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Stealing from the Poor? Game Theory and the Politics of Water Markets in Chile

VICTOR GALAZ

Despite all the potential benefits that are usually attributed to a system of tradable water rights, few countries have fully implemented such a legal institution. The Chilean water market is the exception, often promoted by international organisations such as the World Bank. Experts and governmental officials repeatedly argue that negative social consequences of the Chilean water market have been limited. This paper questions these claims and argues – using game theory combined with empirical evidence – that the introduction of a water market in Chile has created an obvious incentive to violate the water rights of underprivileged users.

The introduction of a new water act in Mexico 1994; the outsourcing of municipal water-supply management in Jakarta to Lyonnaise de Eaux, a French multinational; the introduction of water markets in Chile; and the introduction of private partnerships in rural water-resources development and supply in South Africa. All are examples of one widely discussed and applied solution to the increasing scarcity of water resources in developing countries in the face of failure of public management: to treat water resources as a private economic good [*Bjornlund and McKay, 2002; Bakker, 2002:769*].

It is said that the creation of a free water market provides incentives to water users that increase both economic and environmental efficiency by allocating resources to their most valuable uses. The overall argument is that legal rules and institutions should favour the operation of market mechanisms, such as private bargaining and exchange, and should minimise

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government regulations *[Anderson and Leal, 1991; Smith, 1995; Winpenny, 1994*].

But what are the possible impacts for the poorest water users of a free market approach to natural resource management in developing countries? Despite the importance of the issue to anyone interested in both ecological and social aspects of natural resource management, proponents of the market model have surprisingly little to say on the possible social consequences of the implementation of free market water regimes [for example *Winpenny, 1994; Spulber and Sabbaghi, 1998; Dinar et al., 1997:4ff*].

Free market environmentalism (FME) does not lack critics. Unfortunately, their critique is seldom based on empirical studies conducted in countries where the neo-liberal model has been fully applied [for example *Barry, 1999:150–5; Eckersley, 1993; Blumm, 1992*]. Furthermore, FME is seldom analysed on its own terms, that is, by applying the assumptions and methods normally used by economists [see *Willey, 1992; Zerner, 1999; Menell, 1992; Weale, 1992*]. This paper focuses on two major deficiencies in the debate on the Chilean water market, the leading international example of free market water policies.

The first deficiency is the failure by proponents of the market model to deal seriously with deficient institutions. The second is the failure fully to acknowledge the way in which natural resource markets are embedded in asymmetries of money and social power among users. Once these two aspects are recognised, the case for advocates of FME and the Chilean water market – such as the World Bank – is weakened.

The paper is organised in three parts. Part I, gives an overview of the Chilean water market, and discusses possible definitions of the 'market' and its impacts. Part II shows how the incentives in a market can be understood game theoretically to explain various cases of violations of water rights of underprivileged water users in Chile. Part III summarises the findings and implications for our understanding of natural resource markets.

Part I

The Chilean Water Market

Chile remains the leading example of free market water policies and model of inspiration for other Latin American countries – such as Bolivia, Nicaragua, Peru and a number of countries in Central America – that are in the process of radically modifying their water regimes [*Bauer, 1998; Dourojeanni and Jouravlev, 1999: 8*]. Moreover, a number of powerful international organisations such as the World Bank tend to advance the Chilean water regime as a model for developing countries fighting against ever scarcer water resources [*Silva, 1995; Haughton, 2002*; *Briscoe et al., 1998*].

In 1981 the Chilean military government dictated the new Water Code that completely transformed the country's system of water rights, and created the necessary elements for a market: it strengthened private property, introduced market mechanisms and incentives, and considerably limited the state's power to regulate. The main principles of the Chilean water regime, as presented in the Water Code, are [*Ríos Brehm and Quiroz, 1995: 2; Vergara Blanco, 1998: 314–7*]:

- Water rights are 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 water rights not only legal, but also constitutional, protection.
- The Code distinguishes between consumptive and non-consumptive rights. Non-consumptive rights are mainly for power generation, and the holder of such rights must return the water to the river in a way that does not damage the rights of consumptive users (that is irrigation).
- Application for new water rights is not conditional on the type of use, and there is no governmental priority list for different uses of water.
- Water rights have been allocated by the state with no charge, and in the case of simultaneous requests for the same water rights, these are auctioned off to the highest bidder.
- The role of the state in resolving conflicts is minimal, and resolutions rely on private negotiations within the different water user associations and the judicial system.

Defining the Market and Its Impacts

The successes of the new Water Code have been widely acclaimed [*Hearne and Easter, 1995; Rosegrant and Gazmuri, 1994; Ríos Brehm and Quiroz, 1995*], while others [*Bauer, 1998; Dourojeanni and Jouravlev, 1999*] have taken a more critical position. It is nonetheless interesting to note that the rural population in Chile has less access to improved drinking water (58% in the year 2000) than in countries such as Argentina (73% in 1990), Bolivia (64% in 2000) and Uruguay (93% in 2000) [*UNSD, 2003*]. The new regime has furthermore not been able to halt the ever-increasing degradation and exploitation of water resources in Chile [*Universidad de Chile, 2000: 82–7, 90–2*].

Despite the substantial lack of empirical studies on equity aspects of the water market [*Dourojeanni and Jouravlev, 1999: 20; Bjornlund and McKay, 2002: 770*], both international experts and Chilean governmental officials

tend either to overlook the issue [*Hearne and Easter, 1995; Briscoe et al., 1998; Simpson and Ringskog, 1997:,42ff; Thobani, 1998*], or to claim that these consequences have been insignificant due to the low number of transactions [*Rosegrant and Gazmuri, 1994: 32; Ríos Brehm and Quiroz, 1995; Puig pers. comm., 2002*]. As World Bank economists Monica Ríos Brehm and Jorge Quiroz write:

> Even though some specific equity problems might be involved with the initial implementation of a private water right 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). [*Ríos Brehm and Quiroz, 1995: 27*]

A fact worth mentioning is that the market on some occasions has been shown to *empower* underprivileged groups. In northern Chile, water rights have provided small farmers with alternative sources of income in times of droughts, or an economic resource in times of financial problems. This is done through a temporary and informal transfer of the right to use water [*Hadjigeorgalis pers. comm., 2002; Bjornlund and McKay, 2002: 771*]. Indigenous communities with water rights in the Chilean north have also managed to bargain a beneficial contract with a mining company [*Castro, 1992*]. These transactions would have been impossible in a non-market water regime, which clearly gives the impression that the implementation of the Chilean water market has worked efficiently, and even to the benefit of underprivileged groups. The effects are thus implied to be similar to the 'equity potential' observed in the Indian water market with 'second-round employment and income benefits even for the landless' [*Saleth, 1998: 201*]. This optimistic belief is further strengthened by the fact that reports of water violations against poor users in Chile are scarce and dispersed among various actors, such as agricultural experts, and erratic appearances in media. This belief, however, rests on two highly questionable assumptions.

First, it assumes that the effects of the introduction of a water market are equivalent to the effects of *transactions* in the market. That is, the market should be evaluated solely by the impacts created as a result of transactions in the marketplace and not by whether the new regime in general distorts the distribution of the resource among poor and wealthy users.

Second, the logical connection between low numbers of reported, and *actual* violations rests on the assumption that underprivileged water users consistently report water violations. Neither of these two critical assumptions holds true when subjected to empirical scrutiny.

Taking Institutions and Incentives Seriously

One widespread approach to structuring the possible negative social, economic and environmental effects of the introduction of water markets is to focus on externalities and third party claims, including possible 'area-of-origin' environmental, economic and community effects [*Lee and Jouravlev, 1998: 62–76; Willey, 1992: 407–8*]. The focus is thus explicitly on the effects of a *transfer* of water rights. The separation between the specific effects of water rights transfers, and of other aspects *outside* the market is seen by researchers as essential to tease out the specific effects of the market [*Lee and Jouravlev, 1998: 76*]. This explicit focus on water rights transfers on the market has led to a significant number of studies that discuss the exact number and characteristics of water rights transactions in Chile [for example *Ríos Brehm and Quiroz, 1995; Hearne and Easter, 1995; Rosegrant and Gazmuri, 1994*].

There is, however, more at stake than externalities created by transfers in a water market. The reason for this is the fact that the emergence of a market includes not only the presence of market transactions, but also the emergence of organisations and regulations to facilitate these transfers. These institutions will change the incentives and constraints that users face, and hence alter the behaviour of existing actors and trigger the sometimes unexpected behaviour of new ones [*Ostrom et al., 1993: 8ff*]. In other words, if natural resource users are assumed to be rational and pursue their self-interest – a fundamental assumption in FME – it is highly reasonable to assume that a change in the institutional environment will result in changes of behaviour not only within, *but also outside the marketplace* [cf. *Baland and Platteau, 1996: 42*]. This argument is in line with crucial insights from various versions of institutional theory in political science [*Rothstein, 1996*] and neo-institutional economics [*North, 1990*]but has not been considered seriously in the discussion of the Chilean water regime.

Hence studies conducted so far have had a very limited focus on water transfers. The reason for this is that none of them has seriously dealt with how the neo-liberal regime has affected the full array of incentives that water users face both inside and outside the 'market'.

Part II

Why Reporting Is Not a Rational Strategy

To defend your property in the case of an intrusion might seem like an obvious response. Unfortunately, evidence from the Chilean case indicates

that this assumption seldom holds true, and *in particular for underprivileged water users*. Two cases of fruitless attempts to challenge water rights violations illuminate this.

Peasant farmers in Las Pataguas, Valdivia de Paine, located 50 km from Santiago, have experienced a severe and long-lived water conflict with a real estate investor. The conflict started in the early 1970s as a result of construction by the investor on his own plots. This led to serious disturbances of the water flow to the farmers. The diversion was, according to governmental officials, a *deliberate* attempt to destroy the productivity of the land, and to force the peasant farmers to sell their plots. It was not until 1986 – after more than ten years (!) – that a few of the farmers individually decided to take the problem to court. The ruling was in favour of the farmers, but this did not stop the continued diversion of water by the real estate investor. The same procedure was repeated in 1991: an appeal to the court led to a ruling in favour of the farmers, but this did not stop continued violations of their water rights by the investor. This problem has affected the income of 300 persons dependent on small scale agriculture to such an extreme that a number of them felt obliged to sell their plots and find other sources of income [*Cancino, 2001; Cancino pers. comm., 2002*].

Small farmers organised 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 DGA (General Directorate of Water) – the governmental agency in charge of granting new water rights – for the exploitation of 550 litres per second of water. The request was denied by the DGA, largely because of a petition put forward by the farmers showing that this extraction would severely affect existing water flows normally used by them for irrigation. Despite the DGA's decision, and without the necessary water rights, SENDOS decided in 1984 to start the construction necessary for water exploitation. Once again, the farmers took the case to court, which ruled in their favour and ordered a halt to constructions. This temporarily halted construction, but in 1991 the water company ESSAT (Empresa de Servicios Sanitarios de Tarapacá S.A.) – a privatised version of SENDOS – resumed 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 [*Aviles Herbas, 1993*].

This example is a more detailed description of one of the cases presented in Table 1. The table is a collection of what normally is seen as 'anecdotal evidence', and presents a number of cases of water rights violations against underprivileged water users.

TABLE 1
WATER RIGHT VIOLATIONS – A SELECTION OF CASES

Affected	Accused	Comment	Source
Indigenous Mapuche communities	Aquaculture companies (salmon)	Over extraction from lakes Lleu Lleu, Panguipulli, Neltume, Pullinque, Calafquén, Maihue affects mapuche communities' historical water rights. (Region X)	[*Toledo Llancaqueo 1996*]
Indigenous Mapuche communities	Mining companies	Polluted water due to mining in Santa Celia, Repocura and Guamaqui (Region IX)	[*Toledo Llancaqueo 1996*]
Indigenous Aymara and Atacameño communities	Mining companies and urban water companies	Water historically used by indigenous communities regularised and used by companies(Region I, II)	[*Toledo Llancaqueo 1996*]
Indigenous Mapuche communities	Mining companies, industrial agriculture, forest companies	Water used by indigenous communities regularised and used by others in Quillem, Cautín, Traiguén, Allipén, Toltén (Region IX)	[*Toledo Llancaqueo 1996*]
Peasant farmers	Industrial farmer	Stealing of groundwater rights in Sector El Lucero de Lampa (Metropolitan Region)	[*INDAP 1997*]
Peasant farmers	Industrial farmer	Construction deviates water on purpose historically used for irrigation, Sector El Carmen, Marchique (Region VI)	[*INDAP 1997*]
Peasant farmers	Real estate investor	Deviation of water, case taken to court in a judicial process that has lasted over 30 years. (Metropolitan Region)	[*Cancino 2001*]
Peasant farmers	Industrial agriculture	Construction of water pumps for irrigation by industrial fruit farming affects the water flows of small agriculture in La Paloma/Cogotí. (Region IV)	[*Bahamondes pers.comm. 2002*]
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. (Region I)	[*Aviles Herbas 1993*]
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 (Region II)	[*Melin 2001*]
Indigenous communities	Company Nazca	ompany claimed and received water rights from DGA traditionally used by indigenous community Ayquina in Vegas de Turi. The community took the case to court with help from governmental agency CONADI (Corporación Nacional de Desarrollo Indígena) (Region I,II)	[*Huerta 2000*]

Table 1 could easily be extended with more cases [*Cancino pers. comm., 2002; Bahamondes pers. comm., 2002*], but my purpose here is to specify the *mechanism* [see *Elster, 1998; Schelling, 1998*] – starting from the same assumptions normally used to prove the benefits of the water market – and game theoretically to explain why these apparently isolated occurrences of violations of water rights follow a general logic.

Water Markets and Game Theory

One powerful and frequently used approach to getting a grip on the incentives natural resource users face is that of game theory [see *Ostrom, 1990; Sproule-Jones, 1982; Ward, 1996*]. Despite criticism [see *O'Neill, 1995*], game theory can still be considered as an appropriate tool for analysing strategic interaction that involves a limited number of actors engaged in purposeful action [*Scharpf, 1997: 19–35*]. This is in particular true if we are interested in basing our analysis of water markets on the same fundamental assumptions used by proponents of FME [*Anderson and Leal, 1991: 4–5; Smith, 1995: 70–1*]:

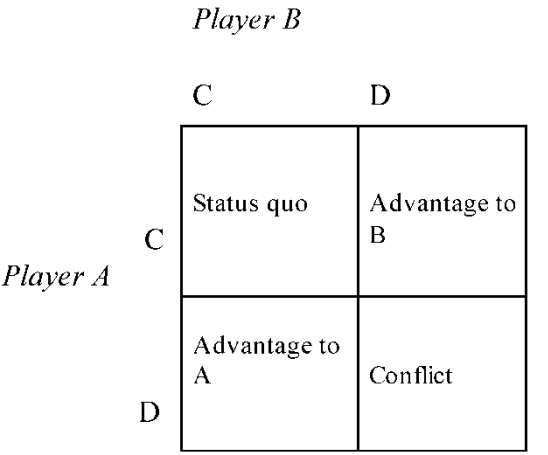
(1) a recognition that natural resource users are self-interested actors who respond to the incentives and information available to them, and
(2) a recognition that institutions – the rules, laws, and customs that govern people – help determine their incentives and information.

With this in mind, let us start with a simple but crucial assumption: a water regime with minimal state intervention – such as a water market – demands that water users respect each other's acknowledged water rights. Whether this demand is met will depend heavily on access to neutral conflict resolving arenas [*Ostrom, 1990: 90–100*].

Figure 1 illustrates two groups or individual water users, A and B. A and B could be any combination of water users. More specifically, the two could be individual and/or groups of irrigators, an urban water and sanitation company, a hydroelectric company, an industrial forestry or any other economic agent (not necessarily a user of water resources). For simplicity, I shall deal only with problems involving pairs of actors cooperating. The problems emerging even in such a simplified setting are, as will be shown, serious enough.

Let us also add a fact frequently ignored by proponents of FME, that natural resource users repeatedly – and especially in developing countries – are heterogeneous in terms of both social and economic power. As an example, let the game explain the interaction between a group of peasant farmer irrigators (B) and an upstream urban water company (A). Ideally,

FIGURE 1
A NORMAL FORM WATER MARKET GAME



Note: The figure shows the available strategies and outcomes of water user A (Player A) and water user B (Player B). The strategies for both players are ''Cooperate'' (retain status quo) or 'Defect' (challenge status quo by polluting, diverting or extracting more water).

neither of these two actors extracts more water than specified by their acknowledged water rights. Hence, the users are dependent on each other's cooperation for the maintenance of the status quo division of water resources.

The critical question is: what happens if someone breaks this agreement, as did the urban water company in the Azapa valley described above? For the market model and according to the Chilean Water Code, those negatively affected have two options: 1) take this violation to the appropriate water user association, or 2) take the case to court [*Vergara Blanco, 1998: 271*]. This response from the affected thereby creates a conflict to be resolved in one such arena. These alternatives can be captured in the following normal form game theoretic model [cf. *Kilgour and Zagare, 1991*].

In this simple game each player has two strategies available: cooperate (C) or defect (D). This means that if player A chooses to defect, and player B to cooperate, the outcome of the game is (DC), the lower left box in Figure 1. Possible outcomes of this game are thus:

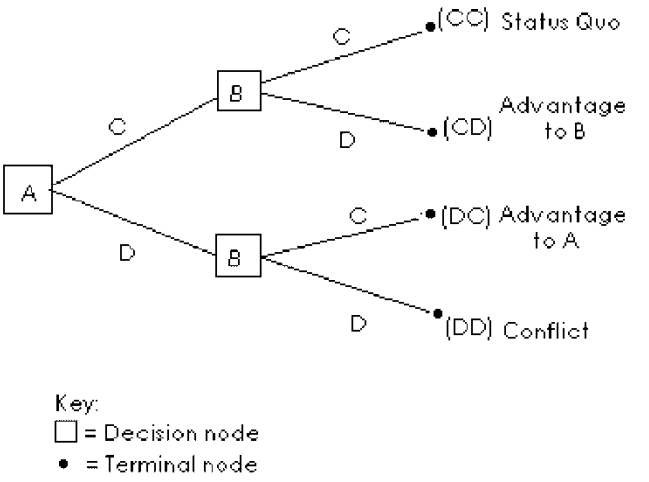
CC: Cooperate, that is, to continue to divide the water according to the acknowledged status quo division of water rights.

DC: Advantage to A, that is, A extracts more water and B accepts the violation.
CD: Advantage to B, that is, B extracts more water and A accepts the violation.
DD: Conflict, violation by A or B is settled either by the water user association or in court.

The status quo division of water for A (Q_A) and B (Q_B) could be anything from $Q_{A,B} = 0, 1, 2, 3, \ldots, n$ litres per second. Briefly put, there is always a possibility for any of the players to defect from the status quo by polluting, diverting or using more water. The water user affected can either accept the violation (CD or DC), or seek resolution at the existing water user association or in court (DD). The game can also be illustrated in extensive form, see Figure 2.

Let us now assume that an urban water and sanitation company A needs to extract more water and elects the option to use more water than it has a right to, which affects the access to water of a small group of peasant farmers downstream. How likely is this defection from A? And what will the peasant farmers do? The answer is far from obvious and depends entirely on the

FIGURE 2
EXTENSIVE FORM WATER MARKET GAME WITH PERFECT INFORMATION
(remade from Kilgour and Sagare, 1991)



Note: The figure is read from left to right and shows available outcomes and strategies in a water market. A and B represent water users. A makes the first choice. If A chooses D, then B has the possibility to either accept the violation (DC), or challenge it in a WUA or court (DD).

preference order of both players, an issue developed in the section below.

Small Farmers and Big Companies – the Players

Before discussing the various options that the imaginary group of peasant farmers (henceforth *campesinos*) has to counter the challenge from company A, it is important to keep in mind several characteristics of this group in Chile. In general, industrial farmers have made an outstanding contribution to Chile's impressive growth rate of 6–7% a year during the 1990s. Since 1985, agricultural trade has been consistently in surplus [*Economist, 1998*], a huge change from the days when trade was in chronic deficit [*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* are a highly heterogeneous group – including both traditional farmers, farmers from the days of the Allende government's Land Reform in the 1970s, and various indigenous groups – but with one important thing in common. These small producers use mainly the labour of their families, and produce mainly to secure their income [*Gómez and Echeñique, 1988: 203ff; CEPAL et al., 1998: 22*]. This makes the *campesino* particularly dependent on agriculture, and a certain availability of water, for survival [*World Bank, 1995: 35*].

As Table 2 shows, members of the *campesino* community add up to an estimated total of 225,000 persons. Estimates by the World Bank show that the large majority have *total annual incomes* below $490 USD (Table 3).

TABLE 2
NUMBER OF FARMERS, LAND DISTRIBUTION AND COMMERCIALISED PRODUCTION IN CHILE

	Number of farmers	Territorial extension (%)	Commercialised production (%)
Industrial agriculture	35 000	61	74
Small agriculture	125 000	37	26
Minifundistas	100 000	2	1

Source: [World Bank 1995:35].
Note: *Minifundistas*, a category 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 and Echeñique 1988:208ff*]

TABLE 3
TOTAL ANNUAL INCOME OF CHILEAN *CAMPESINO* AGRICULTURE

% of small producers	Annual income per capita
65	< 490 USD
30	491- 865 USD
5	866 - 1 940 USD

Source: [*World Bank, 1995:38*].
Note: The minimum wage as of December 31, 2001 was approximately $157 (105,000 pesos) net of deductions per month. This wage is designed to serve as the starting wage for an unskilled single worker entering the labour force. [*ERI, 2003*].

C*ampesinos* seldom enjoy full legal protection of their water resources [*Bauer, 1998: 67; Ministerio de Agricultura et al., 1995: 115–6; Cancino pers. comm., 2002; Bahamondes pers. comm., 2002*]. This does not mean, however, that these communities do not have water rights that, in theory, are protected by law. This paradoxical situation appears because the Water Code makes a distinction between recognised and regularised water rights. The former refer to water rights historically used by anyone (for example for irrigation) from April 1979; the latter refers to water rights registered in an administrative process. Both rights benefit from the same legal protection as established by the Chilean Water Code [*Vergara Blanco, 1998: 322,327–31*].

Challenging Defection

First Option: the Water User Associations

With the general characteristics of *campesino* communities in mind, what will group B do in the case of a water rights violation? One option is to report the violation to the appropriate Water User Association (WUA). This institution dates from the nineteenth century, and is recognised as the most important water conflict resolution institution in Chile [*Figueroa del Rio, 1995: 99–103; Sepúlveda and Sabatini, 1997: 239*]. Its 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.

One major problem, however, is that the Chilean water user associations are by no means are the well-developed institutions some claim [*Figueroa del Rio, 1995: 100–1; Polanco Dabed, 2001*].

First, all Chilean WUAs are far from being as professional as is necessary for the resolution of conflicts. Studies made by the Directorate of Hydrological Works show that many lack the legal as well as technical capacity needed to solve water resource conflicts [*Puig, 1998; Puig pers. comm., 2002*].

Second, even if the number of formalised WUAs in Chile is usually claimed to be high, there is an unknown number of unorganised water users. It is practically impossible to make an estimate of the number of water users that do not have a WUA [*Ojeda pers. comm., 2002; Puig pers. comm., 2002*]. This situation prevails despite ambitious regularisation programmes executed by responsible agencies [*Ríos Brehm and Quiroz, 1995: 26* for details]. The fact that an important number of water users do not possess regularised water rights [*Dourojeanni and Jouravlev, 1999: 13*] – a legal requirement to be a member of a water user association – implies that the number of unorganised water users is considerable.

Third, even when competent and formalised WUAs do exist, *campesinos* seldom have access to them because either they do not tend to be *de facto* members of them, or – if they are – they do not trust them to represent their interests [*Sepúlveda and Sabatini, 1997; Cancino pers. comm., 2002; Bahamondes pers. comm., 2002; Puig pers. comm., 2002*]. Some researchers have argued that the way these institutions are designed (with one vote per water right) effectively marginalises *campesinos* from exercising their rights in them [*ODEPA, 1994: 37*].

Fourth, this marginalisation is further complicated by the fact that the historical distribution of irrigation water has seldom been to the benefit of often-downstream *campesinos*. The distribution of water resources tends to follow the prevailing power structures in the river basin with peasant farmers at the bottom of the hierarchy [*Stewart, 1970: 19; INDAP, 1997; Bengoa, 1988: 182ff; Montecino Aguirre, 1989: 21*]. To sum up, the probability is low that peasant farmers will try to get assistance from the widely recognised and important Chilean WUAs if we assume them to be rational utility maximisers.

On the other hand, there is always a legal possibility to create a WUA. This would strengthen the groups' bargaining power by making their judicial status considerably stronger. Unfortunately, this door too might be closed to many *campesinos*. The problem of collective action is always present and is only overcome under specific circumstances [*Ostrom, 1990*]. Another problem of a more practical nature is the bureaucracy and high formalism within the General Directorate of Water (DGA), the directorate responsible for planning water resources and for granting water rights. According to the governmental agency in charge of promoting and defending the interests of small agriculture, the Instituto de Desarrollo Agropecuario (INDAP), only 5% of the *campesino* water communities they wanted to formalise under the Water Code during a six-year period were regularised [*Cancino pers. comm., 2002*]. The slow bureaucracy and high formalism in the regularisation of WUAs within the DGA is so well known that even governmental agencies under the same Ministry of Public Works avoid getting into the judicial

labyrinths in the implementation of irrigation projects and regularisation of WUAs [*Puig pers. comm., 2002*].

Second Option: the Judicial System

Another way to challenge a potential break of the status quo is to take the case to court. The courts play a strategic role in the market model. They must both protect private rights from unwarranted state regulation and resolve conflicts among private parties [*Correa Sutil, 1999; Bauer, 1998: 19; Menell, 1992: 5001ff*]. This too, however, seems a costly option for *campesinos*.

The main problem with this conflict-resolving institution is, as water experts recognise, that the 'system is too slow, too costly and too unpredictable' [*Briscoe et al., 1998: 9*] and that 'the institutional capacity of the Chilean judiciary to fulfil its more strategic role is dubious' [*Bauer, 1998: 19]*. It is unpredictable because judges often must take a decision based on limited information or technical expertise, few legislative or constitutional guidelines, and little time for deliberation [*Bauer, 1998: 22]*. It is slow because the Chilean judiciary system is obviously under-resourced [*Correa Sutil and Barros Lazaeta, 1993: 76ff, Dakolias, 1999: 11*]. The average length of an ordinary civil case in 1992/93 was of the order of *1009 days* [*Vargas Viancos and Correa Sutil, 1995: 44*]. 'White collar crimes' and environmental violations take most time to settle [*Vargas Viancos and Correa Sutil, 1995: 149*]. The case of the farmers in Las Pataguas did not proceed until the results of costly hydrological studies definitively ascertained the effects of the real estate investor's actions [*Cancino, 2001*]. Thus, water conflicts are far from simple judicial disputes that can be resolved transparently and quickly.

But what if the group still wants to take the case to court? Courts and legal services are in theory available to all – all that is needed is money. The total costs of lawyers' fees in connection with an appeal to court are estimated to be $670 USD, with an additional $140 USD in case of appeal to a higher court [*Balmaceda pers. comm., 2002*]. This might sound like a small sum for protecting such a fundamental resource as water, but the total annual income of a *campesino* in the majority of cases is *well below $500 USD* (Table 3). Free legal assistance – such as from the *Corporaciones de Asistencia Judicial* – tends to be irregular and chronically lacking personnel and financial resources [*Correa Sutil and Barros Lazaeta, 1993: 82–3; Garro, 1999; Harasic Yaksic, 1988*].

The Perceptions of the Courts

Campesinos' willingness to enter the judicial system is further complicated because Chilean courts are not seen as treating all Chileans alike. A majority

of low-income Chileans perceive the Chilean courts as designed 'by the rich, for the rich' [see also *Bjornlund and McKay, 2002: 775*]. A survey of low-income households in three Chilean cities illustrates this (Table 4).

This astonishingly low trust in the judicial system makes low-income households particularly sceptical about taking any kind of violation to court. The result is that most violations are *not* reported by a majority of low-income citizens [*Correa Sutil and Jiménez, 1997: 46*].

NGO Assistance?

There is one final option to get the necessary financial help to pay the costs of a conflict: Non-Governmental Organizations (NGOs). If properly organised and with the appropriate expertise, they can be a key to empowerment of vulnerable groups in society. They could provide the necessary financial, legal and technical help in cases of water conflicts. In other developing countries, such as Bolivia and South Africa, NGOs have provided an important channel for groups opposing the privatisation of public water systems [*Schultz, 2000; Johnson, 1999*].

Unfortunately, Chilean rural NGOs have seen a sharp decline in their membership after the democratisation in the 1990s. For example, the number of *campesinos* associated to a cooperative has declined from 75,000 members in 1973 to 10,684 in 2000. Membership of labour unions has also declined (to 36,000 members in 2000) [*Gómez, 2001: 248ff*]. In other words, a large majority is unorganised.

Furthermore, the capacity of rural NGOs to assist their members in cases of water conflicts is practically non-existent. The same applies to environmental NGOs [*Reyes pers. comm., 2002*]. Even if rural NGOs acknowledge the Water Code's implications for their members as an important issue [*FAO, 2001*], none can provide the necessary legal and technical help [*Cancino*

TABLE 4
LOW-INCOME HOUSEHOLDS AND TRUST IN THE JUDICIAL SYSTEM IN CHILE

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
'Judges treat rich people in one way, and poor people in another'	64	10	No infomation

Source: Vargas Viancos and Correa Sutil 1995:137,155; Correa Sutil and Jiménez 1997:40.

pers. comm., 2002, Bahamondes pers. comm., 2002, La Voz del Campo pers. comm., 2002].

The Game Theoretic Equilibrium

The important question at this point is what the obstacles to access to *both* existing water user associations (if one exists), and the cost and uncertainties embedded in the judicial system imply for the game presented above. If the following relationships between the players' preferences exist, and each player's preference order and the full history of the game is common knowledge, *the outcome will be to the benefit of A*. More precisely; if the preference order for both players is the following;

Water user A: DC $>_A$ CC $>_A$ DD $>_A$ CD
Water user B: CD $>_B$ CC $>_B$ DC $>_B$ DD

(where '$>_A$' means 'is preferred by A to', and so on), then when a more 'powerful' user than B starts to extract water which negatively affects B, *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 (DC $>_A$ CC and CD $>_B$ CC). But the important difference between the two users is that peasant farmers *will avoid a conflict thereby preferring to accept the violation*, that is an outcome advantageous to A. In other words, it seems highly reasonable to assume that *campesinos* will prefer to accept a violation than to initiate a costly, highly unpredictable, and probably non-beneficial judicial process. Let us look at the strategies available in the game presented earlier, but this time in normal form.

As described by Figure 3, A makes the first choice, and B has four possible strategies: (i) always cooperate or (ii) always defect independently of what A does, or (iii) do the same or (iv) do the opposite of A. The Nash equilibrium in this game is DC. *Thus, the characteristics of the game defined by the market's institutional framework, and the fact that water users are highly heterogeneous in terms of social and economic power, make it very costly and irrational for poor water users to report violations of their water rights. This is a fact not considered by experts and governmental agencies.*

Could not these inherent deficiencies in the judicial system and the Chilean water user associations, be used by peasant farmers to steal water from wealthier water users? Stealing of water among peasant farmers, and by industrial agriculture during critical drought periods is a widely recognised fact [*Bahamodes pers. comm., 2002; Puig pers. comm., 2002; Bauer pers. comm., 2002*]. There are, however, several characteristics of the game and of

FIGURE 3
DYNAMIC WATER MARKET GAME IN NORMAL FORM

		Player B			
		Always C	**Always D**	**Same as A**	**Opposite of A**
Player A	**C**	2,2	4,1	2,2	4,1
	D	1,3 *	3,4	3,4	1,3 *

Note: A is an urban water company and B a group of peasant farmers. A makes the first choice, and B has four possible strategies: always cooperate, always defect, do the same as A or do the opposite to A. The values 1 to 4 represent the most to the least preferred outcomes. By convention the first pay-off refers to player A and the second pay-off refers to player B. (*) Nash equilibrium in pure strategies.

richer users – such as industrial agriculture and urban water companies – which makes this theft unlikely.

First, these water users have considerably more economic resources than other users. This implies that they have the possibility to challenge this break from the status quo by taking the case to court, and paying for lawyers and technical studies. The costs involved are sufficient to deter any group with limited financial assets. Less wealthy natural resource users are thus in game theoretic terms more risk averse and have a much weaker bargaining position [*Elster, 1989: 80ff; Knight, 1992: 126ff*].

Second, both industrial agriculture and urban water companies are considerably better organised than rural NGOs. As for industrial agriculture, their organisation *Sociedad Nacional de Agricultura* is considered the most powerful NGO in Chile [*Gómez, 2001; Gómez and Echeñique, 1988: 213–7]*.

Third, big agriculture tends to dominate one key institution in the resolution of water conflicts: the water user associations [*Bahamondes pers. comm., 2002; Puig pers. comm., 2002; Cancino pers. comm., 2002; Bauer, 1998: 67*].

These characteristics make the stealing of water by the poor from wealthier users highly unlikely, and in game theoretic terms, non-credible [*Kilgour and Zagare, 1991: 307–8*].

Implications

What does this mean in practice? I would argue that the predicted equilibrium implies five important things:

First, infringing the water rights of poor water users, such as peasant farmers, will not be reported to any of the organisations responsible for the

solution of these conflicts. Information about these cases will therefore be hard to find without extensive field studies. This explains why evidence of water violations against underprivileged users is anecdotal and dispersed. *This is, again, 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 a logic to the violations of the rights of underprivileged water users. More precisely, all the cases presented in Figure 1 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 of the actor that can pose a credible threat given the structure of the game, and the characteristics of the players.

Third – and as a result of the above – any person, group or organisation that can credibly declare that they can afford a conflict in court can easily exploit the structure of the 'game'. Whether this threat is credible has to do with the economic resources available for lawyers, technical studies etc. In other words, anyone with enough economic resources and knowledge about the water market and thus the 'game', *has theoretical access to 'free water'*. Let us put ourselves in the situation of a relatively wealthy group or company C 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 C is located. Estimates show that the price of 1 litre of water per second lies between 100,000 and 15 million pesos ($145 to $21,400 USD) [*Chileriego, 2000*].
(2) *Increase water efficiency*. In a case where group C 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 of stealing water from underprivileged water users. The risk of, for example, *campesinos* taking the case to court is minimal. The cost of losing such a case is denoted c_s.

Thus, if group C estimates that the expected cost of conflict (that is the probability p_c times the cost c_s) is as low as claimed earlier, the stealing of water will be rational (profitable) when

$$p_c \times c_s < c_e,\ c_b$$

that is, when the probability of paying the cost in a conflict is lower than other alternatives. This mechanism is clearly present in both the cases discussed. As for the real estate investor in Las Pataguas, it was probably more profitable to force peasant farmers off their plots by diverting their water with a minimum risk of facing a costly case in court, than to pay the market price

for their plots. The same most likely applies to all the cases presented in Table 1.

Fourth, the model implies that information is part of the problem rather than the solution. That is, the more underprivileged communities know about the deficiencies in the judicial system, the cost of defending a case, and how other underprivileged communities have fared in earlier water conflicts settled in court, the more they will avoid the judicial system. This means that *current attempts by governmental agencies to inform campesinos about their water rights and the judicial system* [for example *INDAP, 1998*] *will not have the intended effect*.

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 [Lee and Jouravlev, 1998: 22; Rosegrant and Gazmuri, 1994]*. Rather the important issue seems to be to deal with the deficiencies in the institutions intended to support the market, and the underprivileged water users' perception of the judicial system.

Part III
Government or Market Failure? Possible Objections

Similar effects of the rich taking water away from the poor could probably be found around the world under many public and community allocation systems. Critics would thus argue that the introduction of a market under ideal circumstances might even *reduce* the likelihood that powerful interests will take more than their share of water, because there is at least the option to buy out poorer water right holders.

This objection is undeniably relevant, but it disregards that central aspects of the game are *market specific*. First, the institutions in which the market in the end must be embedded exclusively determine the structure and outcome of the game. The fact that the market model relies heavily on the judicial system, and decentralised conflict resolution in water user associations, is a key determinant for the outcome of the game. Once it is recognised that the legal system frequently is a highly imperfect and expensive institution for resolving environmental disputes, the case for FME and water markets is weakened.

Second, the fact that natural resource users consistently – and especially in developing countries – are highly heterogeneous in economic and social power, and thus have highly unequal access to key conflict resolution arenas, makes this problem even more serious. In game theoretic terms, users with a credible threat and high breakdown values, that is wealthy users, are provided with a highly advantaged position. This too is a specific result of the market model with its unique and heavy reliance on decentralised conflict resolution.

Third, the creation of a market not only provides water users with information on increasing demand and prices [cf. *Arrau Corominas, 1998; Alicera et al., 1999: 16*] but also radically reduces uncertainty about how much there is to be gained by a defection. That is, a market provides rational actors not only with the information needed to efficiently allocate water resources through the market, but also with information on exactly how much there is to be gained from violating underprivileged users' water rights, which makes defection more probable [cf. *Baland and Plattau, 1996: 45*].

Concluding Remarks

Underprivileged water users in Chile are especially vulnerable to violations of their acknowledged water rights. The main reason is, as a proponent of FME bluntly puts it: 'like it or not, individuals will undertake more of an activity if the costs of that activity are reduced; this holds as much for bureaucrats as it does for profit-maximizing owners of firms' [*Anderson and Leal, 1991: 10*]. That this has not been considered thoroughly in the discussion of the pros and cons of the Chilean water market is surprising, but understandable given the limited focus of earlier studies.

What do the results imply for countries that are in the process of modifying their water regimes? Policy makers should be aware that the following determine the characteristics of the 'game', and thus negatively affect underprivileged users in particular: 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 NGOs; non-existent or marginalising water user associations; and formalistic and slow governmental agencies that unintentionally inhibit the legal protection of underprivileged water users' rights and organisations.

It is hard to see how any water market that does not consider these key aspects – independently of the efficiency and number of transactions – can be expected to effect socially sustainable water management.

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