

18297



ENVIRONMENT  
DEPARTMENT  
**PAPERS**

PAPER NO. 62

**TOWARD ENVIRONMENTALLY AND SOCIALLY SUSTAINABLE DEVELOPMENT**

**ENVIRONMENTAL ECONOMICS SERIES**

# Managing Water as an Economic Resource: Reflections on the Chilean Experience

John Briscoe  
Pablo Anguita Salas  
Humberto Peña T.

April 1998



Environmentally and Socially Sustainable Development The World Bank

**FILE COPY**



---

# Managing Water as an Economic Resource: Reflections on the Chilean Experience

**John Briscoe**, *Senior Water Advisor, The World Bank*

**Pablo Anguita Salas**, *National Director of Irrigation, Government of Chile*

**Humberto Peña T.**, *Director General of Water, Government of Chile*

April 1998



# Contents

---

*Background* 1

*Water as an Economic Good—the Chilean Approach* 3

Water Markets from a Conceptual Perspective 3

Water Markets in Practice in Chile 3

The Water Resources Management Challenges in Chile 6

*Challenges for the Government of Chile* 9

Current responses by the Government of Chile 10

*Conclusions for the World Bank* 11

## FIGURES

1. WRM Policy Paper concepts 1

2. Map of Chile showing climatic zones and Elqui, Limarí, and Maule Basins 4

3. Indicative and partial characterization of the complexity of water resource management challenges in Limarí and Maule Basins 7

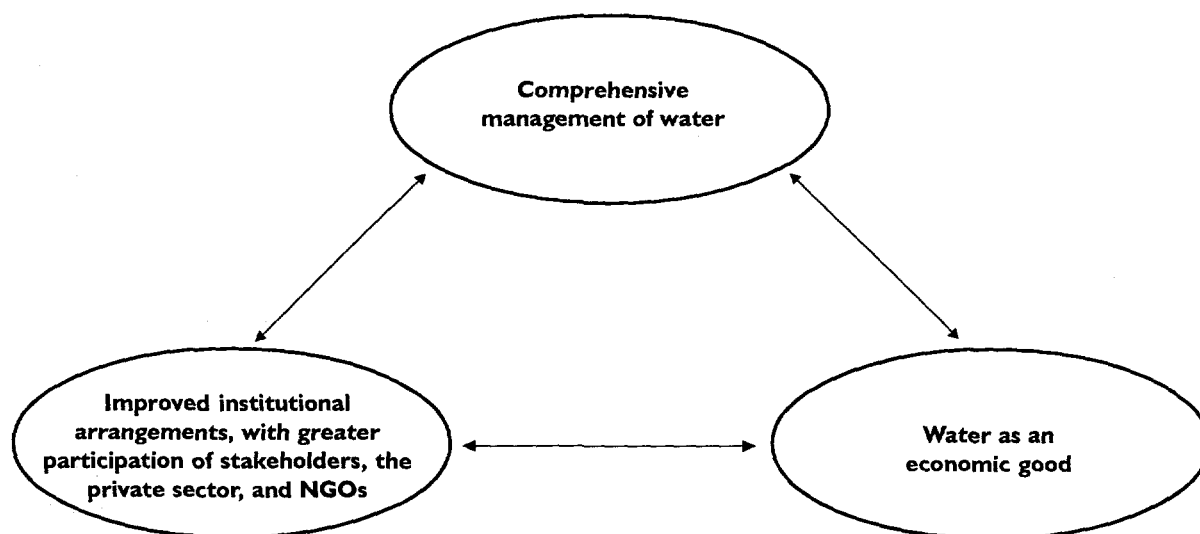
# Background

---

In 1992 the World Bank prepared a new Policy Paper on Water Resources Management (WRM). The WRM Policy Paper comprises three core, interrelated concepts, as indicated in figure 1 below:

shows that many countries are dealing, in a variety of ways, with (a) considering water as a unitary resource, which must be dealt with in a comprehensive way and (b) providing for broader participation by stakeholders in

**Figure 1. WRM Policy Paper Concepts**



There is broad consensus internationally as reflected in the resolutions of the International Conference on Water and the Environment, held in Dublin, Ireland, and in Agenda 21 of the Rio Environment Conference, that these three elements are the keys to a well-functioning water sector. Accordingly there are many countries which are attempting to reorient their water resource management practices to conform to this new view. A review of these experiences

water resource management. There are, however, few countries which have seriously conceptualized what it means to deal with water not only as a natural and social resource, but as an economic good, too. Chile's uniqueness lies in the facts (a) that it has put "water as an economic good" front and center-stage and (b) that it has been translating this principle into practice for over 15 years.

Because of the importance of the Chilean experience, in November of 1995 the Government of Chile hosted a study tour of about 30 professionals, most from the World Bank, some from developing countries. This report draws together the observations of one World Bank participant in that study tour, and the observations of two Chilean professionals who hold leadership positions in the Chilean water sector.<sup>1</sup>

#### **Endnote**

---

1. For more detailed assessments of the functioning of the Chilean water resources

management system, the interested reader is referred to:

Humberto Peña T "Water markets in Chile: What they are, how they have worked and what needs to be done to strengthen them?" Paper presented at the Fourth Annual World Bank Conference on Environmentally Sustainable Development, Washington DC, Sept. 1996.

Renato Gazmuri Schleyer and Mark W. Rosegrant "Chilean Water Policy: The role of water rights, institutions and markets", *Water Resources Development*, Vol 12, No 1, pp 33-48, 1996.

# Water as an Economic Good— the Chilean Approach

---

Since the 1970s Chile has followed, with remarkable success, an export-oriented, market-based approach to economic development. There are several consequences which are of direct relevance in attempting to understand the water economy of Chile. First, there is a broad consensus across most of the political spectrum in Chile on the fundamentals of economic policy—export orientation, trade liberalization, the central role of the private sector, and maximum use of markets as a resource allocation mechanism. Second, the ideas of a liberal market economy are translated with consistency and rigor down into the operation of each and every sector of the economy.

The core of the Chilean approach to treating water as an economic good, as enshrined in the Water Code of 1981, is:

- The acknowledgment that water is not a factor of production only for agriculture, but for other sectors too, and must thus be transferable like any other economic input
- The acknowledgment of the inappropriateness of linking a mobile, flow resource (water) to an immobile, stock resource (land)
- The consequent importance of separation of water rights from those of land
- Dealing with water rights as any other property right, allowing for leases and

sales between willing buyers and willing sellers.

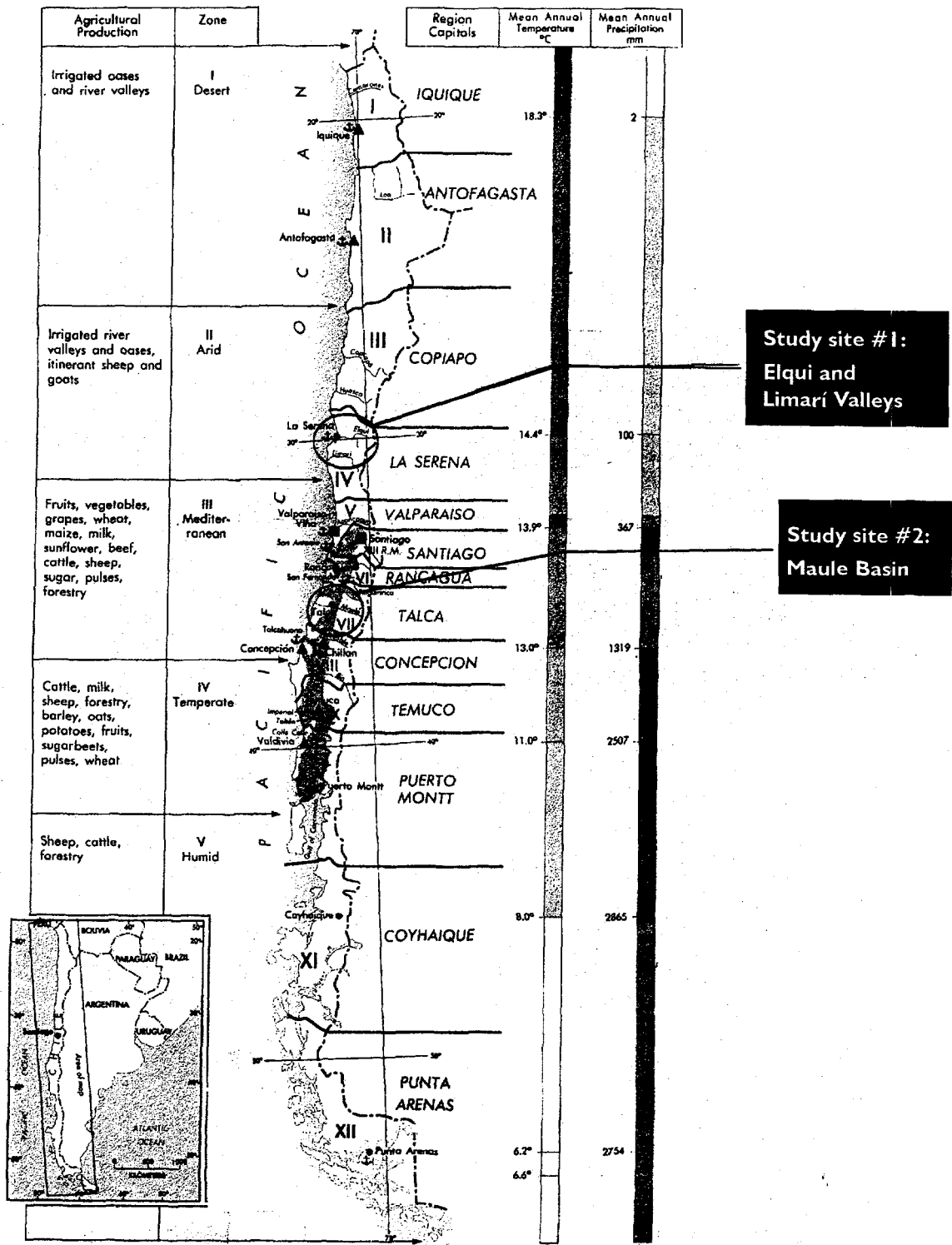
## **Water Markets from a Conceptual Perspective**

From a conceptual perspective, tradeable water rights are a brilliant solution to a universal problem with the economic management of water. The problem is simple. “Common sense pricing” suggests that users are charged a tariff which covers the financial (investment and operating) costs of storing and delivering the water to the user. (It is this which is done by users’ associations who operate water systems at various levels in Chile and which is now being proposed—see below—for costs incurred at the basin level, too). The problem arises because these financial costs are much lower (often an order of magnitude lower) than the “opportunity cost” (which reflects the value of the best alternative use of the water). The existence of a water market means, however, that behavior is not driven by the financial cost of the water but rather by the opportunity cost—if the user values the water less than it is valued by the market, then the user will be induced to sell the water. This is the genius of the water market approach—it ensures that the user will in fact face the appropriate economic incentives, but de-links these incentives from the tariff (which is set on “common-sense” grounds).

## **Water Markets in Practice in Chile**

*(a) In the Limarí and Elqui Basins in the semi-desert climatic zone*

Figure 2. Map of Chile showing climatic zones and Elqui, Limarí, and Maule Basins





The Limarí and Elqui are adjacent basins in a very dry area with a well-regulated river. The Limarí Basin is the area where water markets are generally considered to function best in Chile. The performance of the water market in this area is indeed impressive. There is a broad range of instruments available to buyers and sellers (ranging from short-term sales of specific volumes of water, to annual leases, to permanent sales of rights). The market behaves exactly as one would wish: within a particular area water is traded from lower-value uses to higher-value uses; prices are responsive to both temporary (seasonal) scarcity as well as longer-term scarcity; trading is quite active.

The functioning of the markets (and the users' associations at various levels) in this area are impressive. But there are some problems—some emerging difficulties in matching the location of sellers (generally in the lower reaches of the Limarí Basin) with buyers (increasingly wanting the water in the upper reaches): and the fact that urban water supplies are only partially integrated into the water rights system.

***(b) In the Maule Basin in the Mediterranean Climatic Zone***

The Maule Basin is a large basin in the relatively well-watered Mediterranean climatic zone. Water in the basin was historically used primarily for irrigation, and, more recently, for hydropower, with flows regulated by a reservoir in the upper reaches of the catchment. In the early 1980s "consumptive rights" were distributed free of charge (as elsewhere in Chile) to existing irrigators. The Chilean Water Code of 1981 distinguishes between "consumptive" and "non-consumptive" rights, with the latter primarily dealing with hydropower. (Other non-consumptive in-stream uses, such as navigation, conservation of aquatic ecosystems, dilution of pollution and control of saline intrusion in estuaries are not dealt

with as "rights".) The implicit assumption is that "non-consumptive rights" will generally not interfere with prior consumptive rights—in fact the Water Code requires that the exercise of non-consumptive rights not damage existing consumptive rights.

In practice the interactions between non-consumptive hydropower rights and consumptive (mainly irrigation) rights turn out to be complex. The Maule Basin illustrates the complexity of these interactions. First, in several cases hydropower plants return water to the river 30 or more kilometers downstream of the abstraction point. Given the density of direct irrigation offtakes from the river, this means that there are numerous irrigators whose services are affected by these "non-consumptive uses" (almost 100,000 hectares are so affected by just one power station in Maule). The hydropower companies have made efforts (as is required by law) to compensate irrigators by constructing additional distribution canals so that prior rights are respected. Inevitably, however, there are some farmers (many, in the case of Maule) who perceive (accurately in at least some cases) their services to be negatively affected as a result.

A second complication arises from the fact that, although hydropower plants do not consume water, they affect the hydrographs in the downstream areas in a number of important ways. One result of the changed flow regime is that irrigation canals are now often not of the appropriate design and greater use has to be made of adjustable gates. A second impact is that, as a result of lower silt loads in the water, there are greater problems with controlling algae in the canals. Both of these factors mean that farmers have to incur additional costs in managing the irrigation systems.

The changed discharge patterns also have important effects on the value of pre-existing water rights. Before the construction of the hydropower complex in the Maule Basin, farmers had rights to a constant flow of water during the year (regulated by the pre-existing large reservoir). The license for the power stations stipulated a non-uniform pattern of releases, related to the monthly distribution of agricultural demand. While the power companies appear to respect these stipulations, the farmers are seriously dissatisfied, for several reasons. First, the farmers' rights have essentially been truncated, because the rights no longer correspond to a uniform flow during the year. This effectively means that farmers can no longer sell their rights to users (such as towns) which are interested only in purchasing uniform flows which can be supplied with high assurance. Second, it is not sufficient for the power plants to simply release the agreed-upon quota on a monthly basis. The loss of control of the hydraulics of the system means major difficulties for the users' associations in operating a demand-based irrigation system, with serious impacts on the complexity of managing the system, on costs, and on the quality of irrigation service. Third, there was inadequate consultation when the release regime for the hydropower plants was stipulated, with the consequence that the farmers do not regard the agreements as legitimate. Fourth and finally, there is an "organizational asymmetry" and associated communication challenges between an industrial-type organization (the power company) and a much more loosely-knit farmer's cooperative, on the other.

Although these are not trivial problems to resolve, the level of tension is substantially higher than necessary given the underlying nature of the problems. There are two primary reasons for this unnecessarily-high level of conflict.

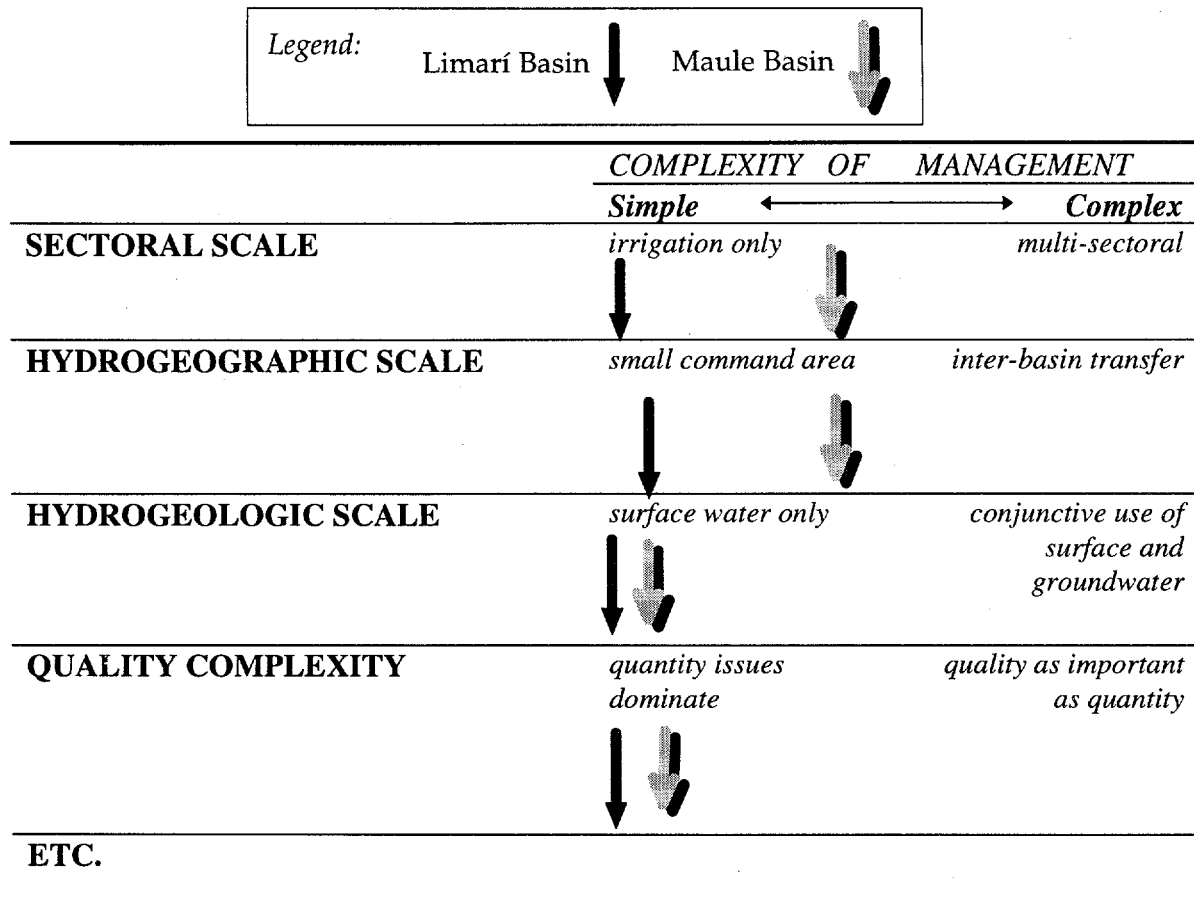
First, it is obvious that the absence of a river basin management institution is a fundamental factor giving rise to the problem in the first place, and is a fundamental factor underlying the ongoing tension. This is evident in several ways:

- There are information asymmetries and gaps—there is a serious lack of coherent, agreed-upon information on basic hydrological facts, and on facts about operating procedures.
- There is no "honest broker" institution responsible for specifying trade-offs and for finding creative solutions to problems.
- There is no low-financial and low-transactions cost arbitration procedure.

Second, it is equally evident that the judicial process—water conflicts are referred to the normal court system in Chile—for resolving conflicts is unsatisfactory from several perspectives. The judicial processes take years to come to conclusion, and are costly. Equally important is the fact that there is no specialized arbiter of water disputes (such as the State Engineer in New Mexico), with the result being that similar cases are sometimes resolved in radically different ways. This means that outcomes of cases are unpredictable and inconsistent, with all parties in the basin facing high transactions costs and substantial uncertainties as a result.

There are two overarching reasons for the low level of activity in the water market in Maule, namely the relative abundance of water in the region, and the high transactions costs arising from both hydraulic rigidities and institutional shortcomings. But it is also apparent that uncertainty regarding property rights in Maule is a contributing factor to the low level of market activity in the area.

**Figure 3. Indicative and partial characterization of the complexity of water resource management challenges in Limarí and Maule basins**



### The Water Resources Management Challenges in Chile

It is instructive to attempt a tentative and partial characterization of the complexity of the water resource management issues in the Limarí and Maule Basins and to use this to assess the future challenges of managing the water resources of Chile.

Figure 3 suggests that:

- The water resource management issues are somewhat more complex in Maule than Limarí principally because of the

presence of major hydropower generating stations in the Maule Basin.

- The water resource management problems in many basins in other countries will be much more complex than those in these two Chilean basins.

With regard to the future of river basin management in Chile, it is obvious to all that complexity is increasing sharply in many basins. Particularly relevant are:

- The rising demands of all traditional water-using sectors

- The emerging importance of the environment as a non-traditional sector with important water demands
- The emergence of sharper conflicts between different sectors
- The consideration of inter-basin transfers
- The need to use surface and groundwater conjunctively in many basins (with the issue likely to be particularly important in the rapidly-growing commercial forestry areas, where extensive eucalyptus and pine plantations are certain to dramatically affect surface water flows)
- The need to consider water quality, in addition to the traditional concerns with water quantity
- The emergence of new or newly-recognized "stakeholders" (including environmental groups and indigenous people).

# Challenges for the Government of Chile

---

The development of a system of tradable water rights and associated water markets is a great achievement and is universally agreed to be a bedrock on which to refine Chilean water management practices. There remain, however, significant resource management problems, which the Government of Chile recognizes and has started addressing. These include:

- As scarcity becomes more widespread, it will be important to regularize and formalize the quite large number of traditional water rights which are not yet formal (but are honored in the current system of management).
  - Although environmental impact assessments have been required since 1991, critical environmental concerns (such as minimal ecological flows, and water reserved for wetlands) have (with a few important exceptions) not been adequately addressed in many water projects.
  - Greater attention will have to be given to the economic management of groundwater and to the integrated management of surface and groundwater resources.
  - Speculative purchases of water rights (especially by the power companies) constitute an important social and economic problem which are being addressed a series of amendments to the Water Act—water rights will lapse if the rights are not exercised within a prescribed time period, and water rights will be taxed.
- It is essential to improve the performance of the administrative and judicial system with respect to water rights and water disputes—at present the system is too slow, too costly and too unpredictable. Experience in the Western United States shows that transactions costs are much lower (and markets function much more effectively) when these disputes are managed through administrative mechanisms (such as the State Engineer, as in New Mexico) than through the courts (as in the case of Colorado, for instance).
  - The Government of Chile is now in the process of complementing the existing framework for water markets with “water market-friendly” river basin management agencies. From the experience in other countries, such river basin agencies:
    - Should be financing agencies, with the power to raise revenues from users and polluters
    - Should involve all stakeholders in the formulation of basin policies
    - Should not usurp the powers of lower-level institutions in the basin (such as water users’ associations and

municipalities) but rather see their role as providing a transparent, predictable and efficient framework in which lower-level users can act more effectively.

### **Current responses by the Government of Chile**

Management of water resources in Chile is the primary responsibility of the Directorates of Water (DGA), Irrigation (DR) and Planning (DP) of the Ministry of Public Works. These agencies define the water management policies, assign water rights, perform hydrological studies and monitoring, and construct the major irrigation infrastructure. Given the issues described above, the Government is currently focussing its attention on a couple of critical issues.

The Directorate of Planning (DP) has carried out a detailed study on water markets in 10 Chilean basins, with special emphasis on three—Copiapó, Limarí and Maipo. The major conclusions of the study were: that it was necessary to strengthen water user's organizations; that the transparency of the markets needed to be improved by providing both buyers and sellers with better information; that the environmental framework needed to be developed, with particular emphasis on polluter charges; and that it was necessary to implement a charging system for water uses and water rights,

including a "non-use patent", which would charge those (in practice mostly the hydropower companies) who hold but do not use water rights.

Since the early 1990s, the DGA focussed on developing an improved river basin management approach, using the critical Bío-Bío river basin as a model. The main objective was to devise a new strategy in which all stakeholders and existing institutions could work together coordinating public and private actions. In 1995 an "administrative Corporation", broadly similar to a French River Basin Financing Agency, was started. Initially, this is a state-financed Technical Office, but within five years it will develop into a Corporation, staffed by about 40 technical personnel. The goal is to have 60% of the costs of basin management paid by charges assessed on both those who abstract and those who pollute the water, and about 40% by regional governmental funds (which would primarily be derived from the proposed charges on those who hold but do not use water rights).

The Irrigation Directorate (DR) is implementing a complementary nation-wide program focussing on improving the functioning of the water users' associations at both the irrigation district and river basin level, and in developing effective mechanisms for implementing both user and polluter fees.

# Conclusions for the World Bank

---

The issue of water markets in general and in Chile in particular have been the subject of heated debate within the World Bank. At one extreme (“the right”) have been some Bank staff who have argued that water markets are a panacea; at the other extreme (“the left”) have been staff who have argued that water markets have failed in Chile and will fail elsewhere. Over the course of the Chilean study tour, the team came to the clear and unanimous judgment that both of these extreme positions were wrong. The team concluded that:

- Countries following the liberal economic development model must ensure that water (as a key factor of production) is allocated to highest value users and used efficiently. This requires movement away from command-and-control approaches to resource management and movement towards the use of market-friendly instruments.
- Water markets are an excellent solution to a limited but very important and widespread problem (primarily the better use of water in irrigated agriculture and the associated voluntary release of some water to higher-value urban and industrial users).
- Water markets function best when rivers are well regulated (hydrologically). In this respect the conditions in many other countries are more favorable than in Chile, where most rivers are short and relatively unregulated.
- An essential requirement for functioning water markets is that transactions costs are low, and that water law is interpreted consistently and predictably.
- Although the water markets in Chile were developed under the non-democratic political circumstances prevailing in the late 1970s and early 1980s, the markets are now broadly popular.
- Externalities and market imperfections are pervasive, and will become more important in coming decades in Chile. To deal with these market imperfections, water markets depend on and need to be supplemented by effective dispute resolution capacity, and by effective basin-level water resources management.
- The DGA and DR have clearly identified both the strengths and weaknesses of “the Chilean model” and are taking appropriate and innovative measures to build on the considerable successes they have achieved to date.

Environment Department  
The World Bank  
1818 H Street, N.W.  
Washington, D.C. 20433  
202 473 3641 202 477 0565 FAX

---



Printed on 100% post-consumer recycled paper