation capacity, which was about 40% of the nation's installed capacity, in 2002. There are 33 hydroelectric plants with installed capacity greater than 10 MW. Many of these are small run-of-the-river plants. There are eight larger plants with reservoir storage, which are mostly concentrated in the Maule, Bío Bío and Rapel Basins. Water pollution levels in Chile are generally high, mainly owing to the discharges of biochemical oxygen demand (BOD), suspended solids, oil and grease and metals from domestic and industrial sources. Nationally, in 1992, the discharges of domestic and industrial wastewaters accounted for approximately 43 m<sup>3</sup>/s (SISS, 1993). Domestic wastewater discharges account for 56% of these discharges and industrial wastewaters represent 44% of the total.

### 3. Nature and extent of institutional changes

#### 3.1 *Water law, water rights and water markets*

Chile has had a tradition of irrigation, private canal users' associations and water use rights that dates back to colonial times. The first Chilean text to regulate the use of water is an 1819 Executive Decree, which defined the dimensions of an irrigating system, form of sale and responsibility for water intakes. The 1855 Civil Code declared that "rivers and all waters that run through natural channels are national goods of public use" and establishes that access to water is obtained by means of water use rights "granted by the competent authority". The concept of "Water Use Right" was further developed in the 1930 and 1951 Water Codes. The latter established that "the right to use water may only be acquired by virtue of a *merced*" or Water Right granted by the President of the Republic". This code defines water use rights as follows: "The water right is an actual right that falls on publicly owned waters and which consists in the use, possession and disposal of such waters fulfilling the requirements and in accordance with the rules prescribed herein". Therefore, the 1951 Water Code formalized the private water use rights and the role of the state in administration of these rights (for more details see Vergara, 1998).

Because of its more centralized political context, the 1967 Water Code reinforced the concept of water as public property but changed the legal nature of water use rights, stressing that these were administrative rights where the state grants the use of the waters, subject to public regulation. These water use rights could expire and the process of water reallocation was to be based on

regional water use plans executed by means of studies that determined the rate of rational and beneficial use. Thus, the 1967 Water Code greatly strengthened the state in its control of water and facilitated the Agrarian Reform, which redistributed large estates. During this period, land and water use rights were expropriated without compensation and water was reallocated in accordance with state planning (Bauer, 1998). However, it is important to point out that the 1967 Water Code was not fully implemented owing to lack of institutional capacity and resources during the Allende government (1970–1973).

After the political changes that occurred in Chile in 1973, where the military coup reversed the “statist” and socialistic tendencies of the previous Frei Montalva (1964–1970) and Allende (1970–1973) governments, the existing economic paradigm changed from one where the state must ensure the optimum allocation of resources, to one where market forces dictated efficient allocation. The government thus introduced neo-liberal economic policies, which supported private property rights, free markets and eventually increased international trade.

Among the many neo-liberal reforms introduced by the military government was the 1981 National Water Code. This reform complemented the final stages of the Agrarian Reform, when land expropriated prior to 1974 was divided into small farms and rights to land and water were granted to the occupants, including approximately 48,000 small farmers. During this process, 28% of the total expropriated land was returned to its original owners (Chonchol, 2000). The 1981 Water Code maintained water as “national property for public use”, but granted permanent, transferable water use rights to individuals. These water use rights granted security to their owners that water would not be expropriated without due compensation and allowed for the possibility of the reallocation of water through market transactions. Rights were initially allocated to those who had been using the water, especially irrigators and urban water supply companies, including the beneficiaries of the privatization phase of the agrarian reform. The 1981 Water Code specified rights for both surface and groundwater as well as consumptive and non-consumptive uses. Non-consumptive rights were designed to facilitate the development of hydroelectricity, while maintaining consumptive rights for irrigators and other users. These non-consumptive rights allow the owner to divert water from a river with the obligation to return the same water unaltered to its original channel. Consumptive use rights are, according to the law, specified as a volume per unit of time. However, given that river flows are highly variable in most basins, these rights are traditionally recognized as shares in a river or canal and reduced proportionally in times of scarcity. In some basins, the traditional shares assigned to potable water utilities are not reduced in times of drought (Hearne & Easter, 1995).

New water use rights can also be obtained upon petition to the Directorate General of Water (DGA), provided there is technical evidence for the availability of water resources and that the new use does not harm existing rights holders. For groundwater rights the yield and depth must be specified. Upon application the solicitude is published in the official journal and can be opposed by other rights owners. If there is competition for solicited water rights, they are to be allocated through an auction with an award to the highest bidder. The DGA may not refuse to grant new water rights without infringing a constitutional guarantee. But, the DGA can declare certain aquifers to be fully exploited and refuse to grant new groundwater use rights. And the state, concerned about monopolistic behavior and supported by the antimonopoly commission, has refused to grant new non-consumptive rights. In fact, the Constitutional Court has established that the state can impose additional conditions on petitions for new water use rights by reformulating

the Water Code. This has led to proposals to amend the dispositions of the Water Code of 1981 that force the state to grant new water use rights (Peña, 1999).

Water use rights need to be officially registered in order for them to be protected. Since the promulgation of the 1981 Water Code, efforts have been made to regularize and grant title for water rights in order to resolve overlapping claims to land and water. This is especially important for water rights that were redistributed under the Agrarian Reform and might be contested by previous owners. Efforts to gain title to water can be burdensome for small farmers. All water use rights should be registered at the local real estate registries. But estimates of those rights that are not registered range from 90% to 60% (Dourojeanni & Jouravlev, 1999). Courts have protected unregistered rights and thus undermined the registration requirement (Bauer, 1998). Because only registered rights can be bought, sold and mortgaged, the fact that most rights remain unregistered impedes not only the transfer of water but also investment in the agriculture sector. However, most water user associations (WUAs) maintain their own registries in order to effectively distribute water to rights owners. These do not imply legal title. The DGA is also responsible for maintaining a Public Water Cadastre, which contains information on all water use rights that are granted by the DGA. This cadastre also contains hydrological and water quality data, information on WUAs and water withdrawals and all transactions. However, this registry does not imply legal title and often this cadastre is incomplete.

The 1981 Water Code has been touted for facilitating the market transfer of water. Although private water rights existed in Chile prior to 1981, the previous water codes restricted the creation and operation of an efficient water market. The framers of the 1981 Water Code sought to achieve the efficiencies of market reallocation of water. As Hernan Buchi, ex-Finance Minister of Chile (1985–1989), points out, “the objective of the governmental action in this field was to create solid water use rights in order to facilitate the proper operation of the market as an allocation mechanism” (Buchi, 1993, 85–87).

Although market reallocation of water has not been common throughout most of Chile, the existence of water markets has been documented. Studies have shown active trading for water use rights in the Limarí Valley, where water is scarce with a high economic value, especially for the emerging agricultural sector (Hearne & Easter, 1997; Donoso *et al.*, 2001; Hadjigeorgalis, 2004; Zegarra, 2002). Inter-sectoral trading has transferred water to growing urban areas in the Elqui Valley (Hearne & Easter, 1997) and the upper Mapocho watershed, where water companies and real estate developers are continuously buying water and account for 76% of the rights traded during the 1993–1999 period (Donoso *et al.*, 2001). Other studies have shown limited trading in the Bío Bío, Aconcagua and Cachapoal Valleys (Bauer, 1998; Hadjigeorgalis & Riquelme, 2002). In all of these studies some permanent transactions of water use rights have occurred.

A key conclusion of these studies is that water markets are more prevalent in areas of water scarcity. They are driven by demand from relatively high-valued water uses and facilitated by low transactions costs in those valleys where WUAs and the infrastructure present assist the transfer of water. In the absence of these conditions trading has been rare and water markets have not become institutionalized in most valleys. This implies that throughout most of Chile, water markets are not the norm and individuals do not have expectations that they can resolve their water allocation problems through water market transfers. Some authors, including the director of the DGA, Humberto Peña, claim that the scarcity of trading implies that water markets do not effectively redistribute water (Bauer, 1998; Peña, 2002; Dourojeanni & Jouravlev, 1999). And although

market transactions are still rare they are becoming more frequent in areas subject to economic growth.

### 3.2 *Water management organizations*

**3.2.1 *Water management*** The DGA, part of the Ministry of Public Works (MOP), is responsible for monitoring and enforcing water use rights. With its 13 regional offices, it collects and maintains hydrological data and a national water cadastre. As the leading government agency in water resources management it develops and enforces the national water policy. In this role it has led efforts to amend the 1981 Water Code, developed a National Water Policy and introduced a planning process for a few river basins (see below). The 1981 National Water Code does grant the DGA considerable discretionary authority – especially in regard to groundwater management, in times of declared drought and in approving water transactions that require a change in river flows – but it has in general maintained a limited role in accordance with the paradigm of limited state interference.

**3.2.2 *Irrigation*** User management of irrigation canals has existed in Chile since the colonial era and currently there are more than 4000 WUAs (Dourojeanni & Jouravlev, 1999). Three types of WUAs exist in Chile and are recognized by the law. Water communities are any group of users who share a common source of water. Canal user associations are formal associations with legal status that can enter into contracts. Vigilance committees comprise all the users and canal associations on any river, river section or stream. They are responsible for administering water and allocating water to different canals. Some manage reservoirs for irrigation water storage and finance their operations with small hydroelectric plants.

Many of these WUAs have professional management. The effectiveness of some of these institutions in managing irrigation systems and reducing transactions costs for water market transactions has been noted (Hearne & Easter, 1995). However, according to the DGA and the Directorate of Water Works (DOH), a large percentage of these institutions have not updated their capacity to meet new challenges. Many managers do not have technical capacity and do not effectively communicate with their members. The vigilance committees have not been effective in resolving inter-sectoral conflicts (Bauer, 1998). To address some of these concerns, the DOH has initiated a program to train WUA managers and directors (Peña, 2000; Puig, 1998).

The Government of Chile has been involved in the development of irrigation infrastructure through two major programs. Under the 1985 Law for Major Irrigation Works, the DOH is responsible for the development and operation of new irrigation infrastructure. Under this program, the Puclaro Dam in the Elquí Basin, with a capacity of 200 million m<sup>3</sup>, was completed in 1999. The modality by which the DOH will develop a new irrigation infrastructure has evolved. A new project to construct a 26 million m<sup>3</sup> irrigation reservoir on the Illapel River in north central Chile is to be implemented through a concession contract. The concessionaire is expected to invest US\$36 million and plans to recoup the investment by selling water to 750 downstream farms. Since these farmers were not actively involved in the design of the project, their willingness to pay for irrigation water might not meet the investors' expectations. Four additional major irrigation projects are planned under this concession program (Rojas, 2004). It remains to be seen what the

real impact of these concessions will be, especially since the proposed dams are in areas of agricultural potential that have not developed a strong agricultural sector.

The development of smaller irrigation projects is supported by the National Irrigation Commission (CNR) under the Law of Irrigation and Drainage Promotion. This program subsidizes small scale, private irrigation investments. It supported much of the installation of drip irrigation systems in the dry north and spray systems in the humid south. The CNR is affiliated to the Ministry of Agriculture and is responsible for the development of irrigation policy. It promotes irrigation investment and conducts studies to assess the feasibility of new irrigation and drainage projects. It has concentrated its efforts on vulnerable farmers and provides up to 75% subsidies for qualifying investments. Formally, the Irrigation Directorate and the DOH, also part of the MOP, is responsible for developing infrastructure for integrated water management. It became inter-sectoral in scope in 1997 with responsibility for planning and developing stormwater drainage infrastructure. It is also responsible for maintaining irrigation canals that flow through suburban areas. The DOH is in charge of an ambitious effort to extend the stormwater drainage system in Santiago.

*3.2.3 Water supply and sanitation* Chile's policy of providing water supply and sanitation (WSS) services through privatized regional and local water companies has been a notable success. Currently, there are 44 potable water companies in Chile. They function as private companies, although the state investment corporation, CORFO, still owns a considerable number of shares in most companies. The privatization process was conducted under a deliberate program first to reform the WSS providers and let them perform as autonomous corporations with private sector incentives and later to sell the valuable assets to private investors (SISS, 2004).

During the 1980s, the sector was dominated by the National Sanitation Service. This governmental water supply utility supplied WSS services to most of Chile. It also provided regulation and oversight authority for WSS provision in all of Chile. In 1990, the sector was transformed and 13 regional water companies were established. The ownership of these companies was transferred to CORFO and they were authorized to function as private enterprises with concessions to service particular communities and urban areas. The Superintendency of Sanitary Services (SISS) was created to regulate the sector. Small private and municipal WSS companies have maintained operation in areas where they have traditionally operated, or in isolated communities outside the regional companies' concessions. The SISS is a small, professional institution attached to the MOP. It oversees concessionaires and regulates WSS service quality and wastewater discharges. It is responsible for setting tariffs for WSS services that cover the full cost of service provision and avoid monopoly rents. Tariffs are automatically adjusted for inflation, but reviewed every five years so that the concessionaires cover operating and capital costs with at least a 7% return on assets (Shirley *et al.*, 2002; SISS, 2004).

The large regional WSS companies were initially created to function as private enterprises, but the privatization of ownership has occurred slowly. EMOS, the large WSS company in Santiago, was not privatized until 1999 when 51% of the shares were acquired by a Spanish-French consortium, which renamed the company Aguas Andinas. Currently, seven of the 13 regional companies are owned by CORFO. But the larger companies have been privatized and private companies service 77% of the urban population (Shirley *et al.*, 2002; SISS, 2003; Versteegen, 2002).

The WSS companies are responsible for wastewater collection and treatment. From 1989 to 2002 sewerage coverage expanded from 81% in urban areas to 94% in 2002 and wastewater treatment expanded from 8% to 42%. CONAMA, Chile's national environmental agency, has set an ambitious program to expand wastewater treatment so that 80% of raw domestic and 50% industrial wastewaters will be treated by the year 2006. The new wastewater treatment plants are being built under "build–operate–transfer" (BOT) contracts. Between 2002 and 2010, nearly \$750 million will be invested in wastewater treatment plants. Since WSS tariff rates are determined so that investors receive a low-risk return of at least 7% on capital expenditures, these companies have the incentive to invest in wastewater treatment (SISS, 2002; Versteegen, 2002). Ultimately, the WSS consumer will cover this cost through increased tariffs.

The tariff structure that SISS enforces has eliminated cross subsidies that are common in WSS systems. But the Chilean government has introduced an innovative program to grant direct subsidies to alleviate WSS costs to poor households. The water consumption subsidy in Chile is one of the few individual, means-tested subsidies applied in a developing country. The subsidy program is administered by the Ministry of Social Planning (MIDEPLAN) together with municipal governments. Under the program, municipalities and central government funds will pay 25 to 85% of the cost of the first 15 m<sup>3</sup> of household water consumption per month for eligible households. Thus, for eligible households the subsidy operates like a rising block tariff structure where the first block of consumption is subsidized. Eligibility is based upon household income and other variables and corresponds to eligibility for other subsidy programs. The aggregate projected expenditure of the subsidy program is included in the national budget each fiscal year and funded entirely from general tax revenues. The SISS is not involved in the process that determines subsidy levels, nor in the operational aspects of the scheme. Thus, there is a complete separation between the subsidy policy and the economic regulation of the industry. This program provides incentives for poor households to limit their consumption and incentives for companies to provide a service to all households (Gómez-Lobo, 2001).

A separate subsidy program has been developed to provide potable water services for concentrated rural populations that are outside of the concession areas of the regional water companies. The MOP provides assistance to community-managed potable water systems. Subsidies are provided for capital construction, technical assistance and consumption for eligible poor households.

*3.2.4 Environmental quality* The 1980 Constitution defends the right to live in a pollution-free environment. However, under the military government (1973–1990) environmental protection was not a priority. During the Aylwin (1990–1994) administration, which corresponded to the 1992 Río Summit and global concern for environmental protection, Chile passed the Environmental Framework Law and created the National Commission for the Environment (CONAMA). CONAMA, which is part of the Presidency: (1) coordinates national environmental policy, along with sectoral ministries; (2) supervises the national system of environmental impact assessments; (3) establishes norms for environmental quality; and (4) establishes decontamination plans when norms have not been met. In the case of water pollution, norms have been established for discharges into sewerage systems and surface water and groundwater. However, ambient water quality norms for surface water have not been established for all parameters.

CONAMA is relatively weak and relies on the sectoral ministries to monitor and enforce norms. It serves as a coordinator of national environmental policy and not as an executor of the policy. The system of environmental impact assessment does provide transparent analysis and mitigatory strategies for investment projects, but the sectoral ministries are responsible for compliance. CONAMA relies upon sectoral ministries to enforce environmental policy. The DGA's role in water quality has been minimal. It has conducted a census of all polluters of water bodies. Other agencies responsible for regulating wastewater discharges are SISS, Agricultural and Livestock Service (SAG) and the Ministry of Health.

### 3.3 *Conflict resolution and non-consumptive water uses*

Water is an important component of Chile's energy sector. Hydroelectric potential is estimated to be 18,000 MW. Energy production and transmission were privatized in the late 1980s, which made the powerful private sector electricity generators important players in water management. As explained by Bauer (1998), the 1981 Water Code definition of non-consumptive use rights did not specify the timing of use. This eventually led to conflicts between irrigators and the electricity generators. Generators scheduled reservoir releases during the cool winter months, when demand for electricity is high. Irrigators favored releases in the dry summer months. This conflict led to court cases and appeals concerning management of hydroelectric dams on the Maule and Bío Bío Rivers. Initially, rulings favored the owners of consumptive rights whose water use was impeded by the newly granted non-consumptive users. Eventually, the Supreme Court ruled in favor of the non-consumptive hydroelectric companies with their more profitable water uses.

The development of large hydroelectric projects in the Bío Bío Basin led to additional conflicts and international controversy. The Pangué Dam was constructed in the early 1990s by the newly privatized ENDESA. Part of the project's financing came from the World Bank's private sector lending agency, the International Finance Corporation (IFC). This project was opposed by environmental groups and the local indigenous Pehuenche population. Since hydroelectric generation was considered to be an important component of economic growth, the government favored the project. International pressure from environmental and indigenous rights groups led to a World Bank investigation of loan conditions. Instead of cooperating with the investigation, ENDESA secured alternative financing and prepaid the IFC loan (Bauer, 1998).

A related development was legislation creating the National Corporation for Indigenous Development (CONADI) in 1993. CONADI was charged with legally defending indigenous rights to land and water. The law also obligated the DGA to constitute and defend indigenousness water use rights. CONADI joined environmental groups and local Pehuenche in efforts to stop construction of the larger RALCO Hydroelectric project upstream of the Pangué Dam. After reaching a financial settlement with local residents, ENDESA began to fill the reservoir in April 2004 with expectations of operation by the end of 2004 (Financial News, 2004).

### 3.4 *Legal and policy reforms*

Throughout the period of democratically elected *Concertación* administrations, (1990–present), the DGA has led efforts to reform the 1981 Water Code. Initial efforts in 1992 included proposals to allow the DGA to cancel and redistribute unused water rights, to create river basin

administrative organizations and to consider the maintenance of water quality and minimum river flows before authorizing new water rights. This proposal met significant opposition. The expropriation of unused water was considered by some to be an unconstitutional infringement of private property rights. And the river basin organizations were poorly defined (Bauer, 2004). The 1992 proposal was eventually withdrawn and a less ambitious proposal was presented to the Congress in 1996. Under the 1996 proposal, all newly constituted and unused water rights would be taxed. The tax was designed to provide an economic incentive for speculators to forfeit their unused rights. This proposal was accepted by the Chamber of Deputies, but has been stalled in the Senate owing to concerns about the arbitrary distinction between unused and used water (Bauer, 2004).

There is little concern about unused consumptive rights for water, given that, under a system of proportional use, all water is eventually distributed to users. Dourojeanni & Jouravlev (1999) estimate the percentage of consumptive use rights that are unused to be less than 1% of the total. However, there are concerns about the rapid allocation of non-consumptive use rights to hydroelectric concerns and to speculators. DGA data indicate that at present non-consumptive use rights have been constituted for approximately 13,000 m<sup>3</sup>/sec, while only 2,500 m<sup>3</sup>/sec are actually used in hydroelectric generation. Part of this concern is that too many rights and too much potential wealth are being granted to ENDESA, which controls 59% of the total number of allocated non-consumptive use rights and that this will inhibit the competitiveness of the electricity generation market. However, there is a corresponding and somewhat opposite worry that too many rights are being held by speculators who are delaying hydroelectric development (Bauer, 1998, 2004; Dourojeanni & Jouravlev, 1999).

In support of its proposed amendments to the Water Code (see below), the DGA released a non-binding National Water Policy in 1999. A draft of this policy was written by the DGA and a series of regional workshops provided public comment. The policy maintains that water is a “national good for public use”, but stresses the existing international paradigm of water management including integrated water management and public participation and that water is an economic good, which should be used efficiently. This policy recommends new institutions to improve water planning and management at the basin and national level. The proposal for river basin administrative corporations was maintained in the document, but as an intermediary step the policy recommends the development of *ad hoc* water resources committees in each basin. These committees would consist of private and public sector participants and would support basin planning for integrated water resource management. In a final comment the document recommends the establishment of a new “Water Commission” that would serve under the MOP and coordinate the assorted tasks needed to implement the national water policy (DGA, 1999).

The basin planning process was initiated in a few key basins. A master plan was developed for the San Jose Basin in 1998. This is an extremely dry area along Chile’s northern border, which includes the city of Arica and some irrigated agriculture. The plan produces a list of projects to increase the quantity of water supplied to Arica and nearby irrigators as well as projects to manage water demand. Many of these projects, including desalinization, are quite expensive, but the plan excludes mention of market transfers of water from farmers to Arica’s residential water supply. Master plans were initiated for the Aconcagua, Imperial and Maule Basins, but the proposed plans have no legal or regulatory authority and the planning process has not produced results beyond some public consultations in 2000.

#### 4. Reasons for institutional reform progress

In many ways, Chile is an atypical case study for institutional change in the water sector. Theories of institutional evolution (Saleth & Dinar, 2004; Ruttan & Hayami, 1984) generally do not account for the dramatic paradigm shift that occurred during military rule. However, the factors that are predicted to influence institutional change, such as ideology, transactions costs, interest group behavior and path dependency (North, 1990; Saleth & Dinar, 2004) have all contributed to the process of institutional change as observed recently in the water sector of Chile.

As North (1990) points out, ideological concerns can initiate institutional change. During the period of military rule (1973–1990), reforms in the Chilean water sector were driven, in fact, essentially by ideological concerns. The establishment and defense of property rights, the restriction of state interference in markets, the use of private sector investments and the privatization of public enterprises are all elements of the neo-liberal economic model adapted by the military government. Certainly, there were influential interest groups who actively opposed the Allende government (1970–1973) and supported the protection of private property. But, often the economists who served as policy advisors to the military government were ahead of the interest groups and not responding to them. The 1981 Water Code was designed to protect traditional rights to irrigation water and to foster economically beneficial reallocation through market transfers (Bauer, 1998; Buchi, 1993). Although protecting private property rights was a principle concern of the conservative groups aligned with the military regime, water markets were not a part of any interest group's agenda.

There are a number of reasons for water markets to have not actively reallocated water in most of Chile. These include high transactions cost, cultural linkages between land and water, continued high value of water in irrigation and the urbanization of irrigated land. Transactions costs include expenses involved in titling unregistered rights, information costs, costs to modify infrastructure and the opportunity cost of time invested in the transaction. In this respect, the institutional transaction cost approach to institutional change (North, 1990; Saleth & Dinar, 2004) does provide an explanation for why water markets emerge in some cases and why they do not in the majority of river valleys. Some of these transactions costs, such as those needed to modify the water distribution infrastructure, which have been estimated to be approximately 10% of the water right's value in the Maipo River (Donoso *et al.*, 2001), will be involved in any type of water reallocation and are independent of water management institutions.

Despite a legal separation between land and water rights, many Chilean farmers maintain that water and land should not be separated. This traditional integration of land and water has kept many farmers from offering water for sale without also selling the corresponding land. Also, the agricultural sector in Chile has continued to grow, often at a rate greater than the rest of the Chilean economy (World Bank, 2003; ODEPA, 2004). Because of this growth, the value of water in irrigation has remained high and farmers have little incentive to sell water. Many farmers maintain surplus water rights in order to mitigate the risk of drought. And given that there are no taxes on water rights, there is no penalty for maintaining surplus rights.

Although some urban areas are continuing to expand, much of this growth is in previously irrigated areas. Developers are often required to turn over corresponding water rights to the water supply service. Thus the urbanization process includes a gradual transfer of both land and water to

residential use. This diminishes the need for potable water services to purchase water use rights from active farmers. The reforms of Chile's public WSS companies were initiated despite the absence of any drastic failures of the previous system. The state shifted its role from provider of WSS services to guarantor and regulator of service provision. Sequencing of these reforms, with market incentives and regulation established before assets were sold, contributed to the program's success (Shirley *et al.*, 2002).

The lack of legislative change since 1981 is partly due to the constraints imposed by the military-sponsored 1980 Constitution, which reduced the role of party politics and introduced a deliberate legislative system, which impedes majority legislation. Because electoral rules ensured representation in the Senate that is, in most cases, balanced between parties regardless of electoral results and because of the presence of non-elected senators representing conservative institutions such as the Armed Forces, the *Concertación* governments were rarely able to secure majorities in the Senate, despite strong electoral support. Given that the *Concertación* governments have been committed to maintain much of the economic program they inherited, there was no strong ideological motivation to reverse the 1981 Water Code. They only proposed minor modifications of the water law in order to address perceived needs (Shirley *et al.*, 2002; Bauer, 1998). This demonstrates the path dependency of institutional change (North, 1990; Saleth & Dinar, 2004). Further reform of the water sector is dependent upon reforms of the constitution. Thus, the historical context of the creation of the 1980 Constitution and the 1981 Water Code, which was a period of radical change, will endure and impede any evolutionary change in water law.

## 5. Successes and remaining challenges

Notable successes of Chile's water policy and water institutions include: (1) the property rights and incentives given to irrigators to stimulate the agriculture sector; (2) the presence of water markets in a few valleys; (3) the performance of many WUAs in distributing irrigation water; (4) the well regulated and mostly privatized, water supply and sanitation sector; (5) the program to subsidize WSS service for needy families; and (6) the ambitious investment program in wastewater treatment. Remaining challenges include: (1) the development of a fair and just system of incentives to ensure that unused non-consumptive use rights do not inhibit investment and growth; (2) improved coordination between consumptive and non-consumptive rights users in reservoir management; (3) increased capacity to resolve conflicts between users; (4) a single comprehensive registry of water rights ownership; and (5) improved environmental protection, including appropriate standards for minimum river flows and ambient water quality.

Chile's agricultural production has continued to grow in value and much of this growth can be attributed to irrigation. New investments in irrigation have been made at the farm level and in the construction of reservoirs. The principal beneficiaries of this investment have been the growers of higher-valued crops, such as fruits, vegetables, vineyards and sugar beets. Government programs have subsidized this effort, but private investment has been significant. The ability of farmers to use water rights to gain credit has been one of the key benefits of Chile's property rights system. It is noteworthy that Chile has been able to use a concession contract to bring private sector investment to construct an irrigation reservoir. This is a clear sign of expected positive returns, although the results remain to be seen.

In much of Chile, water market transactions have been rare. But the presence of inter-sectoral and sectoral trading between farmers in some important valleys demonstrates the advantages of transferable water use rights. Gains from trade have been established, especially in areas with low transactions costs. The advantages of water markets are not limited to areas with trading. The presence of secure property rights and a system of market reallocation of water negate the need for an alternative reallocation system that would threaten the security of water to the less powerful. Chile's WUAs have managed irrigation systems and distributed water among farmers since colonial times. The success of these WUAs demonstrates an adequate structure for user management of irrigation systems. The financial management and communications of many WUAs have been criticized. But efforts by the DOH to increase training to address these weaknesses have been initiated.

The privatization of Chile's WSS companies was the result of a deliberate process that provided private sector incentives to the state-owned utilities before ownership was transferred. The results have mostly been positive. Investment and coverage levels have increased. In Santiago, unaccounted for water has declined and coverage levels and society's welfare has increased despite an expansion in public and private housing (Shirley *et al.*, 2002). The private sector has responded well to the incentives provided and tariffs have been well regulated. A key and very noteworthy component of the WSS privatization is the targeted subsidies provided to support WSS service to poor households. By creating this targeted subsidy program, with its incentives to minimize consumption but increase coverage, the government has assisted those who would be most harmed by rate increases and eliminated the need for wasteful generalized subsidies. Another result of Chile's WSS system is the ability to attract investors for the ambitious program of treating residential wastewater. This ambitious program will address one of the key causes of water pollution in Chile. Water and sanitation fees will eventually pay for this program; thus households are given the correct incentive to reduce water use and wastewater production.

The DGA has been concerned about the accumulation of and speculation on non-consumptive use rights for more than a dozen years. The concentration of ownership of non-consumptive use rights can have a negative impact upon energy pricing. A more pressing concern is that some hydroelectric projects may be delayed because of speculation. The proposed tax upon unused water rights was intended to correct these perceived problems. Although the Congress has not accepted this reform of non-consumptive use rights, hydroelectricity remains one of Chile's most important and secure energy options and further reforms may be necessary.

A system of individual property rights is most efficient when one individual's activities have little external impact upon another's activities. In water use there are often many externalities. Among irrigators, these externalities can often be easily addressed within WUAs' norms. The interaction between hydroelectric generation and irrigation has many possible positive and negative impacts. And the strict defense of either non-consumptive rights or consumptive rights should be expected to produce less economic benefit for society as a whole than a negotiated settlement between the relevant parties. Increased coordination between hydroelectric generators and irrigators is needed to support both sectors. It is noteworthy that none of the five large irrigation reservoirs in the Limarí and Elqui Valleys have hydroelectric components. This is a significant economic loss.

Although the monitoring committees have been effective in allocating water along rivers and resolving disputes between consumptive users, they have not been effective in resolving inter-sectoral conflicts. The DGA has often avoided conflicts. And the court system has been slow and

often excessively formal (Bauer, 1998). But conflict resolution institutions that are respected by all water users and do not involve expensive court cases would facilitate evolution from sectoral water management to integrated water management. Inter-sectoral dam management and conflict resolution are functions that would be suitable for the proposed river basin organizations. Unfortunately, these organizations have not been well defined and were eventually not accepted by the Congress. New efforts to address these needs, perhaps within some form of regional development project, could be fruitful.

The DGA has made efforts at regularizing and creating an inventory of all water rights in certain valleys. However, the provincial real estate registries are the official registries for water rights titles. Many rights remain untitled. And the lack of a single, comprehensive water registry has been identified as a constraint on water markets and an impediment to the establishment of a tax on water use. Efforts to reduce transactions costs and eliminate uncertainty about whom the rights belong to would be a worthy investment. And, if this investment would support a tax on water rights accepted by the Chilean people, then this investment would support governmental revenue generation.

With Chile's current investments in wastewater treatment, the quality of surface water should improve. This may meet the needs of the Chilean people, especially since there is no truly influential environmental lobby. Chile's environmental policy lacks ambient standards for water quality and water quantity. It also lacks an effective agency dedicated to enforcement of emissions standards. Future efforts to improve environmental quality should be guided by goals for ambient quality that include minimum water flows. And if these goals are to be implemented, an agency dedicated to enforcement of environmental policy would be needed.

## 6. Conclusions and observations

This review of institutional reform in Chile's water management comes more than 20 years after the 1981 Water Code and nearly 15 years since the re-establishment of democratic rule. This change has supported growth in the agriculture sector and improvements in WSS services. Despite concerns about inter-sectoral conflicts and misallocation of non-consumptive use rights, moderate attempts at legislative change since the re-establishment of democratic rule have been hindered by the constraints of the 1980 Constitution and the lack of significant political support. Despite the absence of new legislation, slow progress in institutional change has occurred. The MOP and the DGA have released a National Water Policy. Governmental subsidies and collaboration with private irrigation development have progressed. The use of private sector concessions to build irrigation dams has been introduced. Efforts to strengthen the capacity of WUAs have been initiated. And regional participatory planning processes were initiated to develop non-binding river basin master plans.

Institutional change during the period of military rule was rapid, ambitious and favored by private sector and agrarian interest groups that supported their implementation. The somewhat radical introduction of tradable water use rights was based on the ideological adherence to the neo-liberal economic program of the military's policy advisors. Throughout most of Chile, transactions costs have impeded the development of active water markets. However, in some valleys, where transactions costs are low and water is scarce, trading has occurred and benefits have been

documented. Efforts to regularize and register water use rights and to train WUAs should reduce these transactions costs. Further institutional change in the water sector has been delayed by the very deliberate legislative process imposed by the 1980 Constitution, which tends to maintain the *status quo* inherited from the military government. Thus in the near future, further institutional reform in the water sector will be subject to the historical context of the 1980 Constitution and the 1981 Water Code.

## Acknowledgments

The authors thankfully acknowledge the contributions of R. Maria Saleth, Ariel Dinar and an anonymous referee of this journal to the development of this article, with the usual disclaimers.

## References

- Bauer, C. (1998). *Against the Current: Privatization, Water Markets and the State in Chile*. Kluwer Academic, Boston.
- Bauer, C. (2004). *Siren Song: Chilean Water Law as a Model for International Reform*. Resources for the Future Press, Washington, DC.
- Buchi, H. (1993). *La transformación económica de Chile. Del Estatismo a la libertad económica*. Bogota: Norma.
- Chonchol, J. (2000). *Reforma Agraria En Chile*. Presentation to the Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile. November, 2000. Available at: [http://www.geocities.com/jrme\\_chile/reforma\\_agraria\\_charla\\_chonchol.htm](http://www.geocities.com/jrme_chile/reforma_agraria_charla_chonchol.htm), August 2004.
- DGA (Dirección General de Aguas) (1999). *Política Nacional de Recursos Hídricos*. Ministerio de Obras Públicas. Santiago (<http://www.dga.cl/>).
- Donoso, G., Montero, J. P. & Vicuña, S. (2001). *Análisis de los Mercados de Derechos de Aprovechamiento de Agua en las Cuencas del Maipo y el Sistema Paloma en Chile: Efectos de la Variabilidad en la Oferta Hídrica y de los Costos de Transacción*. XI Jornadas de Derechos de Aguas. Universidad de Zaragoza y Confederación Hidrográfica del Ebro. Zaragoza.
- Dourojeanni, A. & Jouravlev, A. (1999). *El Código De Aguas De Chile: Entre La Ideología Y La Realidad*. S E R I E, Recursos Naturales e Infraestructura No. 3. Santiago, Chile. CEPAL.
- FAO (Food and Agriculture Organization of the United Nations) (2000). *Aquasta, Chile* (<http://www.fao.org/ag/aglw/aquastat/countries/chile/indexesp.stm>).
- Financial News (2004). *ENDESA Chile to Start Loading Ralco's Dam, the Hydroelectric Project Will Contribute to 9% of Chilean Central System Interconnected's Electricity Requirements*. (<http://uk.us.biz.yahoo.com/bw/040422/2260311.html>).
- Gómez-Lobo, A. (2001). *Incentive-based Subsidies*, Public Policy for the Private Sector Note #232. The World Bank (<http://rru.worldbank.org/Documents/Public Policy Journal/232 Gomez-531.pdf>).
- Hadjigeorgalis, E. (2004). *Comerciendo con Incertidumbre: Los Mercados de Agua en la Agricultura Chilena*, *Cuadernos de Economía*, 40 (122), 3–34.
- Hadjigeorgalis, E. & Riquelme, C. (2002). *Análisis de los Precios de los Derechos de Aprovechamiento de Aguas en el Río Cachapoal* *Ciencia e Investigación Agraria*, 29 (2) 91–99.
- Hearne, R. & Easter, K. W. (1995). *Water Allocation and Water Markets: An Analysis of Gains-From-Trade in Chile*. Technical Paper #315. Washington DC: World Bank.
- Hearne, R. & Easter, K. W. (1997). *The economic and financial gains from water markets in Chile*. *Agricultural Economics*, 15, 187–199.
- Instituto Nacional de Estadísticas (1998). *VI Censo Nacional Agropecuario 1997*. Santiago de Chile.
- North, D. (1990). *Institutions, Institutional Change and Economic Performance*, Cambridge: Cambridge University Press.
- ODEPA (Oficina de Estudios y Políticas Agrarias) (2004). *Agenda Agroalimentaria Y Forestal 2004–2006* (<http://www.odepa.gob.cl/>).

- Peña, H. (1999). El Desafío De La Gestión Integrada De Los Recursos Hídricos En El Marco Jurídico Y Económico De Chile Presentación realizada para la *Conferencia Internacional de Recursos Hídricos de América Latina en el Umbral del Siglo 21: Temas Clave para su Desarrollo*. VI Jornadas del Comité Chileno para el Programa Hidrológico Internacional y Primera Reunión de Comités Nacionales para el Programa Hidrológico Internacional. Cepal, 25–28 Mayo 1999.
- Peña, H. (2000). *Desafíos a las Organizaciones de Usuarios en el Siglo XXI*. III Jornadas de Derechos de Agua. Universidad Católica de Chile, Santiago.
- Peña, H. (2002). Los Mercados Del Agua: La Experiencia Chilena. Paper presented at the *Conferencia Internacional De Organismos De Cuenca*, Madrid November 2002. Available at <http://www.riob.org/>.
- Puig, A. (1998). El fortalecimiento de las organizaciones de usuarios para una gestión integrada de los recursos hídricos. Paper presented at the *International Conference Water and Sustainable Development*, Paris, 19–21 March 1998. (<http://www.oieau.fr/ciedd/contributions/at2/contribution/aurora.htm>).
- Rojas, C. (2004). Concessions in Chile. Paper presented at the *Conference on Enseñanzas y Perspectivas de la Inversión en Infraestructura en América Latina y el Caribe*, March 2004, Lima, Peru (<http://www.iadb.org/sds/conferences/infraestructura/Rojas-Lima.pdf>).
- Ruttan, V. & Hayami, Y. (1984). Toward a theory of induced institutional change, *Journal of Development Studies*, 20, 203–223.
- Saleth, R. M. & Dinar, A. (2004). *The Institutional Economics of Water: A Cross-Country Analysis of Institutions and Performance*, Edward Elgar, Cheltenham, UK.
- Shirley, M., Xu, L. & Zuluaga, A. (2002). Reforming urban water supply: the case of Chile, in *Thirsting for Efficiency: The Economics and Politics of Urban Water System Reform*, Shirley, M. (ed.), Elsevier Science, Amsterdam.
- SISS (Superintendencia de Servicios Sanitarios) (1993). *Memoria Anual 1992*, Santiago, Chile.
- SISS (Superintendencia de Servicios Sanitarios) (2002). Cobertura De Tratamiento De Aguas Servidas Resumen Principales Empresas. (<http://www.siss.cl/default.asp?cuerpo=481>).
- SISS (Superintendencia de Servicios Sanitarios) (2003). Estructura de Propiedad de Principales Empresas Sanitarias (<http://www.siss.cl/default.asp?cuerpo=483>).
- SISS (Superintendencia de Servicios Sanitarios) (2004). Historia del Sector. (<http://www.siss.cl/default.asp?cuerpo=483>).
- Vergara, A. (1998). *Derecho de Aguas*. Editorial Jurídica de Chile, Santiago.
- Verstegen, C. (2002). Opportunities in the Chilean Water Sector Report to the Netherlands Water Partnership (<http://nwp.netmasters05.netmasters.nl/fulltext/fulltexthandler.cfm?fulltextevent=fulltext&objecttypeID=13-3&ID=11969&frombasket=yes>). Consulted April 2004).
- World Bank (2003). *Country Data Tables* (<http://www.worldbank.org/data/countrydata/countrydata.html>).
- WRI (World Resources Institute) (2003). *Earth Trends Country Profiles*. ([http://earthtrends.wri.org/country\\_profiles/index.cfm?theme=2](http://earthtrends.wri.org/country_profiles/index.cfm?theme=2)).
- Zegarra, E. (2002). *Water Markets and Coordination Failures: The Case of the Limarí Valley in Chile*. PhD Thesis. University of Wisconsin, Madison.

