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**WATER MARKETS: CASE STUDY OF CHILE'S
1981 WATER CODE**

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1. EXECUTIVE SUMMARY

- 1.1. The main objective of this study is to develop a case study of the market of water use rights established in the Water Code of Chile of 1981. With this end, the study presents a description of the case, an analysis of the formulation, development, implementation, and market performance.
- 1.2. It is important to highlight that the water allocation system based on a market of water use rights is not questioned in this study. The central objective is to present the lessons learned, determine its replicability, and to outline the necessary adjustments in the market design in order to insure a socially efficient water allocation.
- 1.3. After the political changes occurred in Chile in 1973, the existing economic paradigm changed from one where the State must protect and ensure the optimum allocation of resources, to one where the market is the one in charge of allocating resources in the most efficient manner. The objective of the governmental action in this field was to create solid, secure and tradable water use property rights and to facilitate an efficient operation of the market as a water allocation mechanism.
- 1.4. Therefore, the authorities and ministers of the time who managed the country's economy delivered the basic guidelines to draw up a new Water Code. This work was commissioned to a team of lawyers and hydraulic engineers, and the underlying philosophical principal was "entrepreneurial freedom". This implies acknowledging that the individual is the maker of its own destiny and that he has the capacity to imagine, create, and above all, exercise his will, all capacities that must be respected so that he may develop them to their full potential.

1.5. The different instruments and ordinances outlined above, including the codes in existence prior to 1981, were limited in their ability to allow for the formation of an efficient water market consistent with the new economic system. These limitations were related primarily to the definition of Rights of Use, the amount of information available to users, transaction costs, potential harm to third parties, mechanisms for resolving conflicts, speculation in water resources, and institutions or legal frameworks needed in order for the market to function properly.

1.6. The water rights system established through Legislative Decree 2.603, of 1979, and the 1981 Water Code, codify the system for granting water rights, maintaining the status of water as a national good for public use. Nevertheless, water rights enjoy broad protection under a special legal framework and can be freely transferred. As a result of implementing an overall system for protecting private ownership, derived from the 1980 constitution, water use rights have been strengthened in the sector, with rights granted by the State (constituted), as well as common law uses and other special uses (recognized by the State) also gaining protection. The water use rights are established over a channel or natural source, specifying the intake where the water is taken from and the volume of water granted expressed in flow units, in other words, volume per time unit.

1.7. Some of the basic characteristics of water use rights in Chile provided by the WC81 are the following (Vergara, 1998):

1.7.1. Free access to the ownership title over the new water use rights. The authority must grant private parties, through concessions, all of the rights requested without any other restriction than damage to third parties.

- 1.7.2. Tradable water use rights. The transfer of the water rights is subject to the provisions of the civil law. This transfer may be carried out absolutely independent of the property, industry or mine where they are used in and, therefore, they may be freely transferred, purchased or leased.
- 1.7.3. Protection of the intangibility of water rights. The authority may not annul the rights, except in the event of an expropriation. Water use rights constitute private property guaranteed by the Civil Code.
- 1.7.4. Free use of the waters. The current legislation establishes complete and permanent freedom in the use of water to which one has rights, with individuals permitted to use the water for whatever purposes and in whatever manner they wish. It is not necessary, in requesting rights, that one in any way justify future use. Nor is it necessary in transferring water rights to continue the previous type of use to which the water was put, with individuals permitted to freely make changes in such use, e.g., from irrigation to human consumption. The only limitation relates to the quantity of water that may be extracted from natural sources, with the requirement that users must show proper regard for the particular status of the rights involved.
- 1.8. The main feature of the new Water Law is that it added freedom of access to the creation and free transferability of water rights. In achieving this objective, the protection and the content of water rights were strengthened. At the same time, the law established the freedom to transact such rights – along with, or separate from land – and allowed owners of water rights the freedom to determine how and where they are to be used (Vergara, 1998).
- 1.9. Each type of water use right has its own characteristics, which are given below:

- **Consumptive** is the right of use that does not require that the water be returned after being used, and the owner of this right may totally consume the water in any activity.
- **Non-consumptive** is the right of use that obliges the user to return the water, observing certain requirements, as specified in the definition of the right. Non-consumptive rights must be used in a manner that does not interfere with or limit the exercise of consumptive rights.

In addition, consumptive and non-consumptive rights can be exercised in a permanent or contingent manner and in a continuous, discontinuous or alternating manner

The legislative objective in creating rights of this type is to increase the possibilities for using existing flows, subject to the basic condition of not causing harm, which involves not preventing or affecting the exercise of constituted water rights downstream.

It is important to highlight, however, that the classification of water use rights as consumptive has presented limitations for of an integrated watershed management. An example of the potential problems are the externalities associated with trades of consumptive water rights which affect downstream water uses.

On the other hand, it is important to point out that granting non-consumptive water rights in the lower sections of watersheds before consumptive rights have been granted generates conflicts between water use rights. In these cases, the possibility of granting consumptive use rights is practically eliminated, since any

new consumptive right that is granted will necessarily affect the volumes of water assigned to non-consumptive uses.

1.10. New water rights holders may obtain such rights free of charge from the governmental agency responsible for granting them (the General Directorate of Water), provided that the following requirements are met: (a) the request must be made according to established legal procedures; (b) it must be technically verified that water is available at the natural source; and (c) the new use must not affect old title holders with current rights. If there is competition for the solicited water rights, they are to be allocated through a bidding process (auction) with an award to the user who offers the highest bid. However, in cases in which there is a societal interest in allocating the available water to a user who did not offer the highest bid, the President of the Republic, and he alone, may order that the auction be voided and may allocate the water to one of the other bidders.

The corresponding public entity (or the courts, as the case may be) is obliged to grant new water rights to new applicants once the three requirements cited above and, specifically, the existence of discharges not previously granted to other individuals, are confirmed. It may not refuse to grant new water rights without infringing a constitutional guarantee.

Nonetheless, is important to highlight that the State, based on evidences of monopolistic behavior, endorsed by the antimonopoly commission, has refused to grant new water use rights. In fact, the Constitutional Court has established that the State can impose additional conditionalities to grant new water use rights by reformulating the Water Code. Due to these situations, the dispositions

of the Water Code of 1981 that force the State to grant new water use rights are under revision (Peña, 1999).

1.11. The water resource management role assigned to the State is the following:

1.11.1. To measure and determine the availability of water resources and to generate the necessary databases that allow for a well informed management of water resources.

1.11.2. To regulate the use of water resources avoiding third party effects and their overexploitation. For that purpose the State must analyses the availability of water resources and potential water use conflicts before granting new water use rights and other authorizations such as changes in water distribution infrastructure.

1.11.3. To conserve and protect water resources, by means of an environmental impact assessment system and environmental policies.

With respect to the effectiveness of this institutional framework, it is opportune to mention that in the last years a wide debate has existed in the country in relation to the convenience of revising the regulatory norms, pointing out the advantages and limitations of alternative definitions. The equity impacts of the actual institutional framework represent one of the main criticisms of the lack of governmental participation. On the other hand, Peña (1999) has pointed out that the unsolved challenge is to implement an integrated watershed management

1.12. On the other hand, the responsibilities of private sector are:

1.12.1. To study, finance, and implement development projects associated with water. In this process, water use rights represent their commercial assets and water is considered to be a productive input.

1.12.2. Distribution of water and its proper use by the members of user organizations, as well as for the construction, maintenance and management of irrigation structures. Three different types of such organizations are provided for in the Water Code: boards of control, canal-users' associations and water communities.

1.13. Since the establishment of the water allocation mechanism based on a market of water use rights in Chile, a series of empirical and theoretical studies have been carried out to determine: the existence of a water use rights market and the number transactions; water use rights market efficiency; bargaining, cooperation, and strategic behaviors of market participants; and the marginal gains from trade.

These studies indicate that water scarcity is without doubts the main factor that motivates the operation of an efficient water use rights market. When water is scarce there exist incentives to participate in these markets in order to achieve a reallocation of the scarce resource.

Additionally, from these studies one can conclude that the performance of the water use rights market in Chile has been variable. The variability in performance of the market can be explained by problems both related to and independent of the allocation system. Problems independent of the allocation system affect the efficient allocation of the resource but are not considered to be related to the free transferability of water rights. In other words, the existence of a rights market neither creates nor aggravates the problem. Furthermore, the problem represents an impediment to reallocating of the resource under any allocation system. At the same time, problems related to the allocation system

affect the efficiency in allocating water resources and are related to the water market system.

The most notable problems independent of the water allocation mechanism are those arising as a result of unavoidable transaction costs, externalities due to inadequate definition of use rights in the Water Code, and uncertainty regarding the availability of water.

In studies related to the water use rights market system, certain problems related to the allocation system have been identified – problems such as the lack of adequate and timely information; the difference between nominal and in rem rights; conflicts arising between users due to the sale of traditional rights; avoidable transaction costs; and the hoarding of non-consumptive rights.

- 1.14. In general, based on the studies conducted to analyse the performance of the water use rights market, one can conclude that the allocation framework established by the Water Code in 1981 has been efficient from an investment point of view, mainly due to the water use rights security granted by the legislation. This is evidenced by significant investments that have been undertaken by several economic sectors to improve water use efficiency and to increase the availability of groundwater through exploration.

Likewise, the free transaction of water use rights, even though in many areas water use rights markets have not been very active, constitutes an efficient reallocation mechanism which has facilitated the reallocation of granted rights. However, it is not clear whether this reallocation of water use rights has occurred from low value to high value users, due to the lack of empirical evidence and information. It is thus necessary to develop a reliable data base in

order to correctly evaluate the performance of the Chilean water use rights markets.

It is important to highlight, however, that the regulatory framework and the heterogeneity of water use rights has allowed for strategic and monopolistic behavior on the part of water use rights holders, thus generating an inefficient allocation from a social point of view. Part of this problem involves the hoarding of non-consumptive rights. This is a strategic action aimed at entrepreneurial development, rather than a matter of speculation, per se. Since water is a basic factor in their productive process, hydroelectric plants can not afford to expose themselves to the risk of future supply shortages, or of having to buy at high prices, which would diminish the profitability of the project.

In summary, water use rights markets represent a useful allocation mechanism for water resources. However, it is necessary to reformulate the regulatory framework of this mechanism so as to reduce the existence of conditioning factors that have limited the efficiency and sustainability and replicability of this allocation mechanism.

1.15. Within the framework of the case study analysis, a round table was organized to analyze the case's main lessons. The main results are:

1.15.1 Which are the conditions that seem to be indispensable to establish a water rights market system in a given society?

In general, the participants agree that the most important conditions are:

- The existence of water scarcity. In other words, when water has a scarcity price.
- Protection of the intangibility of water rights.

- ❑ Clear definition of water use rights.
- ❑ Free transfer of water rights.
- ❑ Adequate regulations that address externalities, damage to third parties, and the public interest, among others.
- ❑ A cultural context of society consistent with the economic paradigm.
- ❑ Water resource inventory.
- ❑ Water must be treated individually, separated from the land.
- ❑ The ownership right must be guaranteed both:
 - a) Physically: Management, knowledge and control of the source.
 - b) Judicially
- ❑ An infrastructure that permits transferring the rights.
- ❑ An efficient system to resolve conflicts and controversies.

It is worth noting that a consensus was not reached with respect to the essentiality of the following elements:

- ❑ The society must have the will to create a market. Political will.
- ❑ The market's existence does not require that the right be safeguarded. There are examples in other countries where the market exists with a different definition of the rights.

1.15.2 Has the market permitted the reallocation of the water rights of lower or higher value? In what conditions has it occurred?

The participants agree that:

- ❑ The transfer of rights has taken place from those who value the resource less to those who value it more.
- ❑ In the field of the water companies –the most active in Santiago– the amount of water transferred from one sector to another is almost equal to historical transfer and it is proportional to the city's growth.

- ❑ Water companies have an open buying power; therefore, the conditions have been created for transactions.
- ❑ Transfers from the agricultural sector to the basic sanitation sector correspond to waters from the agricultural sector that have been marginally used or that have fallen in disuse or have been covered by the urban area.
- ❑ There is no case of transfer from intensive use in the agricultural activity, unless the land has been sold, or there is water surplus.
- ❑ The exceptions to this statement are:
 - ❑ Loa Case: There are important purchases by mining companies of waters that were being used in the agricultural sector which passed to the mining sector, but agriculture in the Loa area is not so significant.
 - ❑ Paloma Case: The short-term market is very active and significant.
- ❑ Transactions occur when there is no water available for the State to provide free of cost; therefore, the phenomenon of shortage is essential for the market's existence.

There is consensus that there is lack of adequate information to answer the question formally on whether the market has permitted the reallocation of the lower value rights to higher value rights. This indicates the urgent need of creating a good public database to verify the market's operation.

1.15.3 What kinds of problems have been resolved through the market? In what situations?

It was concluded that:

- ❑ The market permitted valuing raw water.
- ❑ It has permitted developing mining in areas of water scarcity by buying water rights from agriculture, like in the Loa region.

- ❑ Water companies have solved their problems of greater water demand, for example, the case of Agua Potable Cordillera.
- ❑ It has helped to solve problems of scarcity when a quick response has been required, like the case of Minera Manto Verde in Copiapó.

1.15.4 What problems have not been solved with the allocation system?

- ❑ Inefficiency in the use of water in all sectors, not only in the agricultural sector.
- ❑ Environmental problems, maintaining ecological water reserves.

1.15.5 What elements have hindered the allocation of water rights through the market?

- ❑ The absence of the obligation to use the water encourages a monopolistic behavior.
- ❑ The lack of a register of water right owners.
- ❑ The lack of a rapid, efficient controversy resolution system.
- ❑ Lack of clear definition of water rights.
- ❑ Little flexibility in relation to temporary transfers.
- ❑ Infrastructure rigidities that do not permit the market's operation.

1.15.6 Have there been any problems related to the monopolization of water rights?

The participants concluded that the monopolization of water rights is:

- ❑ Not a problem of the market but of the initial free allocation of the water rights without a restriction which obligates water rights holders to effectively use the water.

- It has occurred, but it is not a problem of the market. It is rather due to the initial allocation and structure of the water rights. It is also a result of the way in which the administration grants the water rights.
- There is evidence of the monopolization of water rights granted in specific basins under the Water Code of 1981, both in relation to consumptive and non-consumptive rights.

2. INTRODUCTION

An analysis of the allocation mechanisms used most commonly in the developing countries points to three basic types: (a) administrative allocation carried out with the assistance of user associations; (b) allocation through imposition of a fee based on the opportunity costs of the resource; and (c) allocation based on a market for tradable water rights. Any mechanism for allocating water rights can be classified in one of these three categories.

Water use rights markets have been implemented in the case of Chile, USA and Australia. These cases indicate that the market mechanism represents a good means to allocate water for two main reasons. First it secures transfer of water from low value to higher value activities. Second, it puts the burden of information collection on water users and avoids problems of asymmetric information common in centrally planned situations. However, to operate properly, water markets require well developed water conveyance facilities and the appropriate institutions to define water rights and water endowments contingent on water availability. It is also necessary to have a complete set of rules for trading in water endowments and in water rights. Finally, institutions are needed to oversee trading activities and resolve conflicts when they arise.

The main objective of this study is to develop a case study of the market of water use rights established in the Water Code of Chile of 1981. With this end, the study presents a description of the case, an analysis of the formulation, development, implementation, and market performance.

This case study thus analyzes the formulation, development, implementation, and evaluation of the results of the operation of the Water Code of 1981, which establishes a water rights market as a water allocation system. With this end, the following section provides a detailed description of the Chilean case of water rights allocation. The third section analyzes the performance of the water rights market established in the code. The fourth section describes the lessons learned from the code's application. The fifth section includes bibliographic references.

3. CASE STUDY DESCRIPTION

This section provides a detailed description of the design and implementation of the water rights allocation system in Chile.

3.1. ALLOCATION OF WATER PRIOR TO THE WATER CODE OF 1981

Prior to the enactment of the Water Code of 1981, there were several projects and ordinances that tried to legislate on the allocation and use of waters. The following paragraphs briefly describe their most significant contributions.

3.1.1. PRIOR TO THE WATER CODE OF 1951

The first Chilean text to regulate the use of waters dates back to 1819, and it belongs to O'Higgins, who issued an Executive Decree that defines the dimensions of an irrigating system, form of sale, and responsibility of the intakes.

The Civil Code that put into effect in 1957, is the first instrument that defines that *“rivers and all waters that run through natural channels are national goods of public use”*, besides regulating that access to waters is obtained by means of water rights *“granted by the competent authority”*.

The Ordinance of 1872 on water distribution, distributes waters in periods of drought. This ordinance created what today is known as the permanent and conditioned rights.

3.1.2. WATER CODE OF 1951

Before the appearance of the Water Code of 1951, there were several projects that finally gave origin to this code. The Water Code of 1951 is a continuation of the principles of the Civil Code indicated above. The most important one is that waters continue being a national good of public use.

The concept of “Water Right” was introduced in the 1930 Water Code bill, and this concept was further developed in the Water Code of 1951 establishing that “the Right to Use Water may only be acquired by virtue of a *“mercedes”* or Water Right granted by the President of the Republic in the way established in this code.”

Art. 12 defines the Water 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,” thus the Water Rights, is to use, possess and dispose of them, without this representing a transfer of water ownership.

In this Code, the law defines water uses, making a list of the preferential areas on which there is a political interest to develop. Thus, it established priorities of use for those cases on which there is competition for the same water. The order of priority established was: drinking water, drinking water services, domestic uses, and sanitation of localities, railway, irrigation, power-generating plants, industry, mills and other uses. In the event of competition in the same area, the relevant authority chose the most important and useful company. This was left to the criterion of the relevant Administrative Authority.

3.1.3. WATER CODE OF 1967

Because of its more centralized political context, the Water Code of 1967, reinforces the concept of water as public property and “*changes the juridical nature of the Water Right*”, the new juridical nature consisting of “*giving this right the character of an actual administrative right.*”

The new juridical nature of the Water Right consists of giving it the character of an actual administrative right, where the State grants the use of the national good of public use subject to public right regulations. The State grants the use of the waters, but never their ownership.

The Water Rights are an administrative right that may expire, and the process of water reallocation subjects it to planning so that it can be executed by means of the “*rational use and beneficial rate.*”

This Code eliminates the list of preferences and leaves drinking water and drinking water services as a priority. The preferred types of industries and agricultural uses are determined as well as water use technologies for a determined geographic area. On the basis of this background information, a calculation is made of the maximum flows that can be used.

3.1.4. THE NEED FOR A NEW CODE

After the political changes that occurred in Chile in 1973, the existing economic paradigm changed from one where the State must protect and ensure the optimum allocation of the goods, to one where the market is in charge of the efficient allocation of resources.

Therefore, the authorities and ministers of the time who managed the country's economy, gave the basic guidelines to draw up a new Water Code. This work was entrusted to a team of lawyers and hydraulic engineers, and the underlying philosophic principle was "entrepreneurial freedom". This implies acknowledging that the individual is the maker of its own destiny and that it has the capacity to imagine, create, and above all, exercise its will, all of which must be respected so that he may develop its capacities to their full potential (Figueroa, personal interview).

The different instruments and ordinances presented above, including the Codes prior to 1981, restricted the creation and operation of an efficient water market consistent with the new economic system. These restrictions are related mainly to the definition of Water Right, the degree of information available to users, transaction costs, the eventual damage to third parties, the methods used to solve

controversies, the speculation of the water resource, and the legal framework necessary for the market to operate properly. Thus, as Buchi, ex Finance Minister of Chile, points out¹, "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".

In synthesis, the underlying philosophy of the Water Code of 1981 is to establish permanent and tradable water use rights so as to reach an efficient allocation of the resource. An efficient water allocation is one where water is allocated to higher-value users. A competitive water use rights market in absence of transaction costs is an efficient means to allocate this scarce resource.

3.2. WATER ALLOCATION IN ACCORDANCE WITH THE WATER CODE OF 1981

The first objective of enacting the new Water Code of 1981 was to provide a better and more equitable use of a socially valuable resource.

The water rights system established by virtue of DL 2603 of 1979, and the Water Code of 1981 defines the concession system of the water rights, because water maintains its condition of a national good of public use. Notwithstanding, the water rights are widely protected, they have a special juridical framework, and they may be freely transferred. As a result of the application of a general protection system to the private ownership titles derived from the 1980 Constitution, the strengthening of the private rights has occurred aimed at the private water rights, and both the rights granted by the State (formal water use rights, constituted) as well as

¹ "La transformación económica de Chile. Del Estatismo a la libertad económica", Bogotá, Norma

customary and other special uses (informal water use rights, acknowledged by the State) have been protected.

The current legislation stipulates the total freedom to use water over which the individual holds a right. Private parties may use these waters for the purposes or types of uses they wish. This freedom is permanent. When claiming water rights it is not necessary for private parties to justify its future use. Also, when transferring water rights, it is not necessary to respect the prior use of the water, and private parties may freely change its use, for example, from irrigation to human consumption. The only limitation is related to the volume of water that may be extracted from a natural source, because the right's condition has to be respected. For example, in the case of consumptive rights, the total volume of water extracted may be consumed, and in the case of non-consumptive rights, water must be used and subsequently returned.

In addition, the new holders of the water rights may obtain them free of cost from the public service in charge of granting them (The Water Authority), provided that the following requirements are fulfilled: a) the application must be “legally in order”, b) there must be technical evidence that there are water resources available in the natural source, and c) the new use cannot affect the prior holders of the current rights. If there is competition for the solicited water rights, they are to be allocated through a bidding process (auction) with an award to the user who offers the highest bid. However, in cases in which there is a societal interest in allocating the available water to a user who did not offer the highest bid, the President of the Republic, and he alone, may order that the auction be voided and may allocate the water to one of the other bidders.

The corresponding public entity (or the courts, as the case may be) is obliged to grant new water rights to new applicants once the three requirements cited above and, specifically, the existence of discharges not previously granted to other individuals, are confirmed. It may not refuse to grant new water rights without infringing a constitutional guarantee.

Nonetheless, is important to highlight that the State, based on evidences of monopolistic behavior, endorsed by the antimonopoly commission, has refused to grant new water use rights. In fact, the Constitutional Court has established that the State can impose additional conditionalities to grant new water use rights by reformulating the Water Code. Due to these situations, the dispositions of the Water Code of 1981 that force the State to grant new water use rights are under revision (Peña, 1999).

Although there is a public entity in charge of establishing the water rights, controlling the resource, authorizing the construction of works, supervising user organizations, and planning the resource, its faculties are rather limited. The water resource management role assigned to the State is the following:

- To measure and determine the availability of water resources and to generate the necessary databases that allow for a well informed management of water resources.
- To regulate the use of water resources avoiding third party effects and their overexploitation. For that purpose the State must analyses the availability of water resources and potential water use conflicts before granting new water use rights and other authorizations such as changes in water distribution infrastructure.
- To conserve and protect water resources, by means of an environmental impact assessment system and environmental policies.

With respect to the effectiveness of this institutional framework, it is opportune to mention that in the last years a wide debate has existed in the country in relation to the convenience of revising the regulatory norms, pointing out the advantages and limitations of alternative definitions. The equity impacts of the actual institutional framework represent one of the main criticisms of the lack of governmental participation. On the other hand, Peña (1999) has pointed out that the unsolved challenge is to implement an integrated watershed management

As it can be derived from the analysis of the foregoing paragraphs, the main characteristic of the new Water Right, is having introduced free access to the creation and free transfer of water rights. This objective was achieved, strengthening the protection and the contents of water rights; establishing the freedom to trade such rights, jointly or separately from the land, and permitting the holders of the water rights the free use and destination of such waters (Vergara, 1998).

3.2.1. WATER RIGHTS

While the 1981 Code considers water to be in the public domain, it creates for individuals a Right of Use over water, with the same constitutional guarantees as are provided for property as established by article 19 N° 24 of the Political Constitution. Based on this right, individuals may use, enjoy and legally dispose of water with complete freedom (Vergara, 1998).

Figuerola (1995) defines the right to use water as the faculty of having the exclusive access to a natural source to extract a specified amount of water from it at a determined point, or to occupy a water body in the same channel to, in both cases,

use those waters. It is worth mentioning that, after the waters of a river enter a channel as a result of exercising the right to use such water, it loses its character of national good of public use temporarily. Once water is conveyed through a channel system, the water belongs to the owners of the channel system during the time that they are able to retain it. Thus it must be understood that once water enters a conveyance facility its character of national good of public use is superimposed with that of a good of private domain.

Thus, the distinctive elements that make up a water right are a determined natural source, a defined volume of water expressed in volume units, and a point of intake. In addition, the law classifies rights as consumptive and non-consumptive, permanent or conditioned; continuous, discontinuous or alternate. Permanent and conditioned rights are related to scarcity, whereas continuous or discontinuous rights are related to the time of use (Figueroa, 1995).

Each kind of Water Right has its own characteristics, which are defined below:

- **Consumptive right** is the water right that does not oblige the user to return the water after it has been used and the holder of this right may consume the water totally in any activity whatsoever.
- **Non-consumptive right** is the water right that obliges the user to return the water fulfilling certain requirements as determined by the establishment of the right. The use of non-consumptive rights must be carried out in a manner that does not prevent or limit the exercise of consumptive use.

The purpose of the legislator when creating this kind of rights, is multiplying the possibilities of using the existent water flows, under the essential condition of not

causing any damage to third parties, which implies not preventing or altering the exercise of downstream rights.

It is important to highlight, however, that the classification of water use rights as consumptive has presented limitations for of an integrated watershed management. An example of the potential problems are the externalities associated with trades of consumptive water rights which affect downstream water uses.

On the other hand, it is important to point out that granting non-consumptive water rights in the lower sections of watersheds before consumptive rights have been granted generates conflicts between water use rights. In these cases, the possibility of granting consumptive use rights is practically eliminated, since any new consumptive right that is granted will necessarily affect the volumes of water assigned to non-consumptive uses.

Also, consumptive and non-consumptive rights may be exercised permanently or under certain conditions, and continuously, discontinuously or alternately, as described in the following paragraphs.

- ***Permanent*** exercise. Those water rights that permit using water in the corresponding supply, except when the supply source does not contain the sufficient amount to meet such supply completely, in which case, the flow shall be distributed in equal parts.
- ***Conditioned*** exercise. Those water rights that authorize the user to occupy the water in the seasons when the main flow has a surplus after having supplied the users with a permanent water right.

- **Continuous** exercise. Those water rights that permit using water in a continuous manner 24 hours a day. In other words, the right may be exercised all day long, 365 days a year.
- **Discontinuous** exercise. Those water rights that only permit using the water during determined periods. In other words, the right may only be exercised at the times or moments that the title specifies.

Finally, rights that may be exercised **alternately**, are those rights where the use of the water is distributed between two or more persons that successively take turns to use the water.

3.2.2. INITIAL ALLOCATION OF THE WATER RIGHT

In Chile, rights of use are obtained free of charge, and the procedure for acquiring a right begins with an application that must be completed and that meets the following requirements: (a) identification of the source from which the water is to be captured, specifying whether the water is surface water or ground water; (b) indication of the quantity of water to be extracted, expressed in liters per second; (c) specification of the points at which the water is to be captured and the method of extraction; and (d) indication of whether the right is consumptive or non-consumptive, permanent or contingent, continuous, discontinuous or alternating.

The administrative procedure requires that this application be published in the *Diario Oficial*, in a daily Santiago newspaper, and in a regional newspaper, where applicable. If the applicant is a single individual, and there is water available, the right of use must be granted and the water authority may not refuse to grant it.

On the other hand, if there is competition for the water rights, they are to be allocated through a bidding process (auction) with an award to the user who offers the highest bid. However, in cases in which there is a societal interest in allocating the available water to a user who did not offer the highest bid, the President of the Republic, and he alone, may order that the auction be voided and may allocate the water to one of the other bidders. In order to establish original use rights, a prior application is not always required. The Director-General of Water is empowered, on his own initiative, to offer available flows at auction.

The resolution establishing the right of use is codified in a public document and entered in the property registry of the competent Real Estate Registry and in the Registry of the General Directorate of Water. Merely by operation of law, land owners have rights over surface water that is surrounded by, emerges from, runs through or disappears within their land.

There are currently two types of water rights: those that are entered in the relevant Real Estate Registries, and other, equally valid ones that are not registered in the corresponding Real Estate Registries. The latter are largely the result of the fact that the current Code declared valid: rights of use recognized by executive rulings, as of the date of their promulgation; those arising from grants given by competent authority, provided that they are currently being used and exercised; and those acquired by prescription. It also provided that the exercise of rights of use recognized or constituted under previous laws shall be governed by their rules, and grandfathered any pre-existing formally registered rights already on record as a result of the rules explained earlier (Figueroa, 1995).

On the other hand, there are cases in which it is not necessary to hold the water right to use the water. These exceptions are detailed below:

- **Rain waters.** The use of this water, fallen and collected on a private property, corresponds to the owner thereof while the waters run within the property and do not fall into natural courses of public use. The works must be within the property and not damage in any way third party rights.
- **Surplus water.** Water that is abandoned at the exit of the property after being used may be used by the property that receives it without any prior requirement.
- **Drainages,** are works that drain land. Before the waters coming from a drainage fall into a course, they may be used by the intermediate properties without requiring a water right.

This initial assignment of water use rights free of charge without considering medium and long term impacts, constitutes a transfer of wealth to water users with important equity impacts and externalities. The main externalities associated with this process are:

- Market imperfections. Part of this problem involves the hoarding of non-consumptive water use rights. This is a strategic action aimed at entrepreneurial development, rather than a matter of speculation, per se. Since water is a basic factor in their productive process, hydroelectric plants can not afford to expose themselves to the risk of future supply shortages, or of having to buy at high prices, which would diminish the profitability of the project. Based on evidences of monopolistic behavior, endorsed by the antimonopoly commission, has refused to grant new water use rights. In fact, the Constitutional Court has established that the State can impose additional conditionalities to grant new water use rights by reformulating the Water Code.

- Third party effects. These impacts are generated when large discharges from rivers still untouched by industry or irrigation are requested by individuals who do not intend to use all of the water.

3.2.3. ORGANIZATIONS THAT ARE IMPORTANT IN THE IMPLEMENTATION OF THE WATER CODE OF 1981

The institutional framework related to the operation of the water code is quite varied and plays a preponderant role in the water allocation process. Following is a brief description of the most important related organizations.

User organizations: are in charge of the distribution and the correct use of water by its members, as well as of the construction, maintenance and management of irrigation structures. The Water Code contemplates three types of organizations: surveillance committees, associations of channel users, water communities.

Dirección General de Aguas – DGA (Water Authority): government agency that reports to the Ministry of Public Works, responsible for the planning, development and exploitation of natural water sources. Its more specific functions include: administration of the National Hydrometric Service, control of the activities of the surveillance committees, and approval of any water improvement project.

Comisión Nacional de Riego – CNR (National Irrigation Commission): government agency in charge of the planning, evaluation, and approval of irrigation investment projects, involving the coordination of several public institutes and private organizations. The CNR, which reports to the Ministry of Commerce,

together with the Irrigation Authority, coordinates the implementation of the irrigation law for major and minor works.

Dirección de Obras Hidráulicas – DOH (Water Works Authority): Government agency in charge of conducting technical and economic studies related to irrigation investment financed by the State after they are approved by the CNR.

Thus, under the institutional framework established by the Water Code of 1981, the water resource management role assigned to the State is the following:

- To measure and determine the availability of water resources and to generate the necessary databases that allow for a well informed management of water resources.
- To regulate the use of water resources avoiding third party effects and their overexploitation. For that purpose the State must analyse the availability of water resources and potential water use conflicts before granting new water use rights and other authorizations such as changes in water distribution infrastructure.
- To conserve and protect water resources, by means of an environmental impact assessment system and environmental policies.

On the other hand, the responsibilities of private sector are:

- To study, finance, and implement development projects associated with water. In this process, water use rights represent their commercial assets and water is considered to be a productive input.
- Distribution of water and its proper use by the members of user organizations, as well as for the construction, maintenance and management of irrigation structures. Three different types of such

organizations are provided for in the Water Code: boards of control, canal-users' associations and water communities.

From the perspective of the State, the positive institutional characteristics are:

- The concentration in a single institution of the research and management water resources.
- The institutional separation of the different tasks that must be undertaken by the State:
 - Water use management (DGA).
 - Water quality and environmental conservation (National Commission of the Environment, CONAMA).
 - The regulation of natural monopolies such as potable drinking water companies (Superintendence of Sanitary Services, SISS, National Commission of Energy, CNE).
 - The development of irrigation infrastructure (CNR and DR).

3.2.4. WATER DISTRIBUTION

The Chilean legislation entrusts water distribution to water users. The Water Code commissions water distribution to Water User Communities and Associations of Channel Users, in the case of waters that run through artificial channels and to the Surveillance Committees in the case of natural channels.

For this purpose, the boards of directors and managers of user organizations have been granted the legal power, in their capacity as arbitrators, to hear and decide about any controversies that may arise among the common users or members of the water associations, or between them and the organization. The Water Code

has also contemplated the possibility that any party that may feel affected or damaged by any resolution or agreement of the board of directors or managers, to appeal to the Ordinary Courts of Justice.

Among the user organizations contemplated in the Water Code, we may mention first the communities of water users. The Chilean legislation defines the water user community as the common use of waters of a same channel or reservoir, or the common use of the water of the same groundwater extraction work by two or more parties. The community is governed by a board of directors or managers that are elected in a regular general shareholders' meeting. The board of directors or managers have the obligations and attributions determined in the by-laws and, in their absence, those specified in the Water Code.

The associations of channel users are the second user organization regulated by the Water Code. Its incorporation and by-laws must be made through a public instrument signed by all the holders of water rights of a same channel or reservoir, or who jointly use the same groundwater extraction works. They may also be legally established in the same manner as the communities of water users. The same rules that regulate the water communities mentioned above are applicable to the associations of channel users.

The surveillance committees are the third user organizations specifically regulated by the Water Code. These organizations have broader functions and attributions than the other two. Individuals or corporations and user organizations that in any way use waters of a same basin or watershed may organize themselves to form a surveillance committee, which shall be created and governed pursuant to the provisions in paragraph 4 of Title III of the Second Book of the Water Code. A surveillance committee may also be organized for each section of a natural course

into which its waters are distributed, independently of the neighboring sections of the same stream. Surveillance committees are responsible for managing and distributing the waters of the natural channels which its members are entitled to, exploiting and maintaining works that are jointly used and fulfilling any other actions that the law may specify.

Surveillance committees are considered created after they have been registered with the Water Authority. Such registration is also required to modify its by-laws. Any member of a surveillance committee that may feel damaged by any agreement adopted by the board of directors on exercising the attributions conferred thereto in numbers 2, 3 and 4 of article 274 of the Water Code, may appeal to the Ordinary Courts of Justice.

Among the most important attributions and duties of the boards of directors are: a) See that water extraction is carried out through adequate works and, in general, take all the steps aimed at the complete use and correct distribution of the water rights under its control; b) Distribute the waters of the natural channels it administers, declare its shortage and, in that case, establish and suspend any extraordinary distribution measures in accordance with the established rights. The declaration of water shortage, as well as the suspension of the extraordinary distribution measures must be made by the board of directors in a meeting specially called for that purpose; c) Deny the use of the waters in the cases determined by the laws or by-laws; and d) Arbitrate in any controversies that may arise in relation to construction or location, within the channel of public use of provisional works aimed at diverting waters towards channel intakes. Definitive works shall require the authorization of the Water Authority (DGA).

Table No. 1 shows the types of user organizations defined in the Water Code as well as their functions and other characteristics.

Table No.1 Types of user organizations and their functions.

CHARACTERISTIC	WATER COMMUNITIES	CANAL USER ASSOCIATIONS	SURVEILLANCE COMMITTEES
Type of Source on which they have influence	Artificial channels	Artificial channels	Natural channels
Jurisdiction	They act over the flow that does not exceed the capacity of its channels.	They act over the flow that does not exceed the capacity of its channels.	They have jurisdiction on the entire basin or watershed or an independent section of a natural stream.
Requirements for their establishment	The fact that two or more parties extract water from a natural source from the same intake and conduct it through the same channel.	The result of a formal act. This association has legal capacity.	To create a vigilance committee it is necessary for channels to be organized.
Acknowledgement	Indicate who are the holders of the water rights, what volumes they are entitled to, and the identification and characteristics of the infrastructure owners.	Requires a document evidencing the unanimous agreement of associating. It must have the authorization of the President of the Republic.	The same than for a water community, besides the acknowledgement of the President of the Republic.
Functions	Channel maintenance, water distribution and management, resolution of conflicts.	Channel maintenance, water distribution and management, resolution of conflicts.	They distribute, manage and resolve conflicts, in addition to: Being in charge of the establishing new water rights and objecting if necessary; Transfer of points of intake; Of polluted water discharged to protect users; Sand extraction; Free run-off and unauthorized water intakes; Groundwater extraction; See that anything done in the upper parts of the basin or other sectors therein do not disturb the water distribution in the lower part of the basin. Execute works to protect the channel.

Source: Prepared by the author.

3.2.5. RESOLUTION OF CONFLICTS

The Water Code establishes that any conflicts that may arise among the users and between the users and the organization, must be solved by the board of directors of the user associations that arbitrate and decide –in their capacity as arbitrating arbitrator– and such decisions may be enforced with the assistance of the public force.

More specifically, in its capacity as arbitrator, the board of directors decides the following matters: a) Water distribution, b) Exercise of the rights of the common users as members of the community, and c) Conflicts that may arise between common water users and the community regarding any of the foregoing points.

The arbitrator shall make a decision with the absolute majority of the members and the award must at least bear the signature of the members that have concurred to the agreement of the majority. In addition, the Code recommends that any members who vote against should also sign stating their reasons for dissenting. The resolutions of these arbitration proceedings are notified through a certified letter and such notification is considered delivered as of the second day it was sent. If necessary, the board of directors may request the competent judge in the territory where the award must be fulfilled to enforce such award using public force. The judge must make sure that the parties that issued the award are actually the members of the board of directors of the community in question and that such community is legally acknowledged.

Finally, whoever feels damaged by the arbitration award, may appeal to the Ordinary Courts of Justice within a term of six months as of the relevant notification.

3.2.6. GROUNDWATER

The Water Code of 1981 establishes that groundwater is a national good of public use. Therefore, the need to define a water right to exploit groundwater is due to the fact that it forms part of a same stream with all the waters of the basin or watershed.

The following requirements have to be complied with to establish a groundwater right: a) the interested party must submit a groundwater right application to the Water Authority (DGA) (which must follow the procedure contained in Title I of Book II of the Water Code); b) supply evidence of groundwater existence; c) prove the availability of groundwater; and d) that the application is legally correct.

In addition, the Water Code and Resolution D.G.A. No. 186 of 1996, establishes three instruments that the Director General of the Water Department has to protect aquifers and the holders of groundwater rights. These instruments correspond to the following limitations to exploit groundwater:

- *Temporary reduction of the right to use groundwater.* This instrument is aimed at protecting holders of groundwater rights against exploitation by other users. The result is the temporary reduction of the exercise of the right proportionately among the holders thereof.
- *Restriction areas.* Restriction areas are those hydrogeological sectors jointly used by different parties, where there is a serious risk of the reduction of a determined aquifer, resulting in damage to already established third party rights in such aquifer. The restricted area is declared by the Water Authority (DGA) upon the petition of any user of the respective sector, on the basis of historical information on the exploitation of its water extraction works, which show the convenience of restricting access to the sector. After an area has been declared a restricted area, the DGA may request the installation of measuring systems and all the information obtained from the wells in that area. The DGA is authorized to grant provisional water rights in those areas that have been declared restricted areas. These rights may be

annulled in the event of confirming that already established rights are being damaged. Water rights granted provisionally may become definitive after five years of actually exercising the rights under the terms they were granted, provided that the holders of already established rights do not prove having suffered damages. The declaration of a restriction area gives origin to a water community made up of all groundwater users in that area

- *Prohibition zones.* By means of a resolution grounded on the aquifer's protection, the DGA may declare prohibition zones where new exploitations are banned, which must be published in the Official Gazette. The DGA is also responsible for issuing the relevant resolutions related to the maintenance or suspension of the prohibition to exploit, at the justified petition, if the results of new investigations on the characteristics of the aquifer or the artificial recharge of the same advise so.

A provisional right is established for a party interested in exploiting new wells under the following conditions: a) the DGA may reasonably restrict the use of the well if it confirms that already existing wells are being damaged; b) the provisional right may become a definitive right if the well has been exploited during five years in the same terms in which the right was established, and the holders of the already established rights do not prove having suffered any damage with the construction of the well.

4. PERFORMANCE OF WATER CODE OF 1981

4.1. INTRODUCTION

Since the establishment of the water allocation mechanism based on a market of water use rights in Chile, a series of empirical and theoretical studies have been

carried out to determine: the existence of a water use rights market and the number transactions; water use rights market efficiency; bargaining, cooperation, and strategic behaviors of market participants; and the marginal gains from trade.

Several authors, (Gazmuri and Rosengrant, 1994; Rios and Quiroz, 1995; Hearne, 1995; Gomez-Lobo and Paredes, 2000; Donoso, Montero and Vicuña, 2001) mention that the Chilean water markets exist because of the evidence of inter-sector and intra-sector water right transactions, specifying that the markets are more active in those areas where the water resource is scarce. These studies indicate that the market mechanism has, in general, represented an efficient water allocation system. On the other hand, others authors such as INECON (1995) and Bauer (1995), state that the efficiency of water markets has been poor due to the existence of thin water markets. Thus, from these studies one can conclude that the performance of the water use rights market in Chile has been variable.

These studies indicate that water scarcity is without doubts the main factor that motivates the operation of an efficient water use rights market. When water is scarce there exist incentives to participate in these markets in order to achieve a reallocation of the scarce resource.

Relative shortage is undoubtedly the chief factor that drives market functioning. When water is scarce, the incentives generated for the market to operate properly are incremented. Investment in adequate water supply and distribution systems is also better justified when there is water shortage and, therefore, marginal benefits are higher.

In the Paloma System, for example, water is a scarce good with a high economic value (especially for the emerging agricultural sector). This generates a strong

competition for water between users, which in turn causes the temporary and permanent water market to be very active, determining the prices of transactions. In the Maipo system, on the other hand, water supply is greater and demand from the agricultural sector lower. In the first section of the Mapocho river (1SMapocho) there is significant demand of water by the drinking water companies that hold 66% of the water rights in this section. They are continuously buying water, and together with the real estate companies², they account for 76% of the rights traded during the 1993-1999 period. Due to this strong competition, the sellers have a great negotiating power that tends to determine the prices of the transactions. In the first section of the Maipo river, on the other hand, the potential buyers and sellers of water rights are not clearly identified like in the 1SMapocho. The principal buyer of water rights in this section is EMOS³, which has adopted a passive attitude in the purchase of water rights⁴, waiting for good offers to buy water rights. In the rest of the sections of the Maipo and Mapocho rivers, water is abundant chiefly because of the contribution of return flows of underused water from the higher part of the basin. This has led the water rights market in these areas to be very precarious.

Therefore, on the basis of the studies conducted we may conclude that the performance of the water rights market in Chile varies greatly. This variable behavior can be explained by problems related and not related to the water rights allocation system.

² Estos dos grupos de empresas pueden ser agrupados suponiendo que los derechos que poseen las empresas inmobiliaria se traspasaran en el futuro a las empresas de agua potable.

³ Empresa Metropolitana de Obras Sanitarias

⁴ EMOS posee una reserva importante de agua en el Embalse El Yeso lo que disminuye sus necesidades de agua

The problems that are independent of the allocation system affect the efficient distribution of water, but are not considered inherent to the free transfer of water rights. In other words, the existence of a water rights market does not generate or aggravate the problem and, besides, the problem represents an impediment to water reallocation with any allocation system. On the other hand, problems that are related to the allocation system affect the efficient distribution of water and are associated to the existence of a water rights market system.

4.2. PROBLEMS NOT RELATED TO THE ALLOCATION SYSTEM

Among these problems are those generated by the inevitable transaction costs, externalities due to the inadequate definition of the water rights in the Water Code and the uncertainty about water availability.

4.2.1. INEVITABLE TRANSACTION COSTS

The transfer of water rights in the market model has certain transaction costs. These costs include costs related to the modification of water distribution physical infrastructure as well as costs related to transaction formalities.

The inevitable transaction costs are determined by the costs of modifying water distribution infrastructure. These transaction costs cannot be avoided because they correspond to an obligation taken on because of the particular characteristics of water and it must be assumed, regardless the water rights allocation system in effect. Therefore, these costs are not relevant to the transaction cost analysis related to the water market, but it must be taken into account that the market permits a greater reallocation of water in those places where there is better water distribution infrastructure. In the Maipo basin, for example, the existing infrastructure is rigid and its modification costly. This cost has been estimated at

approximately 10% of the water right's value in the first section of the Maipo river (1S Maipo). This percentage falls when the total water flow transferred increases. In some cases, this high cost has prevented a significant number of transactions, especially among geographically distant users.

On the other hand, transactions are much more frequent in basins with flexible distribution systems. The transaction costs in the Paloma system, for example, are considerably lower than in the Maipo system because of the existence of a very flexible water distribution infrastructure⁵, which implies that its modification is less costly. This, together with the existence of regulation reservoirs that increase the safety of water availability, have permitted the development of a market of water volumes called transfers, which are of temporary or spot type and possesses a great market depth. The volumes transferred in periods of shortage are up to 10% more than the total volume assigned to sub-basin irrigation users.

Infrastructure costs are inevitable; in other words, they are an obligation that has been taken on because of the specific characteristics of water and it must be assumed, regardless of the water right allocation system in effect. It is not exclusive of the water market. Consequently, these costs must not be considered when analyzing transaction costs related to the water market, but it implies that the market operates best in those places where there is a more flexible distribution infrastructure. It is worth noting that the relative importance of these transaction costs decreases in the extent that the relative shortness of water increases.

⁵ Consiste principalmente en compuertas de tipo variable.

The presence of these unavoidable infrastructure costs indicates the importance of the public and/or private provision of adequate conveyance facilities in order to insure a proper operation of the market system.

4.2.2. EXTERNALITIES DUE TO INADEQUATE DEFINITION OF WATER RIGHTS

Free trade of water rights may cause negative effects to third parties, also called “negative externalities” that prevent the efficient, optimum allocation of water from a social point of view. Among these externalities are the reduction of surplus water, the deterioration of water quality and the reduction of groundwater.

a. Reduction or extinction of surplus water

Surplus water is unused water that has been abandoned by its owners after having been extracted from the relevant water system. This abandonment is evidenced in the fact that the owner stops extracting water, or uses only part of it, leaving the rest to run underground or on the surface towards neighboring properties. Those flows represent an important source of water to users that do not have the original right over them.

The problem arises when the water rights are traded in the market because the farmers that use this surplus water suffer a considerable reduction in water volumes, which may even disappear.

In accordance with the Water Code, in this event, the user of the water for irrigation purposes downstream does not have any legal right to demand any kind of indemnity whatsoever because water rights for water surplus is not

assigned. Therefore, the use of such volumes is conditioned, and the availability of water will depend on the decisions made by upstream users.

Another situation that may arise is that the farmer may want to sell his water rights but such rights are customary and not established rights. These customary rights derive from the actual use of the water granted because it has been traditionally used. This type of right is legally acknowledged, but only in the volumes actually used by the owner. Customary titles do not establish the essential characteristics of: a) flow expressed in volume per time unit; b) whether it is consumptive or not; c) whether it is permanent or eventual, and d) whether it is continuous or discontinuous (Vergara, 1998).

This situation creates conflicts to those farmers who receive surplus water and to farmers that want to sell their customary rights, because the parties affected by the transaction demand the seller not to sell the unused fraction of the rights.

On the other hand, the seller thinks that the rights over the surplus water belongs to him completely, because he has traditionally extracted it. There is a legal gap in this regard because the volume of water that can actually be transferred is not clear.

According to Ríos and Quiroz (1995) surplus water is common in Chile, and “it is an important source of water for many users... Although the problem with these flows is not a consequence of the water market and it can occur under any water distribution system, it represents a challenge for the water rights market. In addition, the existence of tradable water rights may worsen the problem because it encourages water users to keep their water, thereby improving the efficiency of the irrigation system.”

Peña (1995), when referring to the water surplus subject, indicates: ... “This means that a transaction made upstream affects the volume of the water available downstream. In Chile this situation is not a theoretical one but rather quite frequent. It is known that the so called “consumptive uses” of water never represent more than 30% of the actual use of the water consumed, and the remaining 70% of the water returns to the riverbed constituting the source of supply downstream.”

On its part, Rosegrant and Gazmuri (1994) state that the parties affected by the reduction of surplus water need legal protection in Chile. They also indicate that this problem must be solved in the basins of the Elqui and Aconcagua rivers, where surplus is significant, stating that in these basins “the reduction or elimination of surplus because of sale or greater efficiency of the irrigation systems, may dramatically affect the total flow of a section of the river. Therefore, user associations of the Elqui river have divided the basin into several sectors, restricting transactions of the higher sectors of the river only to transactions carried out between those who use water for irrigation.”

Donoso (1995) establishes that the “problem is due to the poor design of the water rights and not to the water allocation system itself.” For Thobani (1994), the Water Code is deficient because it does not explicitly prohibit the sale of water that implies a loss of water for third parties. However, this inconvenient would be controlled in the Water Code of 1981 because the DGA is in charge of supervising and authorizing only transfers at the point of intake, requesting that the water application be published so that third parties that could be eventually affected may object. Therefore, several authors state that the law provides

sufficient protection to third parties that may be affected by the reduction or loss of water surplus.

However, there are others who criticize this way of solving the problem because it favors giving greater attributions to the Administration, thereby attempting against the principle of decentralization of decisions, which is essential in a free-trade system like this market (Vergara, 1997). Another criticism made to this way of solving the problem is that it constitutes a partial solution, because it does not solve other specific situations like that of farmers with customary rights who invest to improve irrigation efficiency, thereby negatively affecting downstream users.

b. Water quality deterioration

The deterioration of water quality is particularly important in the water market because normally those who transfer water rights do not take into account the costs generated by water contamination. Discharge of untreated wastewater and industrial wastewater into watercourses has been identified in Chile. This deteriorates the quality of the water due to the high concentration of sediments of erosion processes, and users that receive those contaminated waters at the end of the riverbed may find that the water is not suitable for irrigation.

According to Ríos and Quiroz (1995) there are three big environmental problems that affect water: water contamination, sedimentation, and the absence of the concept of minimal ecologic flow. The authors add that although the environmental problems can be easily solved in theory, in practice this is not so easy because the solution may be costly.

In addition, Vergara (1997) indicates that one of the most important criticisms made to the free transfer of water rights is that it generates environmental externalities that are not taken into account by those who transfer the rights. Therefore, from a strictly juridical point of view, a legal limit should be established to the granting of new water rights, or transactions should be regulated. In this case, the essence of the freedom of transfer should be respected, exclusively regulating the exercise. At the same time, Allende (1995) points out that the user who has intakes at the end of the river receives contaminated and salty water, which makes it unsuitable for use in agriculture and he considers it is unfair that the farmer should not be compensated for that damage.

On the other hand, Thobani (1994) indicates that, although the problem of contaminated waters is not so severe compared to other countries, there are some regions where that problem is extremely serious.

c. Groundwater reduction

The Water Code of 1981 regulates the exploitation of groundwater, establishing, for example, protection, prohibition and restriction areas that protect the aquifer from overexploitation and prevent possible damage to other users. However, at present there are still cases where aquifers are exploited simultaneously by several independent users, who do not have clearly established ownership rights and, therefore, the aquifer represents a common good of free access. The fact that these users have free access to water generates incentives to exploit the resource at a higher rate than the socially optimum one leading to the rapid depletion of the aquifer, which unlike surface waters, is an exhaustible resource (Donoso, 1995).

It is also worth noting that overexploitation of an aquifer may not only deplete the groundwater resource, but also the resource of hydrologic water existing between both water sources. Therefore, if a user extracts groundwater from an aquifer without any restriction, the rights over surface waters interconnected to this aquifer will be negatively affected.

Coyne et Béliier (1997) illustrate a situation that should be stressed which is the case of the purchase of groundwater rights that were originally destined to agricultural use in areas of water shortage, and now the water is used for mining or drinking water. The problem arises because of the fact that this dramatic change in use varies the extraction rate. Underground water used in agriculture represents a higher cost than surface water; therefore, it is used in a intermittent, complementary manner to surface water (mostly in critical periods). On the other hand, groundwater extraction for mining or drinking water use is continuous during 24 hours a day and 365 days a year.

Finally, it is worth noting that the problem of groundwater reduction is not related to the market system of water rights, but it may occur under any water right allocation system.

In synthesis, the damages to third parties mentioned above, generated by the transaction of water rights cannot be exclusively attributed to the tradability of such rights, because they may occur under any other water right allocation system.

4.2.3. UNCERTAINTY ABOUT WATER AVAILABILITY

Water rights in the Maipo river basin are established in proportion to the flow that passes through the source of supply. In section 1S Maipo the source of supply is the Maipo river, whose volume varies enormously during the year and between consecutive years and, therefore, it is impossible to provide users any forecast about the volume of water they will have available for the season because this is by definition irregular and unpredictable. Therefore, farmers hoard greater volumes of water than necessary because they do not know exactly how much water they will have, thereby limiting the market's normal operation.

In the lower sections of the basin there is little knowledge about the variation in channel volumes where water rights are taken; therefore, the equivalence of useful measurement to analyze the costs and benefits of holding these rights is unknown. In addition, there is no homogeneous quantification measurement in the entire section making it impossible to compare the rights of the different channels, thus, making it impossible to trade such rights.

This does not occur in the 1S Maipo section, where the equivalence of the water share is widely known, especially by the users of water for irrigation in the area. However, in the 1S Mapocho section, the supply of water shares is unknown chiefly because there is an obsolete quantification system that is not consistent with the changes in water demand that have occurred in the basin. The system has two types of rights: water rights for irrigation and water rights for drinking water. The water rights for irrigation has an associated water volume distribution system along the year whose variation is similar to the variation of the irrigation needs of a typical crop. The water right for drinking water, on the other hand, has a continuous

distribution along the year. Making this difference is senseless at present because agricultural demand is practically inexistent.

It is very difficult for a market to operate properly when the available supply of the good that is being traded is unknown. Efforts are being made, however, to solve this institutional problem. The creation of the Regulations for the Public Water Register that obliges water right holders to define their basic characteristics is aimed at this. It is expected that these type of obstacles to the operation of the water market will disappear in the future.

The situation of the quantification of water rights is different in the Paloma System. The water rights in this system are also proportional but not to the variable flow but to the volumes stored in the Paloma, Cogotí and Recoleta reservoirs. This volume can be known at the beginning of the agricultural season. The Paloma System can be seen as a water bank where users maintain a current account, and they are permitted the same activities carried out in a normal bank. For example, they may draw water or charge from the current account; they may borrow water from the bank (subsequently returning it in the following season); deposits of water may be made between different users, and between different activities. The regulation capacity offered by reservoirs increases the safety of water availability, clarifying water supply and permitting users to make rational marginal decisions about how they will use their waters.

This is one of the most important reasons why the water market is sluggish in some places, whereas it has been seen that a water lease market has developed in those places where there are adequate water distribution systems instead of a water rights sale system.

4.3. PROBLEMS DERIVED FROM MARKET ALLOCATION

Studies on water right systems have identified problems like the lack of adequate, timely information; inconsistency between nominal and real rights; conflicts generated between users due to the sale of customary rights; avoidable transaction costs; and hoarding of non-consumptive rights.

4.3.1. LACK OF ADEQUATE, TIMELY INFORMATION

In general, we may observe that there is lack of information about the ownership of water rights or that the information available is incomplete. This is due, on one hand, to the fact that the Register or Water Users is currently not being applied and, on the other hand, that a significant number of water rights have not been registered. This makes it difficult for the parties interested in trading water rights to readily find a counterpart as there is no information about how much water may be traded, what volume corresponds to each share, and whether it is going to be a rainy or dry year.

Studies conducted by INECON (1995) indicate that there are serious difficulties to find information of any kind related to the water market. Thus, not only establishing contact between buyers and sellers is difficult, but also it is difficult to obtain information about water rights in Chile, because the information is dispersed and disaggregated. Also, the little information available has very basic or no processing at all, and has serious quality and reliability problems.

These information problems prevent the holder of water rights from making decisions on the basis of the social and economic benefit. If he(she) does not

know the fundamental economic, hydrological characteristics of his(her) rights, he(she) is unable to value it properly, and tends to under or overvalue it, with the implications this has.

Many of the problems associated with the availability of information can also be classified as independent of the allocation system, because any of them requires having a minimum knowledge to operate adequately. However, the water right market system makes a greater demand. A fundamental aspect is that potential buyers and sellers may have trading price information. If there is no price information system to permit the holders of water rights to know the value of their rights, trading thereof is made more difficult, as they can only have a vague perception but no actual evidence of their value.

4.3.2. INCONSISTENCY BETWEEN NOMINAL AND REAL RIGHTS

One of the problems identified in the literature on the water rights market is the inconsistency between nominal and real rights. There are cases where real rights do not match with the rights the holder defines as his nominal ownership rights. This situation occurs mainly in the case of customary rights and in some cases of groundwater rights. In the latter case, there is a distortion between the potential estimated extraction rates and actual available volumes.

Although this problem cannot be classified as inherent to the market system as it results from a poor definition of the rights, under the transferability situation of the market allocation system, this problem becomes a barrier to transactions. The owners who sell would like to sell their nominal rights, but the buyer will not be

willing to pay for rights that do not have a real associated water flow. This problem becomes evident when trying to trade rights and, therefore restricts the transaction.

4.3.3. CONFLICT BETWEEN USERS DUE TO SALE OF CUSTOMARY RIGHTS

The holders of customary rights frequently want to sell more than what they actually own because the titles do not indicate the volumes clearly; whether or not the rights are consumptive; whether they are permanent or eventual and; whether they are continuous or discontinuous (Vergara, 1998).

This creates conflicts between the sellers of the rights and the potential buyers because the former overprice the rights they wish to sell, and the latter –if they are well informed– will not accept the sale price.

Conflicts also arise between users of consumptive and non-consumptive rights. These conflicts occur due to the fact that the time that the water must be retained in the reservoirs of hydroelectric plants is not clearly specified. The Code clearly establishes that non-consumptive users cannot damage consumptive users due to delays in the delivery of the water; however, this is not fulfilled and is a source of conflict, especially in the basins in the south of Chile (Bauer, 1992).

4.3.4. AVOIDABLE TRANSACTION COSTS

Avoidable transaction costs refer to expenses related to the investigation about offers and applications that must be carried out by the sellers and buyers, the corresponding negotiation, and compliance with the contracts, as well as the legal

validation of the ownership of the water right, contract legalization, and obtaining the necessary permit from the authorities to transfer the water. It is worth noting that these high transaction costs may prevent an initial allocation that is not at its optimum may be naturally corrected.

Transaction costs include registration costs, DGA inspection costs, and the permit from user organizations. We have not included the cost of investigating supply of water rights, which in many cases can be significant.

It is worth noting that there are no quantitative, practical studies that calculate the actual magnitude of these costs nationwide. One of the exceptions may be the study conducted by Hearne (1995), who established the total net earnings associated with the trading of water rights and, therefore, established the estimated transaction costs. However, this analysis was carried out only for the Elqui and Limarí river basins. This study showed that considerable net earnings were obtained in these basins, therefore, the benefit obtained from the transaction of water rights is much greater than the generated cost.

A specific transaction cost occurs when there is asymmetric information between the sellers and the buyers of a good. In this case there is a theorem that shows that there is no absolutely efficient trading system and, therefore, the initial distribution of the rights affects the efficiency of the final allocation of the resources [see Myerson and Satterthwaite (1983) and the McAfee's discussion (1998)], mentioned by Gomez-Lobo and Paredes, 2000.

The existence of transaction costs is equivalent to imposing a tax on the transactions of water rights. If the taxes are high, they may prevent the market from developing and initial rights to be reallocated. Transaction costs act like a

fixed expense that limits the minimal volume of each transaction; in other words, small transactions would not take place, which seems to replicate the situation of small farmers well (Gomez-Lobo y Paredes, 2000).

4.3.5. SPECULATION AND HOARDING OF CONSUMPTIVE RIGHTS

One of the criticisms leveled at the water rights market relates to the fact that the law makes it possible for large discharges from rivers still untouched by industrial or irrigation demand to be requested by individuals who will never use the water. Such requests have no purpose other than to make money by later selling the rights to individuals who need them in order to launch their enterprises and bring progress to remote areas.

According to Jaeger (1999) these market imperfections are mainly due to the initial water allocation of water use rights free of charge without considering medium and long term impacts. The main problems are:

- Market imperfections originated by the hoarding of non-consumptive water use rights. This is a strategic action aimed at entrepreneurial development, rather than a matter of speculation, per se. Since water is a basic factor in their productive process, hydroelectric plants can not afford to expose themselves to the risk of future supply shortages, or of having to buy at high prices, which would diminish the profitability of the project. Based on evidences of monopolistic behavior, endorsed by the antimonopoly commission, has refused to grant new water use rights. In fact, the Constitutional Court has established that the State can impose additional conditionalities to grant new water use rights by reformulating the Water Code.

- Third party effects due to speculative behavior. These impacts are generated when large discharges from rivers still untouched by industry or irrigation are requested by individuals who do not intend to use all of the water.

Based on evidences of market imperfections and monopolistic behavior, endorsed by the antimonopoly commission, the State is modifying the Water Code imposing additional conditionalities to grant new water use rights and non-use fees.

4.3.6. CONFLICT RESOLUTION

Transfer of water rights is significantly reduced in those cases where there is low capacity to solve water conflicts.

In accordance with the Water Code of 1981, the judicial system must solve those conflicts between consumptive and non-consumptive users, after water-user organizations and the Water Authority have not been able to solve it. This has been the case of many conflicts between farmers and hydropower companies, which have been solved in the courts. However, many other cases have not been adequately solved by the judicial system.

It is worth noting that many times in which the cases are transferred to the courts, the offender is not sanctioned because of the slow procedures of the Courts, which extend the existing situation instead of looking into possible solutions (Gallardo, 1995). Chilean lawyers and judges rarely know much about water-right matters and even less about the different uses of water. The legislation on water rights is not taught in the Schools of Law, and it has not been a profitable matter to attract

private lawyers interest. When proceedings are carried out to solve these conflicts, the judges must resort to the DGA to obtain further information (Bauer, 1993).

Private organizations should be able to solve any conflicts arising between the different users more easily because they have more access to the information needed for the investigation of the case. However, private institutions still have problems to solve these controversies. According to several authors, water user associations have weak, inappropriate capacity to solve inter-sector problems and they lack the coordination necessary to assure sustainable development, especially when faced to the interdependencies between the different types of rights (Bauer, 1993 y Hearne, 1994).

The Water Code defines the existence of the Surveillance Committees, which include all users of a river basin, whether consumptive or non-consumptive, and each water share they hold has the right to one vote in the corresponding Committee, regardless the type of user. This has given a disproportionately high participation to non-consumptive users, negatively affecting the vote of consumptive users because non-consumptive rights may be granted in many points of the river basin (Ríos y Quiroz, 1995). This has led to the situation that non-consumptive users are not invited to meetings where conflicts will be resolved.

The origin of these conflicts is the lack of an adequate juridical regulation on the multiple uses of water (Bauer, 1993). The Water Code, for example does not establish what kind of right has priority in the case of usage conflicts. It has not adequately defined non-consumptive rights either, because many times they involve a certain degree of consumption, like in the case of refilling of hydropower company reservoirs for their adequate functioning, thus altering the time during

which the water is available for the consumptive users. This problem arises because the rights do not specify the maximum water extraction.

It is important to point out that these conflicts about water use may be minimized by clearly defining the property rights over the different types of water rights (Vergara, 1997). Also, a better institutional system must be set up that is capable of resolving the conflicts that may arise, taking into account the political aspects that may be caused by this modification because that also represents a significant restriction (Bauer, 1993). Therefore, among the clauses of the Bill sent to Congress in December 1992, the creation of Hydrographic Basin Managers is contemplated, which includes public and private entities. This resolution has not been supported by farmers because it would imply a potential increase of the government administrative participation in water distribution.

As a conclusion we may state that in the water market, conflicts arise among the users from different sectors. The Water Code does not establish a clear system to solve these type of controversies. It does not define non-consumptive rights clearly, thereby generating many conflicts, and it does not grant appropriate faculties to the institutions in charge so that they can solve them properly.

4.3.7. INSTITUTIONAL FRAMEWORK

The creation of a water market does not only require a legal framework and clear rules, it must also be based on the legal, institution, political and cultural conditions of society. According to Bauer (1995), the functioning of the water rights market depends on the existing legal, institutional and political conditions.

In addition, the design and implementation of a tradable water rights system, requires creating and strengthening the administrative, legal and regulatory institutions to minimize the problems described above and to favor the market's performance.

5. LESSONS

Within the framework of the case study analysis, a round table was organized to analyze the case's main lessons. The main results are:

5.1 Which are the conditions that seem to be indispensable to establish a water rights market system in a given society?

In general, the participants agree that the most important conditions are:

- ❑ The existence of water scarcity. In other words, when water has a scarcity price.
- ❑ Protection of the intangibility of water rights.
- ❑ Clear definition of water use rights.
- ❑ Free transfer of water rights.
- ❑ Adequate regulations that address externalities, damage to third parties, and the public interest, among others.
- ❑ A cultural context of society consistent with the economic paradigm.
- ❑ Water resource inventory.
- ❑ Water must be treated individually, separated from the land.
- ❑ The ownership right must be guaranteed both:
 - c) Physically: Management, knowledge and control of the source.
 - d) Judicially
- ❑ An infrastructure that permits transferring the rights.
- ❑ An efficient system to resolve conflicts and controversies.

It is worth noting that a consensus was not reached with respect to the essentiality of the following elements:

- The society must have the will to create a market. Political will.
- The market's existence does not require that the right be safeguarded.
There are examples in other countries where the market exists with a different definition of the rights.

5.2 Has the market permitted the reallocation of the water rights of lower or higher value? Under what conditions has it occurred?

The participants agree that:

- The transfer of rights has taken place from those who value the resource less to those who value it more.
- In the field of the water companies –the most active in Santiago– the amount of water transferred from one sector to another is almost equal to historical transfer and it is proportional to the city's growth.
- Water companies have an open buying power; therefore, the conditions have been created for transactions.
- Transfers from the agricultural sector to the basic sanitation sector correspond to waters from the agricultural sector that have been marginally used or that have fallen in disuse or have been covered by the urban area.
- There is no case of transfer from intensive use in the agricultural activity, unless the land has been sold, or there is water surplus.
- The exceptions to this statement are:
 - Loa Case: There are important purchases by mining companies of waters that were being used in the agricultural sector which passed to the mining sector, but agriculture in the Loa area is not so significant.
 - Paloma Case: The short-term market is very active and significant.

- ❑ Transactions occur when there is no water available for the State to provide free of cost; therefore, the phenomenon of shortage is essential for the market's existence.

There is consensus that there is lack of adequate information to answer the question formally on whether the market has permitted the reallocation of the lower value rights to higher value rights. This indicates the urgent need of creating a good public database to verify the market's operation.

5.3 What kinds of problems have been resolved through the market? In what situations?

It was concluded that:

- ❑ The market permitted valuing raw water.
- ❑ It has permitted developing mining in areas of water scarcity by buying water rights from agriculture, like in the Loa region.
- ❑ Water companies have solved their problems of greater water demand, for example, the case of Agua Potable Cordillera.
- ❑ It has helped to solve problems of scarcity when a quick response has been required, like the case of Minera Manto Verde in Copiapó.

5.4 What problems have not been solved with the allocation system?

- ❑ Inefficiency in the use of water in all sectors, not only in the agricultural sector.
- ❑ Environmental problems, maintaining ecological water reserves.

5.5 What elements have hindered the allocation of water rights through the market?

- ❑ The absence of the obligation to use the water encourages a monopolistic behavior.
- ❑ The lack of a register of water right owners.
- ❑ The lack of a rapid, efficient controversy resolution system.
- ❑ Lack of clear definition of water rights.
- ❑ Little flexibility in relation to temporary transfers.
- ❑ Infrastructure rigidities that do not permit the market's operation.

5.6 Have there been any problems related to the monopolization of water rights?

The participants concluded that the monopolization of water rights is:

- ❑ Not a problem of the market but of the initial free allocation of the water rights without a restriction which obligates water rights holders to effectively use the water.
- ❑ It has occurred, but it is not a problem of the market. It is rather due to the initial allocation and structure of the water rights. It is also a result of the way in which the administration grants the water rights.
- ❑ There is evidence of the monopolization of water rights granted in specific basins under the Water Code of 1981, both in relation to consumptive and non-consumptive rights.

5.7 Summary

The Water Code of 1981 shows that the allocation system based on the water rights market has significant economic benefits because it considers water as an economic good, internalizing its scarcity value. However, the adequate application

of this system requires strengthening the institutional framework to achieve the integrated management and sustainable use of water.

The main conditions to establish a market system based on water rights are:

- ❑ Water scarcity
- ❑ Juridical protection of water rights
- ❑ Clearly defined right over the good
- ❑ Clear market regulations for all participants
- ❑ Adequate inventory of water resources
- ❑ Efficient system to resolve conflicts

Additionally, one can conclude that the performance of the water use rights market in Chile has been variable. The variability in performance of the market can be explained by problems both related to and independent of the allocation system. Problems independent of the allocation system affect the efficient allocation of the resource but are not considered to be related to the free transferability of water rights. In other words, the existence of a rights market neither creates nor aggravates the problem. Furthermore, the problem represents an impediment to reallocating of the resource under any allocation system. At the same time, problems related to the allocation system affect the efficiency in allocating water resources and are related to the water market system.

The most important problems independent of the water allocation mechanism are those arising as a result of unavoidable transaction costs, externalities due to inadequate definition of use rights in the Water Code, and uncertainty regarding the availability of water.

Likewise, certain problems related to the allocation system have been identified – problems such as the lack of adequate and timely information; the difference between nominal and in rem rights; conflicts arising between users due to the sale of traditional rights; avoidable transaction costs; and the hoarding of non-consumptive rights.

In general, one can conclude that the allocation framework based on a market allocation system established by the Water Code in 1981 has been efficient from an investment point of view, mainly due to the water use rights security granted by the legislation. This is evidenced by significant investments that have been undertaken by several economic sectors to improve water use efficiency and to increase the availability of groundwater through exploration.

Likewise, the free transaction of water use rights, even though in many areas water use rights markets have not been very active, constitutes an efficient reallocation mechanism which has facilitated the reallocation of granted rights. However, it is not clear whether this reallocation of water use rights has occurred from low value to high value users, due to the lack of empirical evidence and information. It is thus necessary to develop a reliable data base in order to correctly evaluate the performance of the Chilean water use rights markets.

It is important to highlight, however, that the regulatory framework and the heterogeneity of water use rights has allowed for strategic and monopolistic behavior on the part of water use rights holders, thus generating an inefficient allocation from a social point of view. Part of this problem involves the hoarding of non-consumptive rights. This is a strategic action aimed at entrepreneurial development, rather than a matter of speculation, per se. Since water is a basic factor in their productive process, hydroelectric plants can not afford to expose

themselves to the risk of future supply shortages, or of having to buy at high prices, which would diminish the profitability of the project.

In summary, water use rights markets represent a useful allocation mechanism for water resources. However, it is necessary to reformulate the regulatory framework of this mechanism so as to reduce the existence of conditioning factors that have limited the efficiency and sustainability and replicability of this allocation mechanism.

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