

Privatizing the Commons – Natural Resources, Equity and the Chilean Water Market

Victor Galaz R.

Nueva Serie FLACSO

**Privatizing the Commons –
Natural Resources, Equity and the Chilean Water Market
Victor Galaz R.**

Las opiniones que se presentan en este trabajo, así como los análisis e interpretaciones que en ellos se contienen, son de responsabilidad exclusiva de sus autores y no reflejan necesariamente los puntos de vista de FLACSO.

Esta publicación es uno de los resultados de las actividades desarrolladas, en el ámbito de la investigación y la difusión, por el Área de Relaciones Internacionales y Estudios Estratégicos de FLACSO-Chile. Estas actividades se realizan con el apoyo de diversas fundaciones, organismos internacionales, agencias de cooperación y gobiernos de la región y fuera de ella. Especial mención debemos hacer del apoyo institucional recibido de las fundaciones The William and Flora Hewlett Foundation y Fundación Ford.

Ninguna parte de este libro/documento, incluido el diseño de portada, puede ser reproducida, transmitida o almacenada de manera alguna ni por algún medio, ya sea electrónico, mecánico, químico, óptico, de grabación o de fotocopia, sin autorización de FLACSO.

333.91 Galaz R., Victor

**G147 Privatizing the commons. Natural resources, equity and the
chilean water market. Santiago, Chile: FLACSO-Chile, 2003.**

68 p. Nueva Serie FLACSO

ISBN: 956-205-179-X

AGUA / RECURSOS HIDRICOS / MERCADO DE AGUAS /
DERECHOS SOBRE LAS AGUAS / VIOLACIONES A LOS
DERECHOS DE AGUA / AGUAS DE REGADIO / CHILE /

© Santiago, enero 2003. FLACSO-Chile. Inscripción N° 130.931. Prohibida su reproducción.
Editado por FLACSO-Chile.

Área de Relaciones Internacionales y Estudios Estratégicos.

Av. Dag Hammarskjöld 3269, Vitacura.

Teléfonos: (562) 2900 200 Fax: (562) 2900 270

Casilla electrónica: flacso@flacso.cl

FLACSO-Chile en el Internet: <http://www.flacso.cl>

Diseño de portada Nueva Serie Flacso: A. Dos Diseñadores

Diagramación interior: Claudia Gutiérrez, FLACSO-Chile

Producción: Marcela Zamorano, FLACSO-Chile

Impresión: LOM Ediciones

INDEX

Presentation	7
Preface	11
Acknowledgments	15
Part I	
Theoretical aspects of natural resource managements	17
Part II	
Water and Equity - The chilean water market	27
Conclusions	55
References	61
Appendix. Water Right Violations - a selection of cases	67

SUMMARY

This publication discusses the social impacts of the Chilean water market; an almost forgotten dimension in a debate strictly dominated by economists and lawyers with little interest in equity issues. More specifically, it discusses how the water market has affected underprivileged water users, and it examines institutions and organizations that are fundamental to secure the livelihood of this group. This discussion is guided by the use of a few and simple game theoretic models.

This publication is divided in two parts. The first part - Theoretical Background - is a very short introduction to the research field that has evolved around the paradigmatic work of Elinor Ostrom in *Governing the Commons*. This part presents how game theoretic models can be used to analyze the challenges facing natural resource management, and the dynamics of strategic interaction among resource users. This part should be of particular interest to those who are not familiar with the logic behind game theoretic models in the social sciences.

The second part - *Water Markets and Equity* - is a critical exploration of the Chilean water market and its institutions. This part provides an illuminating example of how game theory combined with empirical data can be used to highlight crucial aspects of public policy, and derive at thought-provoking results. In this part, I show why the common claim that the negative social consequences of the Chilean water market have been limited is faulty; why attempts by Chilean governmental agencies are doomed to be fruitless given the institutional deficiencies surrounding the water market; and what the results imply for other developing countries that are in the process of modifying their water regimes with Chile as a model.

RESUMEN

Esta publicación discute los impactos sociales del mercado de aguas chileno, aspecto casi olvidado en un debate que ha sido dominado en forma irrestricta por estudios de economistas y abogados cuyo interés en investigar dichos problemas ha sido casi nulo. Específicamente, el propósito es discutir cómo el mercado de las aguas ha afectado a los usuarios de escasos recursos, así como, examinar las instituciones y organizaciones fundamentales creadas para asegurar el sustento de este grupo. Esta discusión es guiada por el uso de modelos cuyo origen lo encontramos en la teoría de juegos.

La publicación esta dividida en dos partes. La primera parte consiste en una introducción muy corta al campo de investigación que ha evolucionado en torno al trabajo paradigmático de Elinor Ostrom en *Governing the Commons* (1990). En esta parte se presenta cómo el uso de modelos con origen en la teoría de juegos, pueden usarse para analizar los desafíos que enfrenta el manejo de recursos naturales, y la interacción estratégica entre usuarios de esos recursos. Esta parte debería ser de interés particular a quienes no están familiarizados con el uso de la teoría de juegos aplicada a las ciencias sociales.

La segunda parte es una exploración crítica del mercado de las aguas en Chile y sus instituciones. Se muestra como las violaciones a los derechos de agua de campesinos y comunidades indígenas pueden ser explicadas por los incentivos creados por el mercado. En esta parte también se muestra la deficiencia de aquellas frecuentes conclusiones que señalan que las consecuencias sociales negativas del mercado de aguas chileno son menores; por qué los intentos de agencias gubernamentales chilenas de mediar y resolver en favor de los usuarios de escasos recursos económicos no producen efecto alguno, dado las deficiencias institucionales del mercado de agua; y que resultados son esperables para países en desarrollo que están en el proceso de modificar sus regímenes de agua tomando a Chile como modelo. Esta parte funciona como un ejemplo de cómo la teoría de juegos, combinada con información empírica, puede ser usada para destacar aspectos cruciales de la política pública.

PRESENTATION

Conflicts around natural resources are more than an analytical abstraction. Around the world, competition for water is increasing among actors involved: agriculture, mining, sewerage companies, even among those institutions that have a geopolitical approach. Unfortunately these conflicts are rarely solved to the benefit of the poorest of natural resource users.

One widely discussed solution to the ever-increasing scarcity of water resources in developing countries has been to treat them as a private economic good. It is often said that the creation of a free water market - just like any other market - would provide incentives to water users which increase both economic and environmental efficiency, by allocating resources to their most valuable uses.

From a critical perspective, poor management of natural resources in combination with a liberal and open policy, without a suitable regulatory framework, aggravates and accelerates the environmental deterioration.

Despite all the potential benefits that are usually attributed to a system of tradable water rights, few countries have fully implemented such institution. Chile remains as the international leading example of free market water policies. It has therefore become a model for other Latin American countries - like Bolivia, Peru and a number of countries in Central America - that are in the process of radically modifying their water regimes. Moreover, a number of powerful international organizations, such as the World Bank, tend to strongly promote the Chilean water regime as a model for developing countries fighting against even scarcer water resources. But, in what way has the privatization of water affected the poorest water users in Chile? The sad answer to this question is: we do not know.

The Chilean water regime has attracted much interest from the international research community. No country has implemented in such depth like Chile the idea that natural resource conflicts can be solved by the creation of a market. It remains to be seen whether markets are economically, socially and environmentally more sustainable than the alternatives, (i.e. it is an empirical issue), and the results will be of interest to all developing countries that are in the process of radically modifying their water regimes.

This paper produced much controversy when it was first presented at FLACSO-Chile last May. This says something about the importance and "heat" of the issue, and about the need for FLACSO to provide the general public new research results.

Unfortunately, there is a substantial lack of research on the Chilean water market and its ecological and social impacts. Hopefully this report will help to put more emphasis on these crucial issues.

The results in this report should be seen as a first discussion-paper. Additional field studies will be conducted by the same researcher in 2003. FLACSO is interested in improving the capacities of diagnose in critical areas and to contribute ideas to the negotiated resolution of the national and international conflicts.

The Hewlett Foundation has sponsored the activities to the theme of the natural resources, environmental activities and development. Additionally we are thankful to the Ford Foundation for the contribution to the institutional development of FLACSO-Chile.

Francisco Rojas Aravena
Director FLACSO-Chile

PRESENTACIÓN

Los conflictos sobre el uso de los recursos naturales son más que una abstracción analítica. En distintas partes del mundo la competencia por el uso del agua sigue aumentando entre las partes interesadas: agricultura campesina, agroindustria, minería, empresas de agua potable e incluso aquellas instituciones que poseen una perspectiva geopolítica de los recursos. Desgraciadamente, estos conflictos raramente se resuelven en beneficio de los usuarios más pobres.

Una solución ampliamente discutida para dirimir los conflictos creados por la escasez creciente de recursos de agua en países en vías de desarrollo ha sido tratar dichos recursos como un bien económico privado. Se dice que la creación de un mercado de aguas, produce los incentivos necesarios para aumentar la eficiencia económica y medioambiental, asignando dichos recursos a sus usos más óptimos. Desde una perspectiva crítica el mal manejo de los recursos naturales en combinación con una política abiertamente liberal y privatizadora, sin un marco regulatorio adecuado, agrava y acelera el deterioro ambiental.

A pesar de los beneficios que normalmente se atribuyen a un mercado libre de agua, pocos países han institucionalizado legalmente esta forma. Chile permanece como el ejemplo internacional más destacado de políticas de agua de libre mercado. Ésta es la razón de por qué Chile se ve como un modelo para otros países latinoamericanos -como Bolivia, Perú y varios países en Centroamérica- que están en el proceso de modificar radicalmente sus regímenes de agua. Además, varias organizaciones internacionales influyentes, como el Banco Mundial, tienden a promover el mercado de agua chileno como un modelo a implementar en los países en desarrollo. ¿Pero de qué manera ha afectado la privatización de aguas a los usuarios de más escasos recursos en Chile? Desgraciadamente la respuesta es: no sabemos con seguridad.

El régimen chileno del agua ha atraído mucho interés de la comunidad académica internacional. Ningún país ha implementado en tal profundidad como Chile la idea de resolución de los conflictos sobre recursos naturales por la creación de un mercado. Si los mercados son más sustentables económica, social y ambientalmente que las alternativas, es algo que está por verse y los resultados serán de interés a todos los países en vías de desarrollo que estén en el proceso de modificar radicalmente sus regímenes del agua.

Los resultados de la investigación de Victor Galaz causaron o mucha controversia cuando fue presentado en FLACSO entre especialistas en la materia e primer semestre del 2002. Esto nos muestra la importancia y lo polémico del tema, así como de la necesidad que FLACSO asume en seguir apoyando investigaciones de este nivel de importancia.

Desafortunadamente, hay una carencia importante de la investigación sobre el mercado chileno del agua y sus impactos ecológicos y sociales. Se espera que este informe ayude a poner más énfasis en estos temas cruciales.

Los resultados en el informe se deben considerar como un primer trabajo para la discusión. El investigador responsable continuará realizando estudios de campo durante el 2003. FLACSO esta interesada en mejorar las capacidades de diagnóstico en áreas críticas y aportar ideas a la resolución negociada de los conflictos nacionales e internacionales

La Fundación Hewlett ha patrocinado las actividades académicas vinculadas a la temática de los recursos naturales, medioambiente y desarrollo. Adicionalmente agradecemos a la Fundación Ford por el aporte al desarrollo institucional de Flasco-Chile.

PREFACE

Conflicts about natural resources are not just an analytical abstraction. Around the world, competition for water is increasing among irrigators and between agriculture, industry, urban water supply and other needs. These sometimes conflicting claims seriously challenge social institutions that mediate access to water. One critical question is what the social sciences have to say about a problem of such magnitude and importance.

The main purpose of this publication is to explore the social impacts of the Chilean water market, one almost forgotten aspect in a debate strictly dominated by economists and lawyers with little interest in equity issues. More specifically, the ambition is to discuss how the water market has affected underprivileged water users, and examine which institutions and organizations that are fundamental to secure the livelihood of this group. This discussion is guided by the use of a few and simple rationalist based game theoretic models.

There is a stream of theory and scholarship that embraces the more traditional fields of economics and political science, and that offers the prospect of coherent and systematic knowledge about natural resource management; rational choice theory. This methodology often starts with one (controversial) assumption: social actors – such as individuals or groups – are self-interested and rational, and thus always try to maximize their individually preferred choice given the constraints provided by their environment. Even if it certainly isn't the only methodology able to tackle such an inherently complex research issue, it definitely is an important one. Important in the sense that it has, and continues to attract the interest of a number of disciplines such as anthropology, history, political science, sociology, social psychology and even biology.

This publication is divided in two parts. The first part – *Theoretical Background* - is a very short introduction to the research field that has evolved around the

paradigmatic work of Elinor Ostrom in *Governing the Commons*. In this part I present how game theoretic models can be used to analyze the challenges facing natural resource management, and the dynamics of strategic interaction among resource users. This part should be of particular interest to those who aren't familiar with the logic behind game theoretic models in the social sciences.

The second part – *Water Markets and Equity* – is a critical exploration of the Chilean water market and its institutions. This part provides an illuminating example of how game theory can be used to highlight crucial aspects of public policy, and derive at thought-provoking results. In this part, I show why the common claim that the negative social consequences of the Chilean water market have been limited is faulty; why attempts by Chilean governmental agencies are doomed to be fruitless given the institutional deficiencies surrounding the water market; and what the results imply for developing countries that are in the process of modifying their water regimes with Chile as a model.

The results of the second part might sound illogical to those – especially lawyers – who put their trust in the hands of the judicial system and a further perfection of the Chilean Water Code. As will become clear, I will approach the subject from a different angle. The reason for this is the all too often ignored fact that there often is more than one legal, or law-like, system that is relevant in natural resource management. This means that in many life situations farmers, water users, village headmen, bureaucrats and officials can make use of more than one normative repertoire to rationalize and legitimize their decisions or their behavior. Which specific repertoire and in which specific case, has proven to be a matter of experience, of local knowledge, and power relations between the users.¹

1. Joep Spieritz (2000:191)

Lastly, even if this paper explicitly deals with water resources, there is no *theoretical* reason why the argument couldn't be applied on the privatization of other natural resources such as forests or fishery. Whether this theoretical "hunch" is correct is, as always, a matter of more research. Hopefully, this text contributes to a much-needed focus on equity issues in natural resource management in Chile.

Victor Galaz R.
Göteborg, Sweden
September 2002

ACKNOWLEDGMENTS

I gratefully acknowledge financial support from the following sources: *The Swedish Water Management Research Program (VASTRA)*, *Theodor Adelswärd Memorial Fund* and *The Royal Swedish Academy of Sciences*. I am grateful to Nancy Mathus, Rafael Del Valle and Oscar Muñoz for their comments on an earlier draft of the paper presented at FLACSO in Santiago de Chile, and to my Swedish colleagues Lennart J. Lundqvist, Anna Blomqvist and Patrik Stålgren. However, the author is solely responsible for the views expressed in this publication.

A special thanks to my “señora” Hanna Ahnqvist, and my son Elias Galaz for their love, patience and infinite understanding during our three month stay in Chile.

PART I

THEORETICAL ASPECTS OF NATURAL RESOURCE MANAGEMENT

Social Dilemmas and the Tragedy of the Commons

Natural resources such as pasturelands, woodlands, fisheries and water, have long been shared and used in common by local communities. This might seem obvious as we often take for granted that groups of individuals with common interests will cooperate to achieve the common interest. As an example, if rational and self-interested farmers have a common interest in creating a water user association to coordinate their water use, or defend their interests against an external intervener, it is often assumed to follow logically that the individuals in that group would act to achieve that objective.

Unfortunately, this common sense assumption seldom holds true, and cooperation between self-interested individuals or groups is considerably more difficult to achieve. This section explains why, and how the problem *collective action* affects the possibilities for sustainable natural resource management.

Social Dilemmas and the Tragedy of the Commons

Why does common land tend to suffer overgrazing? And why does every sea fishery suffer from overfishing? Garret Hardin's "The Tragedy of the Commons" published in *Science* 1968 is probably the most famous article in the study of "social dilemmas" or "social traps". Hardin describes a situation in which a number of herdsmen graze their herds on a common pasturage. Each summer, all the farmers graze their goats on the common village green. The "tragedy" arises because each herdsman is aware that it is to his benefit to increase the size of his herd because, while each of his animals represents potential profit to

him, *the cost of grazing the animal, measured as the damage done to the common pasturage, is shared by all of the herdsmen*. That is, it is profitable for each individual herdsman to add one or more animals to the common pasturage. The result of the herdsmen's rational individual choices, each trying to maximize their own benefit, makes the quality of the commons deteriorate.² That is, this *individually* rational behavior deteriorates into collective ruin.

Air pollution in Santiago is a classic tragedy of the commons in the making: each time you burn a liter of gas to drive to a mall, you reap the benefit of it, but the environmental cost in terms of air-pollution is shared with all five million members in Santiago. Being rational and self-interested, you drive, and the city's capacity to absorb air pollution is "overgrazed".

One classical and widely used illustration of the tension between individual and collective rationality as the one described by Hardin, is the Prisoners' Dilemma game. In this game, two guilty accomplices are held in separate cells and interrogated by the police. Each player has two options (or *strategies*) available: confess or not confess. Each is faced with a dilemma. If they both confess (or "defect") they will both go to jail for six months. If they both stay silent (or "cooperate"), they will both go to jail for a month. But if one confesses and the other does not, the defector will walk free, while the cooperator (who stayed silent) will get a nine-month sentence. Figure 1 shows how these options and outcomes can be presented as a "game".

		Prisoner 2	
		Not confess	Confess
Prisoner 1	Not Confess	-1, -1	-9, 0
	Confess	0, -9	-6, -6*

Figure 1. The game-theoretic model illustrates the prisoners' dilemma game (Player 1 vs. Player 2). The prisoners have two options, 'Confess' or 'Not Confess'. Figures represent the pay-offs, i.e. months in prison. '*' represents an equilibrium.

2. Hardin (1968)

By convention, the payoff to the so-called row player (here, Prisoner 1) is the first payoff given, followed by the payoff of the column player (=Prisoner 2). Thus, if Prisoner 1 chooses 'Confess' and Prisoner 2 chooses 'Not Confess', Prisoner 1 receives the payoff 0 (representing immediate release), and Prisoner 2 gets -9 (representing 9 months in jail).

In order to understand the outcome of this game-theoretic model, we must understand the logic behind what is called a *dominant strategy*. This strategy is the strategy, which the player is always better off choosing, *no matter what the other player chooses*. Focusing on the option Prisoner 2 has, we can easily see that he/she is always better off by choosing "Confess", no matter what Prisoner 1 chooses. This means that Prisoner 2 has "Confess" as a dominant strategy, and the other way round.

How do we know this? Pretend you are Prisoner 2. Observe the payoffs column-wise, and you can see that -1 is better than 0 (that is 'Confess' is better than 'Not Confess' if the other prisoner chooses 'Not Confess'), and that -6 is better than -9 (that is "Confess" is better than "Not Confess" if the other prisoner chooses "Confess"). Thus, *you are always better off by choosing "Confess" no matter what the other player chooses*. The same applies to Prisoner 1. As a result, both Prisoners will always choose "Confess", thus leading to the outcome (-6, -6).

Another way to denote this predicted outcome – and a term that will be used later– is "equilibrium". Generally speaking, an equilibrium is a situation in which the player is doing as well as it can for itself, given the array of actions taken by others, and given the institutional framework that defines the options of individuals and links their actions.³

Without digging too deep into the details of this "game", let us conclude that social dilemmas have two main characteristics: 1) that the dominant strategy of the players lead to a non-optimal outcome from the perspective of the players and 2) there exist at least one set of coordinated strategies that is more efficient

3. Kreps (1991:6). The possibility to point out one equilibrium point is what gives rational-choice theory its reputations as the physics of social science. Equilibrium analysis can also be found in physics, economics, and biology.

than current decisions.⁴ In the Prisoners' Dilemma game, the sub-optimal outcome is the fact that both players dominant strategy is to confess, and the coordinated strategy (Not confess, Not confess) is the most beneficial and coordinated strategy for both players.

Thus, *rational self-interested actors will never achieve potential collective benefits*. This result is the complete opposite of what we would expect, and has also been developed to detail in the classical work of Mancur Olson in *The Logic of Collective Action* (1965).

The logic behind the "Prisoners Dilemma" is no doubt a powerful analytical model, and has been used to describe such diverse problems as overexploitation of fish stock, groundwater depletion, the problem of acid rain and the problems of international cooperation.⁵

A General Classification of Goods

But when should we expect to find this problem? And what specific resources are at risk of facing tragedies of the commons? One general answer to this question points at a particular class of goods (i.e. resources) in the world that share two important attributes. These two attributes are (1) the difficulty excluding individuals from benefiting from a good, and (2) the subtractability of the benefits consumed by one individual from those available to others. Allow me to discuss each attribute:

Exclusion. Goods differ in terms of how easy or costly it is to exclude or limit potential users from consuming them, once they are provided by nature or through the activities of other individuals. Fencing and packaging are the ultimate physical means of excluding potential beneficiaries from a good. To be effective, however, these efforts must be backed up by the proper institutional framework, i.e. property rights that are feasible to defend in an economic and legal sense.

Subtractability. Goods also differ in terms of the degree of subtractability of one's person's use from that available to be used by others. If one fisherman lands a ton of fish, those fish are not available for other fishermen. On the other hand, one person's use of a weather forecast on television does not reduce the availability of the information in that forecast for others to use.

4. Ostrom, Gardner, et al. (1994:17)

5. Ostrom (1990:3), Lange, Liebrand et al. (1992)

		Subtractability	
		Low	High
Exclusion	Difficult	Public Goods	Common-Pool Resources
	Easy	Toll Goods	Private Goods

Figure 2. General classification of goods.

These attributes provide a very general classification of four types of goods as shown in figure 2. The four kinds of goods so identified are broad categories that contain considerable variation between them. The “dilemma” and “tragedy” can appear for two of the goods: *public goods* and *common-pool resources*. The reason for this, is that these resources face two different kinds of dilemmas:

(1) *Public goods dilemmas* – a public good is a resource from which all may benefit, regardless of whether they have helped to provide the good. As an example, I can enjoy the parks in my city even if I do not pay municipal taxes. The problem arises because there is a temptation to enjoy the good, without contributing to its creation and maintenance. Those who do so are termed “free-riders”, and while it is individually beneficial to free-ride, if all do so the public good (a park, a new library, etc.) is not provided and all are worse off. There is also a second reason for defection. A person might be willing to cooperate, but fear that not enough others will do so. The concern here is the fear of being a “sucker”, i.e. throwing away one’s effort to a lost cause.

(2) *Commons dilemmas* – the issue here is not the production, but rather the carrying capacity of the commons: the tree I cut, the fish I catch, and the water

I use are not available for others. The problem arises because it is individually beneficial to exploit the commons (e.g. Hardin's herders described earlier). In sum, public goods dilemmas concern the production of, and commons dilemmas involve the use of, a joint good from which it is difficult to exclude others.⁶ Both these goods are under constant threat of overexploitation (e.g. the commons), or under-provision (e.g. public goods). Figure 3 illustrates a number of resources that are at risk of "overexploitation".

		Subtractability	
		Low	High
Exclusion	Difficult	Public television, a sunny day, rain	Water resources, forests, fish stock, etc.
	Easy	Cable TV, Golf club, private library.	Car, personal computer, newspaper, shoes.

Figure 3. Example of goods given the possibility of exclusion and subtractability. Examples in bold are at risk of facing the commons dilemma.

Solutions to the Commons Dilemma

Historically, social scientists have strongly emphasized the *impossibility* of getting self-interested actors to cooperate. The recommendations to solve the commons dilemma have been two: 1) external solutions based on central intervention, or 2) a total privatization of the resource.⁷ Unfortunately, both these solutions face serious problems.

6. Kollock (1998:188 - 192)

7. Ostrom (1990:105)

The presumption that the involvement of an external (i.e. central) agent is necessary to avoid tragedies of the commons, leads to the recommendation that central governments control most natural resources. Applied on Hardin's case, the central authority will decide who can use the meadow, when they can use it, and how many animals can be grazed. However, agents of the central government may lack both the incentives and the information necessary to devise optimal rules. More precisely, this solution is based on unrealistic assumptions concerning the full accuracy of information, unlimited monitoring capabilities, full sanctioning reliability, and zero cost of administration. Without valid and fully reliable information a central agency could make several errors: setting the carrying capacity or the fine too high or too low, sanctioning herders that cooperate, or not sanctioning defectors. The problem of incomplete information has led to a numerous failed governmental attempts, with the continued destruction of natural resources as a result.⁸

Privatization - another popular solution to the commons dilemma and applied on water resources in Chile - also runs into problems. The key issue is the difficulty of establishing private rights for interconnected ecological resources. That is, even if private rights are unitized, quantified, and salable, the resource *system* is still likely to be owned in common rather than individually.⁹ *This implies that an enforcement of a market sometimes would require as large a bureaucracy as if the resource had been centralized in the first place.* Moreover, there is no guarantee that rationality would call for a private owner of an environmental good to preserve it or use it sustainably. When the price is right, many people possibly would not think twice about clear-cutting a forest, exhausting an aquifer, or using the environment as a dumping ground, if all they ever care about is the monetary gain into their pockets.¹⁰

8. Ostrom (1990:8ff)

9. Ostrom (1990:12f)

10. Chang (1989:639)

Neither Market Nor State - An Alternative Solution

What is the alternative if both these solutions are inherently deficient? In *Governing the Commons*, Elinor Ostrom presents a remarkable number of cases when the involved actors actually have avoided the tragedy—contrary to the claim of Hardin and other social scientists—through the voluntary creation of institutions. That is, the “players” have themselves been able to change the structure of the “game” and reach an efficient cooperative outcome. Ostrom also tries to find the factors that might affect the actors’ incentives to cooperate and retain the resources’ productivity and sustainability.¹¹ As the author clearly demonstrates, this result has deep implications for how we look at policy recommendations to solve the commons problem. The question is no longer whether privatization or government procurement of commonly owned natural resources is the solution, but rather how to design policies that enables the users themselves to successfully develop and maintain effective institutions.¹² Evidence from the research field show that farmers with long-term ownership claims, who can communicate, develop their own agreements, establish the position of monitors, and sanction those who do not conform to their own rules, are more likely to grow more rice, distribute water more equitably, and keep their systems in better repair than is done under government operation.¹³ This result is backed by a large number of empirical studies.¹⁴ Table 1 sums up the variables that enable the emergence of long-enduring resource management institutions.¹⁵

11. Ostrom (1990)

12. Bromley (1992), Berkes, F. et al. (1989), Ostrom (1990), Ostrom (1992).

13. Ostrom, E. (2001:21) [Reformulating the Commons in Protecting the Commons]

14. E.g. Bromley (1992), Berkes, et al. (1989), Baland & Platteau (1996)

15. Extracted from Ostrom (1990)

Table 1

Design Principles Illustrated by Long-Enduring Common-Pool Resource Institutions

1. **Clearly Defined Boundaries:** Individuals or households with rights to withdraw resource units from the resource, and the boundaries of the resource itself, are clearly defined.
2. **Congruence:** A. The distribution of benefits from appropriation rules is roughly proportionate to the cost imposed by provision rules. B. Appropriation rules restricting time, place, technology, and quantity of resource units are related to local conditions.
3. **Collective-Action Arrangements:** Most individuals affected by operational rules can participate in modifying operational rules.
4. **Monitoring:** Monitors, who actively audit common-pool resource conditions and appropriator behavior, are accountable to the appropriators, or are appropriators themselves.
5. **Gradual sanction:** Appropriators who violate operational rules are likely to receive graduated sanctions - depending on the seriousness and context of the offense - from other appropriators, from officials accountable to these appropriators, or both.
6. **Conflict Resolution Mechanisms:** Appropriators and their officials have rapid access to low-cost, local arenas to resolve conflict among appropriators and officials.
7. **Minimal Recognition of Rights to Organize:** The rights of appropriators to devise their own institutions are not challenged by external governmental authorities. For common pool resources that are part of larger systems:
8. **Nested Enterprises:** Appropriation, provision, monitoring, enforcing, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Summing Up Game Theory and Natural Resource Management

One important question remains before moving on to the second part of the paper. Why use game theory as a method to approach issues of natural resource management?

Game theory is emerging as one of the theoretical tools in heavy use across of all social sciences, as well as in biology. This is not a coincidence. Game theory has proven to be a tool uniquely appropriate for modeling strategic interaction that involve a limited number of actors that are engaged in purposeful action.¹⁶ One important reason for this is the fact that many conflicts *do* have a rational basis. That is, they can't be understood simply as the unfortunate product of misperceptions or poor communication that some enlightened effort can overcome, but rather as hard-resolved conflicts of interest¹⁷. Actors, such as natural resource users do think carefully about the goals and consequences of their actions. And when they do, game theory is a helpful tool to understand the structure and result of that interaction.

The case of social dilemmas and the tragedy of the commons is an excellent illustration of game theory's potential. Even if the models abstract much from reality, its strength lies in defining common features to many natural resources around the world. As a result, it provides a theoretical path to the resolution of the problem. Put differently, it simplifies and highlights the *mechanism* behind the destruction of important natural resources.¹⁸ Understanding this mechanism allows us to identify both the possibility of intervention and improvement, and what problems of the Chilean water market that might emerge in other countries that are in process of modifying their water regimes. In a world as complex as ours, this is no small achievement. This is important too keep in mind in the next part of the paper.

16. Scharpf (1997), Brams (1990)

17. Brams (1990:xiii)

18. See Schelling (1998) for a definition and discussion of the term "social mechanism".

PART II

WATER AND EQUITY – THE CHILEAN WATER MARKET

Introduction

A common claim in the discussion about the Chilean water market and its possible negative social impacts is that these have been small, or non-existent. A more extreme position is held by those who claim that the water market is “just by definition”.¹⁹ This paper proves both these claims to be faulty.

But let us open up this paper in more general form. Which are the possible social impacts of a free market approach to natural resource management in developing countries? Or more precisely: In what way has the privatization of water affected the poorest water users in Chile? The sad answer to that question is: we don't know for sure.

This part is an initial exploration of the social impacts of the Chilean water market. It is “initial”, because this study is far from being profound enough to be considered as a complete analysis of the Chilean water market. It is “game-theoretic” because it uses game-theoretic models as an analytical tool; and it is about the “social impacts”, because it focuses explicitly on the poorest water users in Chile today. The ambition is to highlight one almost forgotten aspect of the Chilean Water Code, and to provide a basis for further discussion.

19. Donoso (1993:192)

Despite the fact that the Chilean water market in many countries – and a number of powerful international organizations such as the World Bank²⁰ - is seen as a model for developing countries fighting against even scarcer water resources, we know very little of the consequences of the implementation of the neoliberal Water Code in 1981 for the poorest water users.²¹ It is not an exaggeration to claim that the question of equity in the creation of the Chilean water market has, and continues to be, a non-issue.²² As will be shown later, this has probably nothing to do with its real impacts.

The reason for this – and the main point of the paper – is that various deficiencies in the institutional framework of the Chilean water market - combined with the social position of peasant farmers in Chilean agriculture – makes it very costly (and practically irrational) for poor water users to report violations of their water rights. In other words, I intend to show why some groups in the water market are more vulnerable than others, why they are easy to exploit, and what the market and its institutions have to do with it.

This paper is organized in the following fashion. In the first section, I give an introduction to the Chilean Water Code, and the logic of water markets. Next, I discuss possible social impacts of the water market. In this section I argue that the market has impacts beyond the water *transactions*, that is; the water market also has effects created by the market *institutions*. I then show how this approach can be modeled game-theoretically to explain various cases of water rights violations of underprivileged water users. In the last section I summarize the findings and point out what the result implies for the work of Chilean governmental agencies today, and for countries that are in the process of modifying their water regimes.

20. Silva (1995:121), Briscoe, Anguita Salas et al. (1998)

21. Some would even argue that we know practically nothing neither of the economic, environmental nor social impacts of the market. Dourojeanni & Jouravlev (2002), Dourojeanni & Jouravlev (1999:11). The debate in Chile also seems to have nurtured a blind spot on gender issues in natural resource management. See Derce & Lcón (1998, 2001), Meinzen-Dick, et al. (1997) for further details in this subject.

22. Bauer (2002), Reyes (2002).

The Logic of Market and the Chilean Water Code

The sustainable management of natural resources is a major item on the agenda of most governments, and the scarcity of particular natural resources, such as water, is a matter of concern in many communities. It is a policy area, however, where knowledge and recommendations often are conflicting and complex.

The importance of policy that is able to manage important water resources in not only ecological, but also socially and economical rational, shouldn't be underestimated. A projection of the future water demands in Chile for example, predicts an impressive increase in demands in all regions of the country due to the expected economic development, increase in the population, and the possible impacts of a climate change.²³ This is an important challenge to any society considering the fact that the access to water is essential for practically all economic activity in the country, such as the internationally competitive Chilean agriculture. A group particularly vulnerable to changes in the access to water is the large group of peasant farmers (*campesinos*) that rely on agriculture as their most important source of income.

The History and Logic of the Chilean Water Market

One widely discussed solution to the ever-increasing scarcity of water resources has been to treat water resources as a private economic good. According to this view, the creation of a free water market – just like any other market – provides incentives to water users that increase economic efficiency by allocating resources to their most valuable uses. The overall argument is that legal rules and institutions should favor the operation of market mechanisms, such as private bargaining and exchange, and should minimize government regulations.²⁴ Other potential benefits, according to its proponents, are that the creation of a water market would help to reduce costly public infrastructure investment and would foster private investment in irrigation. This because any potential surplus of water due to increased efficiency, can be sold on the market.

23. Pizarro Tapia (2000:100ff), Muñoz Rodríguez (1998: 72)

24. Bauer (1998:11ff, 33ff)

The analogy with energy is enlightening for what is expected to happen in the water sector after a privatization. Until the 1970s the low price of oil produced the same kind of distortions as those seen in the water sector, inefficiency and waste. The increases in oil prices during the 1970s set in motion structural changes leading to economies in energy use. The contemporary moves in the United States to mandate power utilities to conserve rather than sell power, is a possible model for what could happen in the water sector.²⁵

Despite of all the potential benefits that are attributed to a system of tradable water rights, few countries have implemented such a legal institution. Chile no doubt still remains as the international leading example of free market water policies taken to its extreme, and has therefore become something of a model for other Latin American countries – like Bolivia, Nicaragua and Peru - that are in the process of creating new water regimes.²⁶

In 1981 the military government dictated a new Water Code that completely transformed the country's system of water rights, and “swung the pendulum away” from the politics of the 1967 Agrarian Reform Law that greatly expanded state authority over water use.²⁷ In 1969 for example, all surface water and groundwater were declared state property. Although the state continued to grant concessions to private parties, it could, at any time, terminate a concession without compensating the private concessionaire. The concessions could be neither transferred nor sold to another private party.²⁸

The new Code, on the other hand, created the necessary elements for a market: it fortified private property, introduced market mechanisms and incentives and considerably limited the state's power to regulate. The Code follows the institutional structure of the 1980 Constitution, and just like the Constitution it was written and approved while neoliberal ideas within the military regime was at its peak.²⁹

25. Winpenny (1994:19f)

26. Dourojeanni & Jouravlev (1999: 8), Dourojeanni & Jouravlev (2002)

27. Bauer (1998:33)

28. Simpson & Ringskog (1997:39), Bauer (1998:11ff), Bandow (1986), Rfos Brehm & Quiroz (1995)

29. Bauer (1998:33)

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

- Water rights are completely separated from land rights and can be freely transferred, sold and bought. Their private property status is strengthened and warranted based on the property laws of the Civil Code. This grants the water rights not only legal, but also constitutional, protection.
- Application for new water rights is not conditional on the type of use, and there is no priority list for different uses of water.
- Water rights are allocated by the State with no charge, and in the case of simultaneous requests for the same water rights, these are allocated to the best bid.³⁰
- The role of the State in resolving conflicts is very limited, and relies on private negotiations within the different water user associations and the judicial system.³¹

Incentives and Decentralization

The key word to understand the logic behind water markets is "incentive". But what are "incentives"? Incentives can be defined as the *financial rewards and penalties* that actors face. More precisely "they are the positive and negative changes in outcomes that individuals perceive as likely to result from particular actions taken within a set of rules in a particular physical and social context."³² In the case of a water market, if a water user values the water less than it is valued by the market (i.e. potential buyers), then the user will be induced to sell the water. And if a water user sees a potential economic benefit in using water more efficiently through the investment in new technology, the existence of a market gives him/her the right incentive to do so. And all this without costly governmental involvement. This is what some would call "the genius of the water market".³³

30. The last modification of the Water Code will, however, impose a tax to unused water rights.

31. Ríos Brehm & Quiroz (1995:2). I will get back to this last point later in the paper.

32. Ostrom, E., L. Schroder, et al. (1993:8f)

33. Briscoe, Anguita Salas et al. (1998:3).

In other words, the analytical models and logic behind privatization of natural resources – and of neo-classical economics - builds on the assumption of resource users as rational and self-interested actors, all trying to maximize their individual profit within the constraints and incentives provided by their institutional environment.³⁴ If the rationality assumption isn't fulfilled, the behavior of individuals is impossible to predict, and the creation of a market meaningless. This is an important point to understand in the development of the game-theoretic model in the next section.

The Chilean Water Market 20 Years Later

So what can be said about the water market in Chile after more than 20 years? Is privatization of water resources a good solution to the increasing water demand? Has the market been economically, ecological and socially efficient? Unfortunately, the lack of profound and systematic studies of the effects of an internationally well-known reform that has been in function for more than two decades is obvious for any researcher. The research that does exist however, shows mixed results. Among the positive effects of the market we find the following:

- The ample protection of water rights has led to “significant” investment in the improvement of water infrastructure to make a more efficient exploitation possible.³⁵
- The leasing of water rights have played an important role in agriculture in times of droughts in a few regions in Chile. This implies that water actually has been allocated from low-valued activities to more high-valued ones. This market mechanism has been found in the Elqui and Limarí valleys in northern Chile with, according to investigators, substantial gains-from-trade.³⁶
- The market has resulted in transfers of water rights from agriculture to urban water companies. These transfers would have been much more complicated and costly in a water regime characterized by a centralized administrative system.³⁷

34. Sproule-Jones (1982)

35. Dourojcanni & Jouravlev (2002:2), Rosegrant & Gazmuri S. (1994:33)

36. Hearn & Easter (1995), Hadjigeorgalis (2002a)

37. Humberto Peña (1996) as quoted in Dourojcanni & Jouravlev (2002: 2ff), Rosegrant & Gazmuri S. (1994:33)

An important note here is that the actual *transfer* of water rights – or the actual existence of a water market as some would prefer to put it – has been extremely limited in the country as a whole.³⁸ An estimation of these transfers shows that only 5% of the water rights in regions with high water scarcity, have been subject to an actual market transfer.³⁹ Despite this surprisingly low activity in the market, problems attached to the water market have been an important political issue. First of all, the expected increase in water efficiency in agriculture – the major water user in the country – has not been as large as it was expected. Chilean agriculture is still dominated by low water-efficiency that has to be dealt with if future demands are to be met.⁴⁰

Second, serious conflicts have emerged between the so-called consumptive and nonconsumptive uses of water. At first, it was thought that the two uses would not conflict with one another because nonconsumptive users were obliged to replenish the water after using it. In practice, a clear conflict exists and has worked to the disadvantage of consumptive users downstream of the upstream nonconsumptive users. The major nonconsumptive use of water is to generate hydroelectric energy. Invariably, the water reservoirs are not filled in such a fashion as to ensure that downstream uses are unaffected. For example, consumptive users located downstream could lay claim to water trapped by reservoirs during the dry season, so the timing of use has created conflicts that have resulted in complex judicial processes.⁴¹

Third, the way in which water rights have been allocated by the Chilean State – that is, without any charge whatsoever nor the need to motivate the use of the new right to governmental agencies – has led to a troubling speculation with water rights. These often unused water rights are felt to block new development involving other uses, both nonconsumptive (such as hydro-electricity) and consumptive (such as small agriculture). This has been viewed as speculation in

38. Dourojcanni & Jouravlev (1999: 31ff), Bauer (1997), Hearne & Easter (1995). Many experts do claim, however, that the number of transactions and the activity of the market will increase in time. Bauer (2002).

39. Dourojcanni & Jouravlev (2002:4)

40. Dourojcanni & Jouravlev (2002)

41. Bauer (1998)

water rights because the unused water rights were captured and registered free of charge and without any commitment to use the water in the foreseeable future and without a beneficial-use test. This speculation has affected small agriculture, and specially various indigenous groups in Chile. This problem has led to modifications of the Water Code and the creation of the governmental agency *Corporación Nacional de Desarrollo Indígena* (CONADI), with the responsibility of promoting the interests of indigenous communities.⁴²

Fourth, the lack of integration of environmental aspects in the creation of the Water Code is obvious, and has led to other so called “third party effects”. Efforts to safeguard the flora and fauna downstream of the reservoir, just as an example, have suffered due to the fact that a river carries less water during the dry season also implies that less water is available to dilute pollution downstream of the reservoir.⁴³

To sum up: the results of the water market have been mixed. Now to the issue of the social impacts of the market.

Social impacts of the Market

What can be said about the social impacts of the market? Doesn't the fact that the market hasn't been active imply that the social consequences have been very limited? This last claim is common both among governmental agencies⁴⁴, proponents of the market model⁴⁵, and skeptics.⁴⁶ As World Bank economists Monica Ríos Brehm and Jorge Quiroz write in one of the very few studies that evaluate the efficiency and impacts of the water market:

Even though some specific equity problems might be involved with the initial implementation of a private right water market, it seems to be a non issue in the case of Chile given the traditional operation of a water market among farmers (and previous to the Water Code of 1981).⁴⁷

42. Dourojeanni & Jouravlev (1999:19ff). Suggested modifications of the Water Code such as imposing a tax to unused water rights, are supposed to deal with this unexpected incentive. The laws are the Ley N° 19 145 (in 1992), and Ley N° 19 253 (in 1993).

43. Dourojeanni & Jouravlev (1999:46ff)

44. Puig (2002),

45. Rosegrant & Gazmuri S. (1994:32), Ríos Brehm & Quiroz (1995:27)

46. Dourojeanni & Jouravlev (1999:20)

47. Ríos Brehm & Quiroz (1995:27)

Whether the social impacts of the privatization of water resources in Chile have been “negative”, “positive” or “small” will of course depend on how we define “impacts”. And, as will be shown, the “market”. The lack of investigation about the Chilean water market creates a situation where the information available is dispersed as anecdotes in media, among experts and governmental officials. This situation clearly gives the impression that the negative social effects have been limited.

As I intend to show in this section this perception is if not false, so at least faulty. The reason for this is that various deficiencies in the institutional framework of the Chilean water market - combined with the social position of peasant farmers in Chilean agriculture – makes it very costly (and practically irrational) for poor water users to report violations of their water rights. As a result, the fact that the Chilean water market is characterized by “the law of the jungle, where the strongest can do what they want with the water rights of the small” – as one agricultural expert and governmental official puts it⁴⁸ - is a fact almost impossible to find for a researcher without extensive field work. Shortly, the reason that the social impacts of the water market might seem small, is not because that they are limited, but rather because those affected will avoid to defend their rights. In this section I discuss how we can define the “impacts” of a water market, and why we must consider the institutional framework in which markets are applied, to understand all the impacts of neo-liberal natural resource management.

Markets and Equity- How to Get a Grip of the Social Impacts

Generally speaking, there is no reason to expect that a free water market – just like any other market – will result in an *equitable* allocation of water resources. On the contrary, the inherent logic of a market is to allocate these resources to activities and persons with most economic power in the market.⁴⁹ Whether these transfers are “fair” by definition as some would claim⁵⁰, or inherently “unjust” is in the end a matter of value judgment. The important, and indeed thorny question is where to search for these “impacts”.⁵¹ One illuminating and

48. Cancino (2002)

49. Dourojeanni & Jouravlev (1999:12), Lee & Jouravlev (1998: 30), see also Chan (1989)

50. Donoso (1993:192), Bandow (1986)

51. Grumm (1975). The focus of this paper is on water used by agriculture, the most important water user in Chile (e.g. over 80 % of the existing consumptive water rights). This doesn't mean that social impacts in other areas, such as in the privatization of Chilean urban water and sanitation companies, doesn't exist.

common way to structure the possible negative social, economical and environmental effects of water markets is the following;

- Effects to other water users in the same hydrological system – *this has to do with effects caused by a transfer of water rights that decreases the availability of water to other users (i.e. irrigators) in the same river basin.*
- Environmental effects in the hydrological system – *these could be negative changes in the quality or quantity of water crucial for the fish habitat, flora and fauna, etc.*
- Social, economical and cultural effects in the area of origin – *this has to do with the possible impacts of a transfer of water rights to the local economy, or indigenous groups dependent of water resources for the survival of their culture.*⁵²

As we see from the categorization of possible externalities of a water market, the focus is explicit on the effects of a *transfer*. The separation between the specific effects of the market, and of other institutions *outside* the market is seen as important by researchers for analytical reasons⁵³. For example, without this separation it is practically impossible to know whether the same impacts will appear in another country that implements the market model.

This focus on water transfers has led to a number of studies that discuss the exact number and characteristics of water right transactions.⁵⁴ In areas where market transactions have occurred, water rights have provided small farmers with alternative sources of income in time of droughts - by entering the spot-market (i.e. leasing) of water rights - or as an economic resource in times of financial problems.⁵⁵ On one reported occasion, indigenous communities with regularized water rights in the Chilean north, managed to bargain a beneficial contract with a mining company.⁵⁶

52. Lee & Jouravlev (1998: 62-76)

53. Jouravlev (2002), Bauer (2002), Lee & Jouravlev (1998:76)

54. Ríos Brehm & Quiroz (1995), Hearne & Easter (1995), Rosegrant & Gazmuri S. (1994)

55. Hadjigeorgalis (2002b)

56. Castro (1992)

The question now is whether the effects of transfers are the only one we need to consider in a free water market. I would argue that there should be more. First of all, the emergence of a market not only includes the presence of water transfers, but also the emergence of new institutions (i.e. organizations and regulations) to facilitate these transfers. These new “rules of the game” will create changes in the incentive structure, and alter the behavior of existing actors or trigger the (sometimes unexpected) behavior of new ones. This is the most important insight from various versions of the institutional theory in political science and neo-institutional economics⁵⁷ that hasn’t been considered seriously in the discussion of the *pros* and *cons* of the Chilean water regime.

One obvious example of this, is the serious case of *speculation with water rights*. The Chilean water market has experienced an impressive increase in solicitations of new water rights by actors with no intention of using them productively. On the contrary, these rights have been claimed with the intention of waiting for the right time to sell to the highest bidder sometime in the future. In other words, the institutions of the Chilean water market – where water rights were allocated by the State with no charge, and applications for new water rights were not conditional on the type of use - created the *unintended incentives* that lead to speculation.⁵⁸ Shortly, even if the market is inactive, market institutions and incentives never rest, which at the end might create unwanted consequences.

Second, the problems that have arisen in the Chilean case show that this categorization is faulty. Why? Because the problems that have emerged in relation with the implementation of the Chilean Water Code, aren’t specifically attached to the *transfers* of water rights. The list in the first appendix to this paper shows a number of cases of water rights violations with important consequences for the affected.⁵⁹

Is there logic in these cases? And what do these cases have to do with the incentives created by the market institutions? In the next section I argue that *these effects are unavoidable given the incentives created by the Chilean water market and its key institutions*.

57. See Rothstein (1996), North (1990), Ostrom et. al. (1993:8ff)

58. Dourojeanni & Jouravlev (1999:19-21)

59. Note that this list is by no means a complete list of water violations in Chile. On the contrary, the list could easily be extended with more cases. They do, however, provide a basis for the discussion in the next section.

Unintended Incentives – Stealing Water from the Poor

The sector Las Pataguas – Valdivia de Paine, located 50 km from Santiago, has experienced a severe and long-lived water conflict involving 25 plots belonging to small farmers (i.e. *parceleros*) and a real estate investor. The conflict started in the beginning of the 1970's as a result of constructions by the investors. These constructions, built on his own plots, led to serious disturbances on the water flow of the farmers. The deviation was a deliberate attempt to destroy the productivity of the land, and force the peasant farmers to sell their plots. It wasn't until 1986 – after more than ten years (!) – that a few of the farmers individually decided to take the problem to court. The sentence was in favor of the *parceleros*, but this didn't stop the continued construction (and deviation) by the real estate investor. The same procedure was repeated in 1991: an appeal to court, a sentence in favor of the *parceleros*, and continued violations of their water rights by the investor. This problem has severely affected the income of 300 persons dependent on small agriculture, and has gone to such extreme, that number of them felt obliged to sell their plots and find other sources of income.⁶⁰

Small farmers organized in a water user community in the Azapa valley, Arica, have experienced similar problems. In 1981 the water company SENDOS (Servicio Nacional de Obras Sanitarias) made a request to the *Dirección General de Aguas (DGA)* – the governmental agency in charge of granting new water rights – for the exploitation of 550 l/s water. The request was denied by the DGA after a petition put forward by the farmers showing that this extraction would severely affect existing water flows normally used for irrigation. Despite DGA's decision, and without the mandatory water rights, SENDOS decided to start the constructions necessary for water exploitation in 1984. Once again, the farmers chose to take the case to court, which judged in favor of the farmers and ordered the halt of the constructions. This temporarily halted the construction, but in 1991, the water company ESSAT (Empresa de Servicios Sanitarios de Tarapacá S.A.) – practically the same company as SENDOS but with a different name – once again starts the exploitation of the aquifer in the Azapa valley. This violation was once again taken to court, but this time, the court rejected the claim and the farmers lost the case. ESSAT is now exploiting water resources in the valley.⁶¹

60. Cancino (2001), Cancino (2002)

61. Aviles Herbas (1993)

The two cases presented above are description of two of the cases presented in the appendix. Again, is there any logic in these cases? Is it a coincidence that the violations have been directed at indigenous groups and peasant farmers? In the next section I present a model – using the same assumptions normally used to prove the benefits of the water market - that shows that what seems like isolated anecdotes of violations of water rights, has logic.

A Water Deterrence Game

Models theoretically rigorous as the ones used by the proponents (i.e. pro-market economists) of the market are totally absent in the discussion of the Chilean water market's social impacts. This is serious considering the fact that the discussion of the pros and cons of the Chilean water market have been strictly formulated in economic terms.⁶² Lawyers, or economist who neither have the theoretical tools, nor the academic interest in dealing with equity issues dominates studies about the Chilean water market.

Just as in the case of speculation with water rights – a major problem in the Chilean water market that has received ample attention in the latest suggested modifications of the Water Code – one possible way to tackle this problem is by focusing on the incentives that the market and its institutions create for water users. One powerful and common way to approach this problem is through game-theoretical modeling of the incentives that the market and its institutions create for water users.⁶³ Game theory has proven to be a tool uniquely appropriate for modeling strategic interaction that involve a limited number of actors that are engaged in purposeful action.⁶⁴

Water and Cooperation

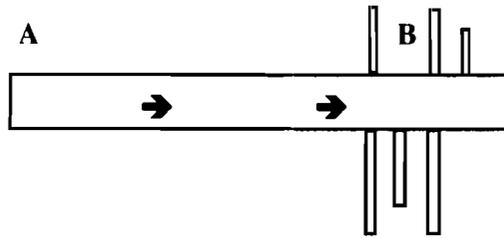
Let us start with a simple assumption: An efficient water market – and a water regime with minimal state intervention– requires the cooperation from a number of actors and institutions. Put differently, an efficient market where water is divided according to the different users acknowledged water rights requires that all actors respect the *status quo*.

62. See for example Donoso (1993), Lagos (1998), Gómez-Lobo & Paredes M (2001). These are also the kinds of studies that have attracted the attention of media. See El Mercurio (2001).

63. See Ostrom (1990) for a ground-breaking work, or Sproule-Jones (1982) for other similar rational-choice models.

64. Scharpf (1997), Brams (1990).

Figure 2. Water and Cooperation



Comment: The figure shows two water users, A and B, dependent of each other's cooperation to sustain the status quo, that is, a division of water resources according to their acknowledged water rights.

Figure 2 illustrates an imaginary river basin with two groups or individual water users, A and B.⁶⁵ A and B could be any combination of water users. More specifically, the two users could be individual irrigators, and/or groups of irrigators, and/or an urban water company, or industrial forestry. As an example, the game can explain the interaction between a group of peasant farmer irrigators (B) and an urban water company (A).

In a situation of *status quo*, neither of these two actors extracts more water than they have the right to. In other words, the users are dependent on each other's cooperation for the maintenance of the *status quo*. But what happens if someone breaks this agreement, like the urban water company in the Azapa valley described above? According to the Chilean Water Code the affected have two choices: 1) take this violation to the appropriate water user association, or 2) take the case to court.⁶⁶ This response from the affected thereby creates a *conflict*. This interaction can be captured in the following game-theoretic model:⁶⁷

65. Usually the number of users is considerably higher, but this simple image still captures the important characteristics of the game described later.

66. Vergara Blanco (1998:271)

67. The following model is inspired by the work by Kilgour & Zagare (1991), and has been used to explain deterrence between super powers in international politics.

Figure 3. A normal form water game

		Player B	
		C	D
Player A	C	Status Quo	Advantage to be
	D	Advantage	Conflict to A

In this game, each player has two strategies available: cooperate (C) or defect (D). This means that if player A chooses too defect, and player B to cooperate, the outcome of the game is (DC), the lower left box in the square. The possible outcomes of this game are thus the following:

CC: Cooperate, that is, to continue to divide the water according to the acknowledged water rights.

DC: Advantage to A, that is, A begins to extract more water and B accepts.

CD: Advantage to B, that is, B begins to extract more water and A accepts.

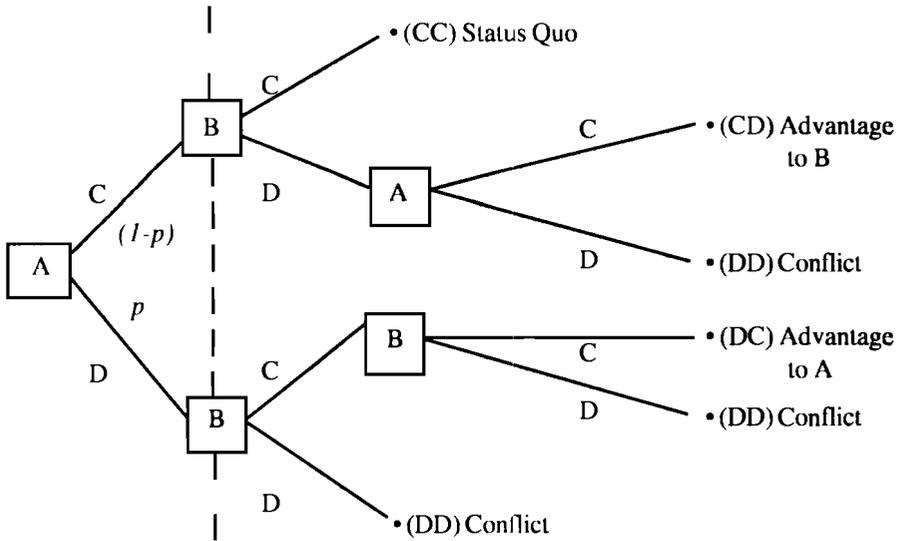
DD: Conflict, taking the problem to Water User Association or Court.

The *status quo* division of water can be anything from 0 l/s to A and n l/s to B, to n l/s to A and 0 l/s to B.

An important note here is that the strategy “extracting more water” only is *one* possible way to decrease the availability of water to the other user. That is, “defect” could also be: polluting the water, deviation of water due to constructions in the river basin etc.

Simply put, there is always a possibility for any of the players to defect from the *status quo* by “using” more water. The water user affected can either accept the violation (CD, or DC), or take this violation to be resolved at the existing Water User Association or making a court appeal (D,D). The game can also be illustrated in extensive form:

Figure 4. Extensive form “water game” in a decentralized water



Key:
 □ = Decision node
 • = Terminal node
 - - = Information partition

Comment: A and B represents players (i.e. water users). As an example A could be an urban water company, and B a group peasant farmers, somewhere in Chile, p represents the probability that A will defect. The game is read from the left, with A making the first choice. B then has the possibility of either accept the violation (DC), or challenge it in a WUA or court (DD). Remade from Kilgour & Zagare (1991).

The process I attempt to model goes like this: First, something exogenous happens (first stage), which determines the probability that de player wil prefer to initiate a defection. This “something” might be a sudden increase in the water demand, an increase in the water prize, a drought period etc., with an unknown probability denoted p . This means that the probability that A will continue to cooperate is $(1-p)$.

Now, why all this fuss? I intend to show that the various deficiencies in the institutional framework of the Chilean water market - combined with the social position of peasant farmers in Chilean agriculture - makes it very costly (and practically irrational) for poor water users to report violations of their water rights. This makes it very easy, and even profitable, to steal water from small water users such as peasant farmers (*campesinos*). Game-theoretically, I will show that (D,C) is the equilibrium outcome, which means that *campesinos* will accept the violation, *and not take these cases to court or to the WUA, as it is assumed.*

The Game

Now let us assume that an unexpected drought period, or a sudden increase in the water demand, puts the water company A in a situation where it needs more water. Company A makes the option to use more water than it has right to, something that affects the access of water of a small group of peasant farmers. What will these peasant farmers do?

Before we discuss the various options that the imaginary group of *campesinos* have to meet the challenge from company A, it is important to keep in mind several characteristics of this group in Chile.

The Campesino Community – Some general characteristics

In general, farmers have made an outstanding contribution to Chile's impressive growth rate of 6-7% a year during the 1990's. Since 1985, agricultural trade has been consistently in surplus, currently to the tune of about \$1.3 billion USD a year; add forest products and the surplus is well over \$2 billion USD. That is a huge change from the days where trade was in chronic deficit. The export drive has been led by fruit producers-about 5,000 growers and a dozen big, mainly multinational, packing firms. More recently, wine makers have made the running and exports have soared from \$50m USD in 1990 to nearly \$400m USD in 1997.⁶⁸

68. Economist (1998), Chonchol (1996:379ff)

This high-tech and internationally competitive industry lives side-by-side with more traditional – and substantially less capital intensive – small farmers. The Chilean *campesinos* is a highly heterogeneous group – including both traditional farmers, farmers from the days of the Allende government’s Land Reform in the 1970’s, and various indigenous groups – but with one important thing in common. These small producers use mainly the labor force from their family, and produce mainly to secure their income.⁶⁹ This makes the *campesino* community particularly dependent on agriculture, and the secure availability of water, for their survival.⁷⁰

Table 1
Number of farmers, land distribution and commercialized production in Chile

	<i>Number of farmers</i>	<i>Territorial extension (%)</i>	<i>Commercialized production (%)</i>
Industrial agriculture	35 000	61	74
Small agriculture	125 000	37	26
“Minifundistas”	100 000	2	1

Source: The World Bank (1995:35).

Comment: ‘Minifundistas’, a category also included in the *campesino* group, is mainly a characterization of small farmers with very limited access to high-quality land. A high concentration of ‘minifundistas’ usually also means a high concentration of extreme poverty. Gomez & Echeñique (1988:208f)

Other important characteristics of the group are the fact that their level of education is significantly lower than of the average Chilean. Illiteracy in the Chilean rural areas (15 percent) is almost five times higher than the urban average (3,3 percent). Estimations also show that the average of completed years of education is 6,2 years, while the urban population’s average reaches 9,6 years. Moreover, less than 3 percent of the rural population’s has a technical education or professional title, equivalent to an American college degree.⁷¹

69. Gomez & Echeñique (1988:203ff), CEPAL, GTZ et al. (1998:22)

70. See The World Bank (1995: 35) for details.

71. The World Bank (1995:34)

The income of the campesino community is also substantially lower than of the average Chilean. 34 % of the rural community has incomes under the poverty line.⁷² Estimates made by the World Bank show that the large majority of the group, has a *total annual income* – i.e. all sources of income included – below \$490 USD.

Table 2. Total income of *campesino* agriculture.

<i>% of small producers</i>	<i>Annual income per capita</i>
65	< 490 USD
30	< 865 USD
5	> 1 940 USD

Source: The World Bank (1995:38).

It is also common knowledge among experts that a minority of campesino communities enjoys a fundamental requisite in the judicial protection of water resources: regularized water rights.⁷³ This might have something to with the fact that a regularization of an historical water right has a cost.⁷⁴

This doesn't mean, however, that these communities lack water rights that are protected by law. This paradoxical situation appears because the Water Code makes a difference between 1) *recognized water rights*, and 2) *regularized water rights*. The first ones refer to water rights historically used by anyone (e.g. for irrigation) from April 1979; the second refers to water rights registered in an administrative process. In short: recognized water rights can be transformed to regularized water rights, but not the other way around.⁷⁵ These rights benefit from the same legal protection as established by the Chilean Water Code.⁷⁶

72. The World Bank (1995:37)

73. Bauer (1998:67), Cancino (2002), Bahamondes (2002), Ministerio de Agricultura et al. (1995:115f).

74. Montecino Aguirre (1989). The problem of non-regularized water rights is a general problem in the Chilean water market. See Vergara Blanco (1998).

75. Vergara Blanco (1998:322,327ff).

76. Vergara Blanco (1998:322).

The Water User Associations

With the general characteristics of campesino communities in mind, what will group B do in a case of water rights violations? One first option is to take this violation to the appropriate Water User Association (WUA), an institution with a history of water conflict resolution that dates back to the 19th century⁷⁷, and recognized as the most important water conflict resolution institution in Chile. Their main role is to distribute water and enforce its correct use by its members, and to collect fees for construction, maintenance and administration of irrigation infrastructure. Three different types of associations are considered in the Water Code: '*juntas de vigilancia*', '*asociaciones de canalistas*' and '*comunidades de aguas*'.⁷⁸ So, what not take this violation to the WUA, thereby ending up in the column (D,D) as in conflict?

One major problem is that the Chilean water user associations by not always are the well-developed institution as some present it⁷⁹, and as natural resource experts would like it to be. The reasons are the following:

First, all Chilean WUA's are far from being as professional as they need to be for the resolution of conflicts. An unknown number of these organizations are run by the same family for decades, and these are not always informed of the number of water users they are supposed to monitor in the river basin.⁸⁰ Studies made by the Directorate of Hydrological Works (*Dirección de Obras Hidráulicas, DOH*) in the Ministry of Public Works, also shows that many of these organizations lack both the legal and technical capacity needed to solve water resource conflicts.⁸¹

77. Figueroa del Rio (1995:99ff), Sepúlveda & Sabatini (1997:239)

78. These organizations all have different functions, with the *juntas de vigilancia* as the most ample functions. Figueroa del Rio (1995:100f,119ff)

79. Figueroa del Rio (1995:100f), Polanco Dabed (2001).

80. INDAP (1997).

81. Puig (1998), Puig (2002). The number of organizations studied by the DOP was around 20, and included all types of WUA's. Puig (2002). Note: I'm not claiming that all WUA have these problems. On the contrary, very professional WUA do exist, specially in northern Chile. Hadjigeorgalis (2002b).

Second, even if the number of formalized water user associations in Chile usually is claimed to be “high”, there is an unknown number of unorganized water users. The estimate of the number of water users, and thereby hydrological entities, that do not have a WUA is practically impossible to make.⁸² Considering the fact that a big number of water users in Chile don’t have regularized water rights - a legal requisition to be a member of a water user association - implies that the number of unorganized water user is considerable.

Third, even if competent and formalized WUA’s do exist and the legal possibility of membership is recognized by the Water Code, *campesinos* seldom have access to them either because they don’t tend to be *de facto* members in them, or – if they are – have a very low trust in how these institutions represent their interests.⁸³ Some researchers have argued that the way in which these institutions are designed (with one vote per water right) efficiently marginalizes *campesinos* from executing their rights in them.⁸⁴

Fourth, this marginalization is complicated further by the fact that the distribution of irrigation water historically, seldom has been to the benefit of *campesinos*. On the contrary, the distribution of water resources tends to follow the dominating power structures (with *campesinos* at the bottom of the hierarchy) in the river basin.⁸⁵

To sum up, the probability that *campesinos* will try to get assistance from the widely recognized Chilean WUA’s is, to say the least, low.

82. Ojeda (2002), Puig (2002). This despite the ambitious regularization programs executed by the DGA. See Ríos Brehm & Quiroz (1995:26) for details of this program.

83. Cancino (2002), Bahamondes (2002), Sepúlveda & Sabatini (1997), Puig 2002).

84. ODEPA (1994:37)

85. Arias Q. (1980), Stewart (1970:19), Bauer (2002), INDAP (1998), Bengoa (1988:182f); Montecino Aguirre (1989:21). However, note that no systematic studies of the water distribution exists for all WUA:s in Chile.

Why not create a water user association (WUA)?

On the other hand, in the case that one organization doesn't exist, there is always the *legal* possibility to create one. This would strengthen the groups bargaining power by making their judicial status considerably stronger. Unfortunately, this door too might be closed for many *campesino* communities. The problem of collective action discussed in the beginning of the paper, is always present, and only possible overcome under specific circumstances.⁸⁶

Another problem of more practical concern, is the high number of non-regularized water rights. According to the governmental agency in charge of promoting and defending the interest of small agriculture, *Instituto de Desarrollo Agropecuario (INDAP)*, the bureaucracy and high formalism within the General Directorate of Water (*Dirección General de Aguas, DGA*) - the directorate responsible for planning water resources and for granting water rights – makes this a very difficult option. According to estimates by INDAP, only 5 % of the *campesino* water communities they wanted to formalize according to the Water Code were regularized in a 6-year period.⁸⁷

The slow bureaucracy and high formalism in the regularization of water user associations within the DGA is so recognized, that even governmental agencies *under the same Ministry of Public Works* avoid to get into these judicial labyrinths in the realization of irrigation projects and regularization of water user associations.⁸⁸

The Judicial System and the Price of Justice

Another way to challenge a potential break of the status quo is to take the case to court. Unfortunately, this too seems to be a very difficult and costly option for the *campesino* community.

86. See page 28.

87. Cancino (2002). See also communication between the DGA and INDAP, DGA (1997)

88. The government agency is the DOH. Puig (2002)

Generally speaking, the courts have a strategic role in the market model. They must both protect private rights from excessive state regulation, and resolve conflicts among private parties, as in the issue of different kinds of water conflicts.⁸⁹ The Chilean creation *recurso de protección* (suit for protection) grants wide standing for people to request judicial review when certain rights are violated, whether by state agencies or by other private parties. These suits go directly to the regional Appellate Courts that are supposed to rule quickly.⁹⁰ Other applicable – but slower – judicial options are the “*Accesiones posesorias*” and the “*Amparo Judicial*”.⁹¹

The main problem with this institution is, as water experts recognize, that the “system is too slow, too costly and too unpredictable”⁹² and that “the institutional capacity of the Chilean judicial to fulfill its more strategic role is dubious.”⁹³ It is unpredictable, because like in the case of *recurso de protección*, judges must often take a decision based on limited information or technical expertise, few legislative or constitutional guidelines, and little time for deliberation. This gives the suit an unpredictable and contradictory character.⁹⁴ It is slow, because the Chilean judicial system is obviously under-dimensioned to the needs of Chilean society.⁹⁵ An estimate of the average length of an ordinary civil case in 1992/93, as an example, is of *1009 days*.⁹⁶

Studies also show that “white collar crimes” and environmental violations are those kinds of procedures that take most time to settle.⁹⁷ This might have to do with the complexity of ecological systems – such as the hydrological – a fact that makes it notoriously difficult to point out the accused without costly studies. Like in the case of the parceleros in Las Pataguas – Valdivia de Paine, the case didn’t proceed until the realization of costly hydrological studies that definitely settled the effects imposed by the real estate investor⁹⁸, which speaks in favor

89. Bauer (1998:19)

90. Bauer (1998:21)

91. INDAP (1998:33)

92. Briscoe, Anguita Salas et al. (1998:9)

93. Bauer (1998:19)

94. Bauer (1998: 22)

95. Correa Sutil & Barros Lazacta (1993:76f), Dakolias (1996, 1999).

96. Vargas Viancos & Correa Sutil (1995:44). However, a reform of the Chilean judiciary system is underway. See http://www.minjusticia.cl/reforma%20procesal/Ver04_6/ for details.

97. Vargas Viancos & Correa Sutil (1995:149)

98. Cancino (2002)

of those who claim that water conflicts are far from a simple judicial disputes. But what if the group still wants to take the case to court? Courts and legal services are in theory available to all, but just like the Sheraton Hotel – anybody can enter, all that is needed is money. As to the costs of lawyer fees in connection with an appeal to court, the estimated total cost is of \$670 USD, with an additional fee of \$140 USD in case of appeal to a higher court.⁹⁹ This might sound like a small sum for protecting such a fundamental resource as water, but we must keep in mind the total annual income of a campesino in the majority of cases is well below \$500 USD.¹⁰⁰ Even if the Chilean government actually provides possibilities for free legal assistance – such as from the Corporaciones de Asistencia Judicial - this assistance tends to be irregular and with chronic lack of personal and financial resources.¹⁰¹ Furthermore, a minority of Chileans knows that this kind of assistance actually exists.¹⁰²

The governmental agency in charge of promoting and defending the interest of small agriculture, *Instituto de Desarrollo Agropecuario* (INDAP), is currently designing a project to facilitate the access to legal help for peasant farmers. The project “*Bono del Agua*” that is due this month is however, according to the designer herself, only a minor step in what is needed to protect the water rights of small farmers.¹⁰³

The Perceptions of the Courts

One aspect that complicates *campesinos* willingness to enter the judicial system is the fact that the Chilean courts aren’t seen as an institution treating all Chileans alike. On the contrary, a majority of low-income Chileans sees the Chilean courts as an institution, put bluntly, “by the rich, for the rich”. As an example, a survey study among a representative sample of low-income households in three Chilean cities show the following results:

99. Personal communication with lawyer J. Francisco Balmaceda H. at *Balmaceda, Hoyos & Cía. Abogados*, Santiago de Chile.

100. See pp. 26 in this paper.

101. Correa Sutil & Barros Lazacta (1993: 82f), Garro (1999), Harasic Yaksic (1988:182ff, 189).

102. Vargas Viancos & Correa Sutil (1995:152f).

103. Cancino (2002)

Claim	Agree	Disagree	No opinion
“In Chile, there are two kinds of justice. One for the rich, and one for the poor.”	88,7 %	8,8 %	2,6 %
“Reporting a robbery or assault is a waste of time, because nothing will happen anyway.”	84,2 %	12,4 %	3,4 %
“The Chilean judicial system is slow”	95 %	3,1 %	1,9 %
“In the Chilean judicial system, everything can be taken care of if you have the economic resources”	86,5 %	6,9 %	6,6 %
“Lawyers are too expensive”	87,8 %	5,3 %	6,9 %
“Lawyers care more about defending their clients, than money.”	17,4 %	70,2 %	6,9 %
“Lawyers are blood-suckers. They work just because they want to take money from they clients.”	77,8 %	8,0 %	14,1 %
“Judges treat rich people in one way, and poor people in another”	64 %	10%	No info.

Table 3. Low-income households and trust in the judicial system

From: Vargas Viancos & Correa Sutil (1995:137,155) and Correa Sutil & Jiménez (1997:40).

This astonishing low trust in the Chilean judicial system, makes low-income households particularly skeptic about taking any kind of violation to court. The results of this widespread skepticism to the courts and its officials leads to that in most cases - such as robbery, trespassing or sexual abuse – a majority of low income citizens chose not to report the violation.¹⁰⁴

And the NGO’s?

But there is still one final option to get the necessary help to defend their interests, the Non-Governmental Organizations (NGO’s). If properly organized and with the appropriate knowledge, they can be a key to empowerment of vulnerable groups in society. In our case, they could provide the necessary legal and technical help in cases of water conflicts. In other developing countries, such as Bolivia and South Africa, NGO’s have provided an important channel to groups opposing the privatization of public water systems.¹⁰⁵ What about the Chilean rural NGO’s?

104. Correa Sutil & Jiménez (1997:46). An interesting observation is that even *lawyers themselves* are dissatisfied with the way in which the Chilean judiciary system works. Vargas Viancos & Correa Sutil (1995:169)

105. Schultz (2000), Johnson (1999)

The Chilean rural NGO's have seen a very sharp decline in their membership after the democratization in the 1990's. Just as an example, the number of *campesinos* associated to a cooperative has declined from 75 000 members in 1973, to 10 684 in the year 2000. In the case of membership in labor unions, the tendency is the same. In 1973 the unions had over 300 000 members, in the year 2000, the figure decreased to 36 000.¹⁰⁶ In other words, a large majority of the group is unorganized.

Furthermore, the capacity of rural NGO's to assist their members in cases of water conflicts, is practically nonexistent.¹⁰⁷ Even if rural NGO's do see the Water Code and its implications for their members as an important issue¹⁰⁸, very few of them (if any) can provide the necessary legal *and technical* help.¹⁰⁹ In fact, one of the only organizations that did provide such help, had to shut the assistance down due to financial problems.¹¹⁰

The Equilibrium

The important question is now what the presented obstacles to access to *both* the existing water user association (if one exists), *and* the judicial system means for the game presented in the beginning of the section. If the following relationship between the players' preferences exists, *the outcome will be to benefit to A*. That is, if and when a more "powerful" user than B starts to extract water that negatively affects this group, *group B has no other rational option than to accept the violation*.

More precisely; if the preference order is the following;

for water user A:	$DC > CC > DD > CD$
for water user B:	$CD >_{B} CC >_{B} DC >_{B} DD$

106. Gómez (2002)

107. The same applies to environmental NGO's in Chile. Reyes (2002)

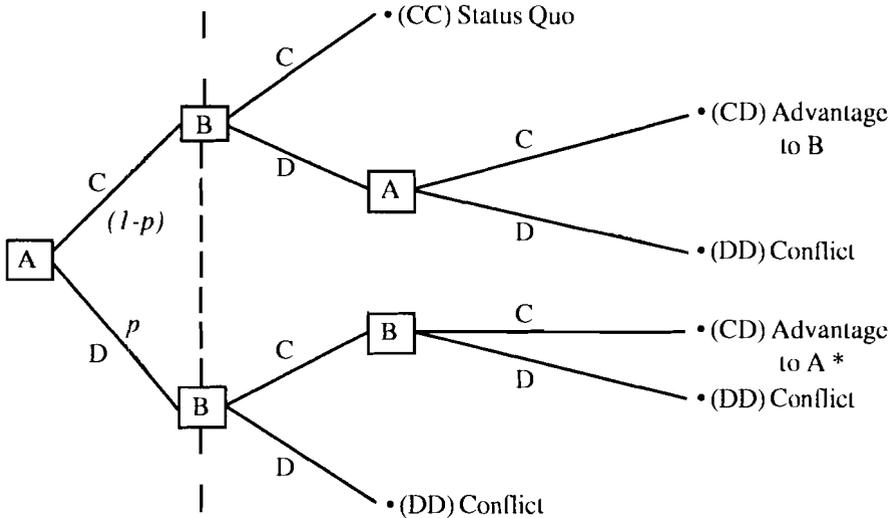
108. E.g. FAO (2001)

109. Cancino (2002), Bahamondes (2002)

110. Personal communication with rural NGO "La Voz del Campo", March 2002.

(where " $>_A$ " means "is preferred by A to", and so on), then when a more "powerful" user than B starts to extract water that negatively affects this group, group B has no other rational option than to accept the violation. More precisely, both water users prefer a division of water to their benefit, compared to the status quo (i.e. $DC >_A CC$ and $CD >_B CC$). But the difference between the two users – and the key in understanding the outcome of the game - *is that the small water user will avoid a conflict, thereby preferring to accept the violation* (i.e. an outcome advantageous to A). Let us once again look at the game presented earlier.

Figure 4. Extensive form water game with equilibrium



- Key:
- = Decision node
 - \bullet = Terminal node
 - — = Information partition

Comment: A and B represents players. A is an urban water company, and B a group of peasant farmers, somewhere in Chile. p represents the probability that A will defect. The game is read from the left, with A making the first choice. B then has the possibility of either accept the violation (DC), or challenge it in a

WUA or court (DD). The bolder lines shows the equilibrium track, with * (DC = advantage to A) as the only Nash-equilibrium.

That is, if A chooses to defect (with a probability p), B has the option of either retaliate (DD), or accept the violation (DC). The fact that B “prefers” a violation to a costly conflict with unpredictable result in court (i.e. $DC >_B DD$), results in the equilibrium outcome DC (* in figure 4). I will develop what this prediction implies for how we understand the Chilean water market later.

Can B steal?

One important question remains to be answered: isn't it possible for B to steal water from A? Couldn't these inherent deficiencies in the judicial system and the Chilean water user associations, be used by peasant farmers to steal water from richer water users? The issue of stealing of water between peasant farmers, and by industrial agriculture during critical drought periods is widely recognized among agricultural and water experts.¹¹¹ But there are several characteristics to the affluent users such as industrial agriculture and water companies that make this robbery unlikely.

First of all, both these players have considerably more economical resources. This implies that they both have the possibility to challenge this break from the *status quo* by taking the case to court, and paying the additional lawyer fees and technical studies. Considering the costs involved with loosing such a case, and the extremely limited economical resources of *campesino* communities, should by itself intimidate this group from such attempt.

Second, both groups are considerably better organized compared to the rural NGO's. As for industrial agriculture, their organization *Sociedad Nacional de Agricultura (SNA)* is considered the most powerful NGO's in Chile today.¹¹² The SNA also has a considerable competence about the Water Code.¹¹³

Third, big agriculture tend to dominate one key institution in the resolution of water conflicts: the water user associations.¹¹⁴ All these three characteristics makes water steals from wealthier highly unlikely, and in game-theoretic terms, non-credible and irrational.

111. Bahamondes (2002), Puig (2002), Bauer (2002)

112. Gómez (2002), Gomez & Echeñique (1988:213ff). Other organizations are the Confederación de Productores Agrícolas (CPA), and Consorcio Agrícola del Sur (CAS).

113. See for example SNA (1993). The organization even has its own commission in this area. See *Comisión de Aguas*, in <http://www.sna.cl/accion/comites.html>

114. Bahamondes (2002), Puig (2002), Cancino (2002). See also Bauer (1998:67)

CONCLUSIONS

The Difference Game Theory Makes

But what does this mean in practice? Didn't we already know that water right violations exist? I would argue that this equilibrium and the game theoretic model implies five important things:

First, violations of the water rights of poor water users, such as peasant farmers, will not be reported to any of the organizations responsible for the solution of these conflicts. Information of these cases will therefore be very difficult to find without extensive field studies. This explains why evidence of water violations against underprivileged users are anecdotic and dispersed among various actors, such as agricultural experts and erratic appearances in media. The fact that Chilean rural NGO's are weak makes this situation worse. **This is a fact not considered by experts and governmental agencies that claim that the social impacts of the market have been negligible.**

Second, this simple game-theoretic model shows that there is an actual logic in the violations of the rights of underprivileged water users. More precisely, **all the cases presented in the first appendix** that at first glance look like different phenomena, **can be explained by the same mechanism**: a break from the *status quo*, that is to the advantage to the actor with the credible threat given the structure of the game.

Third - and as a result of the above - it shows that **any person, group or organization that can credibly commit that they can afford a conflict in court easily can exploit the structure of the game.** Whether this threat is credible has to do with the economic resources available for lawyers fees, technical studies etc. In other words, anyone with enough economic resources

and knowledge about the dynamics of the water market (i.e. the “game”) **has theoretical access to “free water”**. Allow me to develop this point further. Let us put ourselves in the situation of a relatively wealthy group or company x , that needs more water. The options are:

1. *Buy, or lease water rights.* The cost (c_b) depends on the market, and will vary on where in Chile group x is located. Estimates show that the price of 1 l/s water lies between \$100 000 to \$15 million pesos.¹¹⁵
2. *Increase water efficiency.* In a case where the group x has water rights, there is always the option of increasing water efficiency. This option too has a cost (c_e).
3. *Steal water.* There is also the possibility to steal water from underprivileged water users. The risk of, for example, *campesinos* taking the case to court is minimum, and even if they do, the probability of getting a sentence against them is small. The cost of loosing such a case is denoted c_s .

Thus, if the group x makes the estimate that the probability of actually having to pay the cost of a conflict (p_c) is as low as claimed earlier, the stealing of water will be rational (i.e. profitable) when

$$p_c * c_s < c_e, c_b$$

That is; when the probability of paying the cost in a conflict is lower than the other alternatives.

I would argue that this mechanism is clear in both the presented cases. As for the real-estate investor in Las Pataguas – Valdivia de Paine, it was probably more profitable to force the parceleros out of their plots by deviating their water with a minimum risk of facing a costly case in court, than to pay them the market price of their plots. The same most likely applies to the urban water company in the Azapa Valley, *and all the cases presented in the appendix.*

Forth, the model implies that the more information the players have about the possible outcomes of the game, the easier will they find the presented equilibrium outcome. This means that attempts by governmental agencies to inform *campesinos* about their water rights and the judicial system will not have the

115. Chileriego (2000)

expected effect. On the contrary, **the more *campesino* communities know about the deficiencies in the judicial system, the cost of defending a case, and how other *campesino* communities have done in water conflicts settled in court, the more will they avoid the judicial system.** As an example, had the farmers in the Azapa Valley been aware of the high probability of loosing, and the costs involved with such a lost, they would probably never have initiated a judicial process and accepted the violation.

Fifth, to deal with these unintended incentives created by the Chilean water market, **is not a simple matter of more regulation** as some have claimed on other occasions.¹¹⁶ The important issue seems to be to deal with the deficiencies of the water user associations, the *Dirección General de Aguas (DGA)*, the perception of the judicial system, and even the weaknesses of rural and environmental NGO's. Only by improving these institutions will the market work without harming the most underprivileged water users in Chile.

Objections to the Model

Now to three possible objections of the model. First, are water users really aware of the "game" presented in this paper? The real world is obviously never simple or transparent. It is characterized by, among other things, nuance, ambiguity, mistakes, duplicity and ultimately uncertainty. When players only have uncertain knowledge of an opponent's preferences, they cannot tell whether the game they are playing is as the one presented. Despite this inherent complexity in social interaction, I would argue that players such as water users *do* make estimates about the likely motives (and actions) of an opponent. And when they do, game-theoretic models are indeed valid.

Second objection: Are people really rational egoists as assumed? One fundamental assumption made by game theory - and by any rational-choice model - is that the actors involved in an interaction are "rational". That is, they know what they want, and they will use the best means to get to that preferred option. Sometimes this assumption doesn't hold true. People obviously have norms and values that inhibit them to make a "rational choice".¹¹⁷ The farmers in the Azapa Valley, for

116. Lcc & Jouravlev (1998:22), Roscgrant & Gazmuri S. (1994)

117. See Green & Shapiro (1994) for a critique of rational-choice theory.

example, *did* take the case to court, but they lost. So did some of the *parceleros* in Las Pataguas – Valdivia de Paine, but only after 10 years of continued violations.

In the last case, the violation wasn't settled until INDAP and the Ministry of Justice chose to use the case as part of a pilot-project.¹¹⁸ My claim is therefore not that this mechanism of stealing will occur as soon as a steal is "rational" or profitable. *What I'm saying, however, is that there is an "open space" - created by the incentive structure as a result of the market and its institutional framework - for anyone with a "credible threat" to exploit.*

One important thing to keep in mind in the critic of game-theoretic models is the fact that the whole logic behind the creation of a water market - and the suggestions to its modifications in 2002 - is based on the assumption that individuals are well informed rational egoists, i.e. they are based on the *exact same assumptions* used in the game-theoretic model. It would be strange to assume that individuals will act as rational agents *only* to create societal positive impacts.

Is it Really the Market?

Now to a final, but important question: Is it really the market that creates these incentives? Wasn't this possibility of stealing open even before 1981? The answer to this question is important for analytical reasons, but depends completely on how we define the "market". If the definition of the "market" is equivalent to market transactions, the answer is "no". But if the definition includes the institutional framework in which a water market has been - and in the end *must* be - implemented, the answer is "yes". The reason for the latter is that this effect appears when a water market is introduced, *without strengthening key institutions*.

One important conclusion, is that these unintended incentives in a water market only will be created in countries with similar characteristics in the "game", that is with:

118. Cancino (2001)

- a slow and erratic judicial system
- underprivileged water users with neither the trust, nor the economic resources to defend their rights in the judicial system
- weak rural NGO's
- non-existent or marginalizing water user associations
- formalistic governmental agencies that unintentionally inhibit the legal protection of underprivileged water users water rights and organizations

It is hard to see how any water market that seriously doesn't consider these key aspects – independently of the efficiency and the number of transactions, an issue that has dominated the Chilean debate so far – can be expected to promote socially sustainable water management.

References

- Arias Q., M. E. (1980). *Análisis de la distribución del agua de riego del Río Ñuble*. Chillan, Chile, Universidad de Concepcion, Fac. de Agronomía.
- Aviles Herbas, D. (1993). Sobreexplotación del acuífero del Valle de Azapa - Arica I Región. *III Convención de Regantes de Chile*. Conferederación de Canalistas de Chile. Santiago de Chile, Conferederación de Canalistas de Chile: 232-234.
- Baland, J.M and Platteu, J.P. (1996). *Halting Degradation of Natural Resources. Is There a Role for Rural Communities?* Claredon Press, Oxford.
- Bandow, D. e. (1986). *Protecting the Environment : A Free Market Strategy*. Washington D.C, The Heritage Foundation.
- Bauer, C. J. (1997). "Bringing Water Markets Down to Earth: The Political Economy of Water Rights in Chile, 1975 - 1995." *World Development* **25**(5): 639-656.
- Bauer, C. J. (1998). *Against the Current: Privatization, Water Markets, and the State in Chile*. Dordrecht, Kluwer Academic Publishers.
- Bauer, C. J. (1998). "Slippery Property Rights: Multiple Water Uses and the Neoliberal Model in Chile, 1981-1995." *Natural Resources Journal* **38**(109-155).
- Bengoa, J. (1988). *El Poder y la Subordinacion - historia social de la agricultura chilena (Tomo I)*. Santiago de Chile, Ediciones Sur.
- Briscoe, J., P. Anguita Salas, et al. (1998). *Managing Water as an Economic Resource: Reflections on the Chilean Experience*, The World Bank.
- Cancino, C. (2001). *Conflicto de aguas de regadío en el sector Las Pataguas-Valdivia de Paine*. III Encuentro de Aguas, Santiago de Chile.
- Castro, M. (1992). *Cultura Hídrica - un caso en Chile*. La Habana, Cuba, ORCAL.
- CEPAL, GTZ, et al. (1998). *Agroindustria y pequeña agricultura: vínculos, potencialidades y oportunidades comerciales*. Santiago de Chile, ECLAC/CEPAL.

- Chan, A. H. (1989). "To Market or Not to Market: Allocating Water Rights in New Mexico." *Natural Resources Journal* **29**: 629-643.
- Chileriego (2000). Reportaje Al Riego. *Diario Chileriego*. Santiago de Chile. **Nr. 1, July 2000**.
- Chonchol, J. (1996). *Sistemas agrarios en América Latina - De la etapa prehispánica a la modernización conservadora*. Santiago de Chile, Fondo de Cultura Económica.
- Correa Sutil, J. and L. Barros Lazaeta (1993). *Justicia y Marginalidad - Percepcion de los pobres*. Santiago de Chile, Corporación de Promoción Universitaria.
- Correa Sutil, J. and M. A. Jiménez (1997). *Sistema Judicial y Pobreza - Estudio sobre el acceso a la justicia en Argentina, Chile, Perú y Venezuela*. Santiago de Chile, Ediciones Universidad Diego Portales.
- Dakolias, M. (1996). *The Judicial Sector in Latin America and the Caribbean - Elements of Reform*, World Bank Technical Paper No. 319, Washington D.C.
- Dakolias, M. (1999). *Court Performance Around the World - A Comparative Perspective*, World Bank Technical Paper No. 430, Washington D.C.
- Deree, C.D. and M. Leon (1998). Gender, Land and Water: From Reform to Counter-reform in Latin America. *Agriculture and Human Values* **15**: 375-386.
- Deree, Carmen Diana and Magdalena León (2001). *Empowering Women - Land and Property Rights in Latin America*, University of Pittsburgh Press, Pittsburgh.
- DGA (1997). Registro de Comunidades de Aguas constituidas judicialmente por INDAP. Santiago de Chile. (Letter from DGA's Departamento Legal to Instituto de Desarrollo Agropecuario (INDAP), 1997-07-10)
- Donoso, G. (1993). Proyecto de reforma al Código de Aguas: Mejora la asignación del recurso? *III Convención Nacional de Regantes de Chile*. Conferederación de Canalistas de Chile. Santiago de Chile, Conferederación de Canalistas de Chile: 189-195.
- Dourojeanni, A. and A. Jouravlev (1999). *El Código de Aguas en Chile: entre la ideología y la realidad*. Santiago de Chile, ECLAC/UN. (LC/L.1263-P)
- Dourojeanni, A. and A. Jouravlev (2002). *Siete lecciones de la experiencia de Chile en materia de mercados del agua*. Santiago de Chile, ECLAC/UN. (Manuscript)
- Economist (1998). New Farms for Old. *The Economist*. **346**: 30-. 01/10/98

- El Mercurio (2001). CEP Criticó al Gbno. por Envío del Proyecto Código de Aguas. *El Mercurio*. (2001-01-24)
- FAO (2001). Taller Nacional FAO-NGO/OSC - Alianzas productivas para la seguridad alimentaria y el desarrollo rural sustentable. May 23-24 2001, Santiago de Chile, Food Agricultural Organization.
- Figuroa del Rio, L. S. (1995). *Asignación y distribución de las aguas terrestres*. Santiago de Chile, Universidad Gabriela Mistral.
- Garro, A. M. 1999. Access to Justice for the Poor in Latin America. Méndez J. E. et. al (eds.). *The (Un)Rule of Law and the Underprivileged in Latin America*, University of Notre Dam Press, Indiana: 278-302.
- Gomez, S. and J. Echeñique (1988). *La agricultura chilena: Las dos caras de la modernización*. Santiago de Chile, FLACSO/AGRARIA.
- Gómez, S. E. (2002). Organización campesina en Chile: reflexiones sobre su debilidad actual. AGRARIA, Santiago de Chile. (Manuscript)
- Gómez-Lobo, A. and R. Paredes M (2001). "Mercado de derechos de agua: Reflexiones sobre el proyecto de Modificación del Código." *Estudios Públicos* Documento de Trabajo Nr. 313.
- Green, D. P. and I. Shapiro (1994). *Pathologies of Rational Choice Theory : A Critique of Applications in Political Science*. New Haven, Yale University Press.
- Grumm, J.G. (1975). The Analysis of Policy Impact. *Handbook of Political Science*. Greenstein, F.I. & N.W. Polsby, (eds.) Reading, Mass.: Addison & Wesley.
- Hadjigeorgalis, R. (2002a). Chapter 3: The Limari River Basin Water Market. *Ph.D. Dissertation*: 13-63. (Manuscript)
- Harasic Yaksic, D. (1988). La asistencia juridica y el acceso de los pobres al sistema legal. *Justicia y sectores de bajos ingresos*. M. Aylwin Byarzún. Santiago de Chile, Editorial Juridica Ediar-ConoSur Ltda.: 175-192.
- Hearne, R. R. and K. W. Easter (1995). *Water Allocation and Water Markets: An Analysis of Gains-from-Trade in Chile*. Washington D.C., The World Bank (World Bank Technical Paper No. 315).
- Huerta, O. (2000). Derechos de Agua. *El Mercurio*. Santiago de Chile. (2000-05-19)
- INDAP (1997). Asegurar el Agua. Videosur. Santiago de Chile, INDAP. Video
- INDAP (1998). *Manual Básico para la Capacitación en Gestión de Recursos Hídricos*. Santiago de Chile, Instituto de Desarrollo Agropecuario (INDAP), Departamento de Riego.

- Joep Spiertz, H.L. (2000). Water Rights and Legal Pluralism: Some Basics of a Legal Anthropological Approach. *Negotiating Water Rights*. Bruns, Bryan R. and Ruth S. Meinzen-Dick (ed.). International Food Policy Research Institute I, ITDG Publishing, London: 62-199.
- Johnson, C. (1999). "Privatizing Water - Political Intrigue and Free Market Economics in South Africa." *Multinational Monitor* (April 1999): 13-18.
- Kilgour, D. M. and F. C. Zagare (1991). "Credibility, Uncertainty, and Deterrence." *American Journal of Political Science* 35(2): 305-334.
- Kollock, Peter (1998). Social Dilemmas: The Anatomy of Cooperation. *Annual Review of Sociology* vol. 24, 183-214.
- Lagos, R. (1998). "Visión pública del agua, caracterización de la legislación vigente y propuestas de reforma." *Revista de Derecho de Aguas IX*: 311-319.
- Lee, T. L. and A. Jouravlev (1998). *Los precios, la propiedad y los mercados en la asignación del agua*. Santiago de Chile, ECLAC/UN. (LC/L.1097)
- Maffei, E. (1992). *Evaluación del programa de Riego Campesino*. Santiago de Chile, Convenio FOSIS/INDAP.
- Meinzen-Dick, Ruth S. et al. (1997). Gender, Property Rights, and Natural Resources. *World Development* vol. 25, No. 8, 1303-1315
- Melin, J. (2001). Falta de Agua Provocarí­a Fin de Pueblo. *El Mercurio*. Santiago de Chile.
- Ministerio de Agricultura, Ministerio de Obras Pú­blicas, et al. (1995). *Anales de la 1a Conferencia Nacional Sobre Desarrollo del Riego en Chile*. Santiago de Chile, Oficina de Estudios y Políticas Agrarias (ODEPA).
- Montecino Aguirre, M. (1989). Dos casos de aplicacion del actual Cód­igo de Aguas: Metodologías, Problemas y Resultados. *Riego - distintas visiones sobre la aplicación del Cód­igo de Aguas*. SEPADE. Santiago de Chile, Programa Desarrollo Rural, Servicio Evangé­lico para el Desarrollo.: 12-43.
- Muñoz Rodríguez, J. (1998). *La administracion de los recursos hidricos - analisis historico, juridico y economico. Seminario - realidad y proyeccion del derecho de aguas*. Universidad de Antofagasta, C. Jurídicas). Santiago de Chile, Universidad de Antofagasta.
- ODEPA (1994). *Políticas de desarrollo del riego en Chile: 1974-1993*. Santiago de Chile, Oficina de Estudios y Políticas Agrarias (ODEPA).
- Ostrom, E. (1990). *Governing the Commons- The Evolution of Institutions for Collective Action*: . Cambridge, Cambridge University Press.

- Ostrom, E., L. Schroeder, et al. (1993). *Institutional Incentives and Sustainable Development*. Oxford, Westview Press.
- Pizarro Tapia, R. (2000). Recursos Hídricos. *Informe País: Estado del Medio Ambiente en Chile - 1999*. Universidad de Chile /Centro de Análisis de Políticas Públicas. Santiago de Chile, LOM Ediciones: 77-115.
- Polanco Dabed, J. (2001). Reforma a Código de Aguas. *El Mercurio*. Santiago de Chile. (2001-01-21)
- Puig, A. (1998). *El fortalecimiento de las organizaciones de usuarios para una gestión integrada de los recursos hídricos*. Conferencia Internacional "Agua y Desarrollo Sostenible", Paris.
- Ríos Brehm, M. and J. Quiroz (1995). *The Market for Water Rights in Chile - Major Issues*. Washington D.C., World Bank.
- Rosegrant, M. W. and R. Gazmuri S. (1994). *Reforming Water Allocation Policy Through Markets in Tradable Water Rights: Lessons from Chile, Mexico, and California*. Washington D.C., International Food Policy Research Institute. (Discussion paper)
- Rothstein, B. (1996). Political Institutions: An Overview. *A New Handbook of Political Science*. R. E. Goodin and H.-D. Klingemann. Oxford, Oxford Univ. Press.
- Schelling, Thomas C. (1998).
- Schultz, J. (2000). "Bolivia's Water War Victory." *Earth Island Journal* (Autumn 2000): 28-29.
- Sepúlveda, C. and F. Sabatini (1997). Asociaciones de Canalistas en Chile: Tradición, poder y legalismo en la gestión de conflictos. *Conflictos ambientales: entre la globalización y la sociedad civil*. F. Sabatini and C. Sepúlveda. Santiago de Chile, CIPMA.
- Silva, E. (1995). Environmental Policy in Chile: the politics of the comprehensive law. *Greening Environmental Policy - The Politics of a Sustainable Future*. F. Fischer and M. Black. London, Chapman.
- Simpson, L. and K. Ringskog (1997). *Water Markets in the Americas*. Washington D.C., The World Bank.
- SNA (1993). Código de Aguas - Observaciones de la SNA al proyecto que modifica la ley. *El Campesino*. **June 1993**: 8-14.
- Sproule-Jones, M. (1982). "Public Choice Theory and Natural Resources: Methodological Explication and Critique." *The American Political Science Review* **76**(4): 790-804.

- Stewart, D. L. (1970). *El Derecho de Aguas en Chile - Algunos aspectos de su historia y el caso del Valle de Illapel*. Santiago de Chile, Editorial Juridica de Chile.
- The World Bank (1995). *Chile - Estrategia para elevar la competitividad agrícola y aliviar la pobreza rural*. Washington D.C., The World Bank.
- Toledo Llancaqueo, V. (1996). *Todas las aguas - el subsuelo, las riberas, las tierras*. Temuco, Chile. (Manuscript)
- Vargas Viancos, J. E. and J. Correa Sutil (1995). *Diagnóstico del sistema judicial chileno*. Santiago de Chile, Corporación Promoción Universitaria.
- Vergara Blanco, A. (1998). *Derecho de Aguas (Tomo II)*. Santiago de Chile, Editorial Juridica de Chile.
- Winpenney, J. (1994). *Managing Water as an Economic Resource*. London and New York, Routledge.

Interviews

- Bahamondes (2002). Interview with Miguel Bahamondes, Grupo de Investigaciones Agrarias (GIA), Santiago de Chile 2002-05-06.
- Bauer (2002). Interview with Carl J. Bauer, Resources For the Future/Universidad de Chile, Santiago de Chile 2002-04-10.
- Cancino (2002). *Interview with Carmen Cancino*, Instituto de Desarrollo Agropecuario (INDAP), Santiago de Chile 2002-04-25.
- Hadjigeorgalis (2002b). Interview with Rene Hadjigeorgalis, Universidad Católica, Santiago de Chile 2002-05-17.
- Jouravlev (2002). Interview with Andrei Jouravlev, United Nations Economic Commission for Latin American and the Caribbean (ECLAC/CEPAL), Santiago de Chile 2002-04-14.
- Reyes (2002). Interview with Bernardo Reyes, Instituto de Ecología Política/ Foro del Agua, Santiago de Chile 2002-03-23.
- Ojeda (2002). Interview with Aldo Ojeda, Dirección General de Aguas, Santiago de Chile 2002-04-22.
- Puig (2002). Interview with Aurora Puig, Dirección de Obras Hidráulicas, Santiago de Chile 2002-05-02.

Appendix. Water Right Violations - a selection of cases

Region	Affected	Accused	Comment	Source
X	Mapuche communities	Aqua-culture companies (salmon)	Overextraction from lakes Lleu Lleu, Panguipulli, Neltume, Pullinque, Calafquén, Maihue affects mapuche communities' historical water rights.	Toledo Llancaqueo (1996)
IX	Mapuche communities	Mining companies	Polluted water due to mining in Santa Celia, Repocura and Guamaqui.	Toledo Llancaqueo (1996)
I and II	Aymara and Atacameño (indigenous) communities	Mining companies and urban water companies	Water historically used by indigenous communities regularized and used by companies.	Toledo Llancaqueo (1996)
IX	Mapuche (Indigenous) communities	Mining companies, industrial agriculture, forest companies	Water used by indigenous communities regularized and used by others in Quillem, Cautín, Traiguén, Allipén, Tolén.	Toledo Llancaqueo (1996)
Metro-politan	Small farmers (campesinos)	Industrial farmer	Stealing of groundwater rights in Sector El Lucero de Lampa.	INDAP (1997)
VI	Small farmers (campesinos)	Industrial farmer	Construction deviates water on purpose historically used for irrigation, Sector El Carmen, Marchique.	INDAP (1997)

M	Parceleros	Real estate investor	Deviation of water, case taken to court in a judicial process that has lasted over 30 years.	Cancino (2001)
IV	Campeños	Industrial agriculture	Construction of water pumps for irrigation by industrial fruit farming affects the water flows of small agriculture in La Paloma / Cogotí.	Bahamondes (2001)
I	Small agriculture	Servicio Nacional de Obras Sanitarias (SENDOS), ESSAT and others	Repeated illegal construction of infrastructure and exploitation of groundwater affects agriculture activity in the area Valle de Zapata.	Aviles Herbas (1993)
II	Small agriculture	Mining company Sociedad Química y Minera de Chile (Soquimich)	Company claimed and received water rights from governmental agency DGA. Water resources were traditionally used by farmer community in the Loa River, Quillagua Valley.	Melin (2001)
I/II	Indigenous farmers	Comany Nazca	Company claimed and	Huerta (2000)