The Distributive Impact of the Water Market in Chile:
A Case Study in Limarí Province, 1981 - 1997

DONATO ROMANO[‡] – MICHEL LEPORATI[†]

ABSTRACT: The introduction of a strong market-oriented economic policy after the 1973 *golpe* in Chile led to economic reforms during the 1980s, characterised by deregulation, decentralisation and privatisation of several economic sectors. The reform of the water sector took place as part of this trend. Its overall objective was to increase water-use efficiency, implementing a private management model based on the development of water markets.

The model represents the most profound reform that has ever been carried out worldwide in this sector, due to its radical neo-liberal conception and to its duration (in force since 1981). Many studies have been carried out focusing mainly on the efficiency impact of the reform but no one on its distributive effects. This paper aims to fill this gap. The case study (Limarí Province, IV Region) examines the distributive impacts on the relevant population (in particular on the poor and the most vulnerable groups, like peasants) through the analysis of all water use rights transactions which have taken place in the area from 1981 to 1997, and the determinants of peasants' participation in water market, using survey data from a significant sample (2.4%) of peasant households in the area.

The study shows that the distribution of water rights has worsened since 1981. Namely, peasants' share of water rights decreased significantly as time went on, both in aggregate and per capita terms, undermining their agricultural production potential and leading to a deterioration of their standards of living. Moreover, the share in water rights by the agricultural sector as a whole decreased, while that by non-agricultural sectors increased.

The study shows also that peasants access water resources primarily through the claim of original rights and enter only marginally the water market, usually as sellers, showing a weak bargaining power. Their behaviour in the water market is determined by well identified social, economic and institutional variables, such as the age of the head of household, the educational level of the family, the participation in agricultural organisations, the managerial positions in water users' associations, the access to information in local water market, the access to credit and the crop mix.

1. INTRODUCTION

Market-oriented economic policies, set up in Chile after the 1973 *golpe*, became most evident at the beginning of the 1980s, through a series of structural reforms, characterised by trade liberalisation, privatisation of public enterprises, deregulation of several markets and decentralisation of various economic sectors (Scott, 1996). The water market reform[1] took place within this setting, aiming at increasing water-use efficiency through the creation of a private water market.

This model is particularly interesting, since it represents the deepest reform ever carried out in this sector, due to its radical neo-liberal conception and duration (it has been in force since 1981). Many studies have been carried out analysing the efficiency performances of the

---

[‡] Department of Agricultural and Land Economics, University of Florence, Italy.
[†] Instituto Nacional de Desarollo Agropecuario, Santiago de Chile.
[1] The reform has been implemented through the issue of the Water Code (DFL n. 1112 of 1981, see Código de Aguas, 1981), that established private rights on water, rules for the use of inland waters, operational rules of water users organisations, etc.

private management model (Hearne and Easter, 1995 and 1997; Ríos and Quiroz, 1995; Thobani, 1995; Bauer, 1997), but no one has focused on the distributive impact of the water reform. The present study aims to fill this gap, analysing the case of Limarí Province, in the IV Region of Chile. The case study examines: (*i*) the distributive impact of the water market on the involved population (with emphasis on the poorest sectors and on those whose subsistence is mainly dependent on access to water, such as the case of peasants), through the analysis of all water rights registrations and market transactions which have taken place in the area from 1981 to 1997, and (*ii*) the determinants of peasants' participation in the water market, using original data from a survey carried out in the area in 1998.

The paper is organized as follows: section 2 provides a brief review of literature on private water markets; section 3 submits the analysis of the distributive impacts of the reform, both at intra- and inter-sectoral levels; section 4 presents the analysis of the determinants affecting peasants' participation in the water market; and section 5 summarizes the main findings of the study.

2. THE WATER MARKET IN CHILE

According to the 1981 reform, water is a public good, whose exploitation is left to private economic agents through a system of transferable water rights[2]. To comply with this, private ownership and perfect divisibility of water-use rights have been established, water registers created within the "*Conservadores de Bienes Raices*", and a legal framework (procedures, etc.) for the judicial system has been set up.

As a result, water resources allocation is left to the interplay of demand and supply. The state guarantees the functioning of the system by simply establishing the 'rules of the game' with which all parties must comply (Ríos and Quiroz, 1995; Bauer, 1997).

2.1. Efficiency effects

According to Hearne and Easter (1997), private water markets are more efficient than public provision of water since they provide incentives for:
- concentrating resources in higher-value uses;
- a more rational use and conservation of resources;
- public budget savings, since private economic agents will directly make at least part of the required investments.

The most positive assessments of the Chilean experience are the ones by Gazmuri (1994), who argues that the water market has led to a more efficient water allocation, and by Holden and Thobani (1995), who argue that the Chilean experience has proven that private markets are more efficient than public provision whenever water resources are scarce, infrastructures satisfactory (or conditions for their development exist), institutional competencies available, and the relative law framework has been set up.

Ríos and Quiroz (1995) also argue that the model has worked relatively well in Chile, especially where water is scarce and infrastructure more flexible. However, the authors stress the existence of regulatory, physical and environmental constrains that limit further development of private markets.

---

[2] The owner of a water-use right can freely use the resource, provided that he complies with existing laws. From an economic point of view, the main characteristics of water rights are: (*i*) they are 'real' rights, (*ii*) they are divisible; (*iii*) they can be mortgaged; (*iv*) their ownership does not imply obligation or priority in use.

More recently Bauer (1997) contends that the model has worked more as an incentive towards investments than as an effective transaction institution. This is due to some inconsistencies in the water code that limited transactions, especially between different sectors. According to the author, the main advantage of the market is higher flexibility in water ownership, use and management (for instance, through water users organisations).

Peña and Retamal (1992) have a different opinion, emphasizing the lack of perfect competition conditions in Chilean water market, due to spatial and time imperfections, like market power, constrains on resource mobility, asymmetric information, etc.

According to Barrientos (1995), the low number of transactions proves the absence of perfect competition. Bauer (1997) reports that local technicians and experts maintain the same argument. However, Ríos and Quiroz (1995) argue that it is incorrect to assess the existence of competition taking into consideration only the number of transactions, since competition is influenced, among other factors, by the distribution of original water rights: a low number of transactions represents only a rough proxy of competition in a very heterogeneous context and does not clearly reflect the variability of different situations characterised by the areas with a very dynamic market and the areas where the market does not work.

In conclusion, most authors agree that the advantages of the water market exceed its disadvantages. In particular, Hearne and Easter (1997), in a case study carried out in the same area of the present research, conclude that at least in the Limarí valley[3] water rights transactions have led to consistent gains from trade, averaging 3.4 times the value of each water share coming from the Cogotí reservoir.

2.2. Distributive impacts

In principle, if conditions of perfect information, free access and good technical assistance exist, farmers should not have problems in entering the water market. However, many authors (Barrientos, 1995; Ríos and Quiroz, 1995; Bauer, 1997) reported a loss of water rights by many farmers due to their poor knowledge of the new regulations and/or lack of financial resources required to enter the process of water rights claim. This is why the *Direccíon General des Aguas* is trying to target its current share on the most vulnerable groups.

According to Gazmuri (1994) and Thobani (1995) the water market should alleviate poverty through trickle-down effects: the market provides incentives for the use of water in more efficient activities, which in turn lead to higher employment rates and incomes that improve quality of life. On the other hand, Gazmuri (1994) stresses that in the past the building of under-utilised infrastructures, the distortion of water prices, and the public mismanagement of water resources had been financed through taxation, often draining resources from the poorer sectors to the wealthier ones: the water market should therefore save resources which may be utilised by the government for income redistribution.

Ríos and Quiroz (1995) and Bauer (1997) do not share the same optimistic view: according to these authors the water market in Chile has mainly caused negative distributive impacts, especially in rural areas. Farmers have indeed had only marginal access to the potential benefits of the model, usually entering the market as sellers, with a weak bargaining

---

[3] However, it should be stressed that the Limarí valley is characterised by peculiar conditions, e.g. relatively low transaction costs (approximately 0.02% of the value of the transaction for buyers and 0.05% for sellers) and good infrastructures that favour water rights transactions (such as the presence of the Cogotí reservoir, water intakes provided by flow gauges and well organised water users organisations).

power. Hearne and Easter (1995) also show a certain degree of concern for the distributive effects of the water markets. Referring to the Limarí valley, they state that their research

> 'has demonstrated that the market transfer of water-use rights does produce substantial economic gain-from-trade. These economic gains occur in intersectoral trades and in trade between farmers, and they produce rents for both buyers and sellers. Yet buyers, especially large table-grape producers (…), receive higher rents than sellers' (Hearne and Easter, 1995: 38)

In summary, several authors claim that the water market reform in Chile has had negative distributive impacts, namely those on the poorer and more dependent on water resources for their subsistence, such as peasants. This result is not accidental and it fits into the wider Chilean growth model characterized by a dramatic widening of the gap between the poor and the rich in the last 20 years[4]. Therefore some authors have defined such process as 'exclusionary growth' (Carter and Barham, 1996).

This is where this research starts from: we want to analyse whether the water market reform has had any distributive impact and to identify the determinants that affect peasants' participation in the market itself. The study area is the valley of the Limarí river (IV Region), in the northern part of the country. It was chosen because:

- it has been already studied (Hearne and Easter, 1995 and 1997) under the perspective of the efficiency effects of the water market and such studies reported the existence of a very active water market;
- agriculture in the region is highly representative of the national context (Agraria, 1996).

3. DISTRIBUTIVE IMPACTS OF THE WATER MARKET

The distributive impacts of the water market have been studied through the analysis of all registrations[5] (original registrations and transfers) of rights among agents, at an intra-sectoral and inter-sectoral level, which took place between 1981 and 1997 in Limarí Province.

---

[4] Londono and Szekely (1997) argue that income distribution in Chile has consistently worsened from 1971 to 1989 (Gini's coefficient increased from 0.47 in 1971, to 0.53 in 1980, and 0.59 in 1989 and has then slightly decreased at the beginning of the 1990s, reaching 0.57 in 1994). On the other hand, Ferreira and Litchfield (1999: 529), though admitting that 'Chile's inequality is high compared to international standards and has remained unchanged between 1987 and 1994', point out how 'inequality scalar measures – such as Gini's coefficient and Theil's index – remained practically unchanged during the examined period and there is no statistical evidence of dominance according to Lorenz, in the years considered in the sample'. In spite of the lack of scientific evidence, the Episcopal Conference reports evidence on the increase of inequality in Chile through a document of 1996 entitled *'¿Es Chile un país equitativo?'*. The document asserts that 'The present income distribution in our country should be a reason of shame for Christians (…) The distance between rich and poor has grown dramatically in Chile. An aware nation cannot accept this situation. Nor a modern country can tolerate these differences' (Comisión Nacional de Justicia y Paz, 1996: 24).

[5] The registration of water-use rights at the *Conservador de Bienes Raices* in Ovalle (CBR) is required by the law in order to prove the ownership of a right. Water rights ownership can be obtained through:

- the claim of 'original rights' by an entitled person to the *Dirección General de Aguas* (DGA) who, through an administrative act, makes the decision if the applicant has the right to the quantity of water he applied for;
- market transactions, that is transactions of rights among private agents through purchasing and selling;
- non-market transfers, that is transfers among private agents other than market transactions, like inheritance transfers, donations, etc.

3.1. Registrations[6]

The data show clearly that the water market is a very active institution in Limarí Province (Table 1): the number of registrations, excluding years when unusual factors have caused "abnormal" figures[7], shows an annual increment to the total (on average, almost 40 more registrations each year), of which over 84% consists of market transactions and the remaining are registrations not transacted in the water market (like original right claims, inheritances, donations) (Table 2).

Table 1. Registrations of water-use rights in the CBR of Ovalle, 1981-1997

Years	Total registrations (TR)		Non-agricultural sector registrations		Agricultural sector registrations					
					Totals		Capitalist agriculture		Peasant agriculture	
	n.	%	n.	% in TR	n.	% in TR	n.	% in TR	n.	% in TR
1981	506	37.02	76	25.85	430	40.07	109	24.12	321	51.69
1982	37	2.71	11	3.74	26	2.42	18	3.98	8	1.29
1983	21	1.54	15	5.10	6	0.56	3	0.66	3	0.48
1984	24	1.76	5	1.70	19	1.77	13	2.88	6	0.97
1985	59	4.32	21	7.14	38	3.54	15	3.32	23	3.70
1986	57	4.17	8	2.72	49	4.57	33	7.30	16	2.58
1987	48	3.51	25	8.50	23	2.14	14	3.10	9	1.45
1988	224	16.39	19	6.46	205	19.11	35	7.74	170	27.38
1989	37	2.71	18	6.12	19	1.77	9	1.99	10	1.61
1990	31	2.27	7	2.38	24	2.24	16	3.54	8	1.29
1991	28	2.05	4	1.36	24	2.24	18	3.98	6	0.97
1992	48	3.51	16	5.44	32	2.98	29	6.42	3	0.48
1993	87	6.36	17	5.78	70	6.52	65	14.38	5	0.81
1994	51	3.73	8	2.72	43	4.01	22	4.87	21	3.38
1995	37	2.71	11	3.74	26	2.42	21	4.65	5	0.81
1996	34	2.49	14	4.76	20	1.86	13	2.88	7	1.13
1997	38	2.78	19	6.46	19	1.77	19	4.20	0	0.00
Total	1,367	100.00	294	100.00	1,073	100.00	452	100.00	621	100.00
μ	80.41	100.00	17.29	21.51	63.12	78.49	26.59	33.07	36.53	45.43
$\mu*$	39.29	100.00	13.00	33.09	26.29	66.91	17.36	44.18	8.93	22.73

μ = average; $\mu*$ = average excluding 1981, 1988 and 1993.

Source: elaboration of original data, CBR of Ovalle.

The data show that peasant agriculture[8], capitalist agriculture and non-agricultural sectors differ markedly in terms of their own economic behaviour (Table 2). It seems there is a gradient moving from non-agricultural sectors at one end to peasant agriculture at the other end, passing through capitalist agriculture which lies in an intermediate position. Non-agricultural sectors are characterised by a strong (and ever increasing) involvement in market transactions vs. peasant agriculture. For example, non-agricultural sector agents have access to water rights mainly through markets transactions (86.05% of total non-agricultural

---

[6] Whatever the way of accessing a water right, the validation of legal ownership requires its registration in the CBR: under the term 'registrations' all items listed in the previous footnote, i.e. original registrations, markets transactions and non-market transfers are therefore considered.

[7] In particular, some years show values well above the average trend due to 'abnormal' factors. 1981, the year the new model was introduced, accounted for the highest number of demands for original rights. 1988, the year in which the election campaign for the constitutional plebiscite took place, and 1993, when the presidential elections took place, have both been years in which the 'political cycle effect' was evident, since Pinochet's government tried to buy off votes of certain political sectors (namely peasants) through the assignation of original rights. This is why in Table 1 the values of averages excluding such years are also included.

[8] The Chilean agricultural census defines peasant agriculture (*agricultura campesina*) as any farm that receives more than 50% of its revenue from agricultural activities which are carried out in farms not exceeding 12 hectares with 'basic irrigation' (this represents the 'standard' adopted under the agrarian reform that corresponds to the yield of one hectare of land under low intensity irrigation, within the basin of the Maipo river), and whose production is worth less than 54,250 million pesos (in 1997). Any other farm is considered as a capitalist farm. We will adopt the same distinction in this paper.

registrations, Table 2) while peasants mainly through the claim of original rights (81.63% of total peasant agriculture registrations, Table 2). Moreover, re-sales[9] of a given water right amount to 60.84% of total sectoral rights in the case of non-agricultural sectors vs. only 13.16% of total peasant agriculture rights.

Non-agricultural agents act mainly as buyers (28.57% of water rights total purchases vs. only 4.43 of total sales, Table 3) whilst peasants as sellers (16.78% of water rights total purchases vs. 62.82 of total sales, Table 3). Non-agricultural sectors show a certain degree of market power. This statement is supported, only indirectly, by different indicators[10]: (*i*) the ratio between purchasing prices and selling prices, averaging 0.91 in the non-agricultural sectors and 1.04 in the peasant agriculture sector; (*ii*) the water rights concentration index, equal to 1.60 registrations/individual in non-agricultural sectors and 1.15 among peasants; and (*iii*) the average number of water shares[11] per registration, around 16 shares in non-agricultural sectors vs. 7.5 in the peasant agriculture sector.

In conclusion, water market seems to be quite far from a perfectly competitive market. Peasant agriculture clearly suffers from the market power of other sectors. Moreover, despite owing roughly one third of irrigated land in the Province (Agraria, 1996), peasant agriculture is still plagued by problems of legal recognition of water-use rights, poor technological infrastructures, poor organisation and difficulties in accessing information[12].

Table 2. Characterisation of agents' behaviour in the water market per sector, 1981-1997

Characteristic	Non-agricultural sectors	Agriculture total	Capitalist agriculture	Peasant agriculture
Type of registration (% on total sector registrations)	Orig. registrations = 13.95 Market transactions=86.05	Orig. registrations = 56.28 Market transactions=43.72	Orig. registrations = 21.46 Market transactions=78.54	Orig. registrations = 81.63 Market transactions=18.37
Average registrations size (shares/registration)	16.24	12.24	15.55	7.48
Concentration index (registrations/individual)	1.59	1.44	1.60	1.15
Purchasing/selling ratio:				
- Registrations	1.94	0.90	1.80	0.48
- Prices	0.91	1.07	1.51	1.04
Re-sales (% on sales)	60.84	32.35	60.17	13.16

Source: elaboration of original data, CBR of Ovalle.

[9] Re-sales of the same right represent the most evident feature of an active market. Analysing such a phenomenon in the area (and considering only the first five re-sales of a given right) we found that on average a right has been re-sold after 3.75 years, with a strong increase in real price: the price ratio was 1.66 between the first and second re-sales and 1.74 between the second and third ones. It also should be emphasized that since 1992 nearly all transfers of water-use rights have not included transfers of land ownership.

[10] Indeed, the reported indicators can only be interpreted as *prima facie* indicators of market power. The rationale behind them is that if market power exists, the economic agent showing this characteristic should be able to impose higher prices when he acts as seller and/or lower prices when he acts as a buyer: this is why we computed the ratio of purchasing/selling prices per each sector. Moreover, the quantity of the exchanged commodity per agent should be on average greater in the case of an agent showing market power: this is why we also reported the water rights concentration index (number of registrations per individual) and the average number of water shares per registration.

[11] According to the Water Code (Código de Aguas, 1981), a water share corresponds to 1 l/s with 85% of irrigation security, varying in conditions of water scarcity. A water share is the 'measurement unit' of water rights.

[12] This emerged clearly from the comments made by many agents in the study area. See also section 4 for a quantitative assessment of the role of these variables in determining water market behaviour by economic agents.

Table 3. Intra-sectoral and inter-sectoral water rights transfers (% of the total), 1981-1997

Sales	Purchases				
	Total	Non- agricultural sectors	Agriculture total	Capitalist agriculture	Peasant agriculture
Capitalist agriculture	32.73	1.24	31.48	27.32	4.16
Peasant agriculture	62.82	25.93	36.89	25.52	11.37
Total agriculture	95.56	27.18	68.37	52.84	15.53
Non-agricultural sector	4.43	1.38	3.05	1.80	1.24
Total	100.00	28.57	71.42	54.64	16.78

Source: elaboration of original data, CBR of Ovalle.

3.2. Distributive effects on the whole population

The distribution of water rights (in terms of water shares) among the various groups has been very unbalanced since the inception of the reform: in 1981 the two higher quintiles (Q_4-Q_5) accounted for more than 80% of total the water rights (Table 4) and the Gini's coefficient[13] was 0.54. As time went on, the water rights distribution worsened: indeed, the three lowest quintiles showed a decrease in the number of water shares, while the quintile that originally held the largest percentage in water share holding increased its percentage, forming a consistent increase of the Gini's coefficient - which in 1997 was 0.57. On the whole there has been a general decrease of the per capita water volume, in all segments of population, which was caused by an increase in the number of users[14]. The quintiles Q_1-Q_3 are the most affected by these dynamics. In fact they have lost between one-fifth and one-third of the average volume held in 1981, while the two higher quintiles have lost only around one-tenth of the initial volume (Table 4).

Table 4. Distribution of per capita water rights (number of water shares), 1981-1997

Quintiles	1981		1987		1992		1997		% change 1981-1997	Difference in % change
	P.c. shares	% in total	P.c. shares	% in total	P.c. shares	% in total	P.c. shares	% in total		
1°	0.93	1.18	0.91	1.18	0.74	1.06	0.73	1.11	-21.62	-0.07
2°	3.52	4.49	3.29	4.30	2.65	3.79	2.33	0.01	-33.74	-4.48
3°	9.43	12.04	9.28	12.13	7.20	10.31	5.96	9.11	-36.83	-2.93
4°	16.91	21.58	16.90	22.08	16.31	23.36	15.27	23.35	-9.70	1.76
5°	47.57	60.70	46.16	60.31	42.93	61.48	41.12	62.86	-13.55	2.16
Total	15.67	100.00	15.27	100.00	13.97	100.00	13.06	100.00	-16.63	-
Gini coeff.	0.54		0.54		0.56		0.57			

Source: elaboration of original data, CBR of Ovalle.

It should be stressed that the impact of the decreases on the three lower quintiles is important not only in terms of the relative amount (i.e. percentage) of such decreases, but also because of the low absolute figures on which they occur (between 0 and 10 water shares per capita), thus undermining future farming activities[15], while the decreases in the higher quintiles take place on larger volumes (between 10 and 216 water shares per capita).

---

[13] The Gini coefficient was computed taking into account the owners of water rights as relevant population.

[14] The increase in the number of users is due to population growth, especially in urban areas, and the diffusion of fruit and vegetable crops in irrigated areas: the total number of users has grown from 141,000 in 1981 to 179,000 in 1997.

[15] Indeed, in the Limarí valley the control of water is a strategic determinant of agricultural development (Hearne and Easter, 1995; Agraria, 1996) and therefore of income attainments.

3.3. Distributive effects on peasant agriculture

Also in the case of peasant agriculture there is a clear worsening of water resources distribution during the examined period: the Gini coefficient increased consistently from 0.50 in 1981 to 0.58 in 1997 (Table 5).

Peasant agriculture shows a general and consistent loss of water resources (-83.37% in terms of per capita water shares, with the number of users decreasing from 10,360 in 1981 to 4,800 in 1997); only the highest quintile has been able to limit its loss[16] (-4.91%), while lower quintiles show remarkable losses (in particular Q_2 and Q_3), especially considering the modest volumes they owned in 1981 (Table 5).

Table 5. Per capita distribution of water rights among peasants (number of water shares), 1981-1997

Quintiles	1981		1987		1992		1997		% change 1981-1997	Difference in % change
	P.c. shares	% in total	P.c. shares	% in total	P.c. shares	% in total	P.c. shares	% in total		
1°	0.81	1.38	0.76	1.36	0.55	1.08	0.52	1.06	-35.85	-0.32
2°	2.70	4.58	2.25	4.03	1.40	2.75	1.26	2.57	-53.31	-2.01
3°	8.34	14.19	7.15	12.82	4.93	9.69	4.32	8.84	-48.16	-5.34
4°	15.50	26.36	15.70	28.16	13.76	27.04	12.88	26.34	-16.88	-0.01
5°	31.46	53.50	29.88	53.62	30.26	59.44	29.92	61.18	-4.91	7.68
Total	58.81	100.00	55.74	100.00	10.18	100.00	9.78	100.00	-83.37	-
Gini coeff.	0.50		0.51		0.56		0.58			

Source: elaboration of original data, CBR of Ovalle.

We are not able to say if the revenue from water sales by peasant households have had a positive effect on peasants livelihood[17]. We only have indirect information that show that the worsening of water resources distribution among peasants has been paralleled by the worsening of peasants' income distribution (Table 6): indeed, the poor[18] have increased by 150%, due to the increase of poor in Q_1 (from 38% to 66%) and owing to the fall to below the poverty line of peasants in Q_2 (nearly 30%). Though it is not possible to define a causal relationship between the loss of water-use rights and poverty (or vice versa), there is an evidently strong correlation between the two phenomena.

On the other hand this represents an empirical evidence that the market, when left to itself, though able to increase the general efficiency of the system, is not able to ensure an equitable distribution of resources and income (López, 1995; Londono and Szekely, 1997). In the specific case, it should be emphasized that the harsh liberalistic economic policy, promoted by the military government towards the peasants (aimed at leaving the market to select *elite* groups who are able to link themselves to the globalisation processes of the agricultural sector, and to free resources and channel them towards more efficient uses), has enabled the most socially and economically influential ones to exploit the opportunities offered by the market reform and gain most of its benefits.

---

[16] Indeed it increased its percentage in water share holding (7.68% over the whole period).

[17] For instance, giving them the opportunity for diversifying their own income sources and/or increasing other household income assets.

[18] From the point of view of socio-economic characterisation, all peasants are considered as *minifundistas*, i.e. small farmers who generally represent the most vulnerable groups of the rural sector (López, 1995). Among peasants we can classify as poor the so-called *sitieros*, i.e. former beneficiaries of the agrarian reform, whose plots do not exceed 1,500 m². The remaining peasants, known as *parceleros*, are not considered as poor: they are peasants whose farm does not exceed 12 hectares of 'basic irrigation'.

Table 6. Evolution of poverty among peasants (percentages), 1981-1997

Quintiles	1981		1987		1992		1997	
	Poor	*Non-poor*	*Poor*	*Non-poor*	*Poor*	*Non-poor*	*Poor*	*Non-poor*
1°	38.10	61.90	40.37	59.63	54.86	45.14	66.48	33.52
2°	0.00	100.00	10.00	90.00	25.00	75.00	29.36	70.64
3°	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
4°	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
5°	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
Total	10.22	89.78	13.33	86.67	20.26	79.74	25.21	74.79

Source: elaboration of original data and INDAP, 1996.

4. DETERMINANTS AFFECTING PEASANTS' PARTICIPATION IN THE WATER MARKET

The economic, social and institutional factors, which affect peasants' behaviour towards the water market (enter/not enter, buy/sell), were analysed using a logistic regression analysis. The data needed for the analysis were obtained through a survey carried out on 114 agricultural households[19], corresponding to 2.38% of peasants' irrigated farms in 1996 in Limarí Province.

4.1. Peasants' involvement in water market

The determinants affecting peasants' involvement in the water market have been analysed by estimating a logit model, whose dependent variable is the probability of entering the water market. The best model is a five-independent-variable model (Table 7), which has very high values of overall significance (χ^2=36.54 that for 5 degrees of freedom means a probability level higher than 99%) and statistically significant estimates of the coefficients (all asymptotic ts have a probability level greater than 95%).

The coefficients have all the expected signs. The variables MEDNI, OTRO and INF have negative coefficients, that means that the higher the educational attainment of the household, the participation in agricultural organisations and the level of information about the water market, the higher the probability of entering the water market. On the other hand, the variables JFED and PAS have a positive coefficient, i.e. the older the household head and the higher the values of the grazing areas, the higher the probability of not entering the water market.

---

[19] The sample was designed by using the information on the variability of farms' structural characteristics provided by the 1996 General Agricultural Census (INE, 1998). Therefore a random stratified sample was adopted.

Table 7. Logit model estimates for peasants' involvement in the water market transactions

Dependent variable	y=1 do not transact y=0 transact	
Degrees of freedom	5	
-2logl restricted	144.406	
-2logl non-restricted	107.865	
χ^2	36.541	
Percentage of correct forecasts	82.8%	
Variables	*Coefficients*	*Pr > χ^2*
Intercept	1.2146	0.0482
JFED: Age of household head	0.1989	0.0153
MEDNI: Household education attainment	-0.3258	0.0013
OTRO: Being member of agricultural organisations other than water users	-3.3168	0.0005
PAS: Farm grazing area	0.9293	0.0154
INF: Level of information about local water market	-3.3251	0.0290

4.2. Peasants' behaviour

The analysis of peasants' behaviour in the water market has also been carried out through the estimate of a logit model: the probability of selling a water right is determined by six variables, that are partly the same variables affecting the participation in the market (Table 8). The estimated model is statistically highly significant both in terms of its overall significance (χ^2=28.683 with 6 degrees of freedom, that is more than 99% of probability) and in terms of parameters estimates (all *t* statistics exceed 95% of probability).

The variables MEDNI, CRE, DIR, INF and ACC have negative signs, that means that the higher the household education attainments, the size of agricultural credit obtained, the participation as managers in water users associations, the owned volume of water, and the level of information about local water markets, the higher the probability of buying (and the lower the probability of selling) water use rights. Again, as the head of the household gets older, the probability of selling water use right becomes higher.

Table 8. Logit model estimates for peasants' behaviour in the water market

Dependent variable	y=1 sell y=0 buy	
Degrees of freedom	6	
-2logl restricted	73.325	
-2logl non-restricted	58.682	
χ^2	28.683	
Percentage of correct forecasts	87.6%	
Variables	*Coefficients*	*Pr > χ^2*
Intercept	0.1895	0.0918
JFED: Age of household head	0.0759	0.0321
MEDNI: Household education attainment	-0.0857	0.0119
CRE: Credit	-1.9503	0.0225
DIR: Being manager of water users associations	-1.3870	0.0293
ACC: Total number of water shares	-0.1358	0.0291
INF: Level of information about local water market	-7.5430	0.0009

5. CONCLUSIONS

A first conclusion of the present research is that water market has become a very active institution in the Limarí valley. However this does not mean that it is a competitive market; on the contrary, there are evidences that the market is highly imperfect, mainly because of

asymmetric information and of barriers to entry - as proven by the econometric estimates reported in tables 7 and 8 - due to social, cultural, economic, and institutional conditions existing among different agents.

The distribution of water resources is heavily unbalanced and it tended to worsen in the period of analysis. This is a long lasting phenomenon that dates back to years before the market reform (Londono and Szekely, 1997), but it worsened markedly between 1981 and 1997, because of the negative impact of the new institutional model. Such a period is characterised by two general trends: (*i*) a general decrease in the amount of per capita rights and (*ii*) the accumulation of resources by the most powerful social-economic groups.

If we contrast these trends with the socio-economic structure of the population, it becomes evident that peasants are the group that suffered the greatest loss. In the Limarí valley the control of water is a strategic determinant of agricultural development (Hearne and Easter, 1995; Agraria, 1996) and therefore of income attainments. This raises strong concerns because of the high level of poverty in the rural areas of the Province (World Bank, 1994; López, 1995). The consequence of the above mentioned trends are that the worsening of water resources distribution took place in a broader 'immiserising' context for a non-trivial part of peasant households.

Concerning the determinants affecting peasants' participation in the water market, it is interesting, from an institutional point of view, to consider the effect of the variables relative to information, education and participation in agricultural organisations and in water users associations. In short, the econometric analysis proves that the probability to transact in the water market decreases with the increase of poverty – meant primarily as lack of education and access to information rather than scarcity of resources and income. This emphasizes the potential role of government interventions in the training of human resources[20] and the promotion of adequate and accessible information for the whole population, in order to eliminate socio-cultural barriers and ensure equal opportunities to all agents.

Peasants' market behaviour (buy/sell) is largely determined by the same factors affecting the entry in the market. If we link this result with the increasing competitive pressure on peasants' resources and with the peasants' weak market power, we can conclude that the market behaviour is not a pondered decision concerning entering/not entering the market competition, but rather the consequence of a set of socio-cultural and institutional failures, which eventually forces peasants to sell.

The core of the discussion on the distributive effects of water market is not to be in favour or against the water market *per se*, but rather it concerns the absolute Government's abdication from its role as "referee" of the game, which is a consequence of the radically liberalistic cultural environment where the reform was designed and implemented, that prevented any form of public intervention, both in correcting market failures (informative asymmetries, just to mention the most evident in the Limarí valley), and in redistributing resources in favour of the most vulnerable groups of society.

In conclusion, we must say that, even in the case of the water market, the strategic objective of 'growth with equity' formally pursued by the *Concertaciòn* democratic Governments ever since 1990, has not been achieved, since water resources distribution kept on its negative trend during the 1990s.

---

[20] López (1995), studying the causes of poverty and of income differentials in Chile, tests various hypotheses (quality of human capital, technological level, market imperfections, infrastructural deficiencies) and proves that the low quality of human capital is the main determinant of poverty.

REFERENCES

Agrarian, 1996. "Informe final de la situación de la agricultura campesina". Report for INDAP. Santiago de Chile. October (mimeo).

Barrientos, C., 1995. "La situación del riego en Chile desde la perspectiva de la gestión del agua". Report presented at the seminar "Transferencias de sistemas de riego a los usuarios". Riobamba, Ecuador. November 1995.

Bauer, C.J., 1997. Bringing Water Markets Down to Earth: The Political Economy of Water Rights in Chile, 1976-95. *World Development* 25(5): 639-56.

Carter, M.R., and Barham, B., 1996. Level Playing Fields and Laissez Faire*: Post-Liberal Development Strategies in Inegalitarian Agrarian Economies. *World Development* 24(7): 1133-1150.

Código de aguas, 1981. *Código de Aguas DFL 1122 del 29 de octubre de 1981 de la República de Chile*. Santiago de Chile: Editorial Jurídica.

Comisión Nacional de Justicia y Paz, 1996. "¿Es Chile un país equitativo?". Area Pastoral Social de la Conferencia Episcopal de Chile. Santiago de Chile. January, 1996.

Easter, W.K., 1994. *"*The World Bank's Water Resources Policy". In Le Moigne, K., and Easter, W.K., (eds.). "Water Policy and Water Markets: Selected Paper and Proceeding from the World Bank's Ninth Annual Irrigation and Drainage Seminar. Annapolis, Maryland, 1992". World Bank Technical Paper 249: 11-16. Washington, D.C.

Ferreira, F.H.G., and Litchfield, J.A., 1999. Calm After Storms: Income Distribution and Welfare in Chile, 1987-1994. *World Bank Economic Review* 13(3): 509-38.

Gazmuri, R. 1994. "Chile's Markets-Oriented Water Policy: Institutional Aspects and Achievements. In Le Moigne, K., and Easter, K., W., (eds.). "Water Policy and Water Markets: Selected Paper and Proceeding from the World Bank's Ninth Annual Irrigation and Drainage Seminar, Annapolis, Maryland, 1992". World Bank Technical Paper 249: 65-78. Washington, D.C.

Hearne, R.R., and Easter, W.K., 1995. "Water Allocation and Water Markets: An Analysis of Gain-From-Trade in Chile". World Bank Technical Paper 315. Washington, D.C.: The World Bank.

Hearne, R., and Easter, K.W., 1997. The Economics and Financial Gains from Water Markets in Chile. *Agricultural Economics* 15: 187-199.

Holden, P., and Thobani, M., 1995. Tradable Water Rights: A Property Right Approach to Resolving Water Shortages and Promoting Investment. *Cuadernos de Economía* 97(dec): 263-89.

INDAP, 1996. "Programa Regional Operativo IV Región". INDAP IV Región. La Serena. (mimeo).

INE, 1998. "Superficie regada en el año agrícola 1996/97". Instituto Nacional de Estadísticas, Censo Agropecuario 1996. Santiago de Chile.

Londono, J.L., and Szekely, M., 1997. "Persistent Poverty and Excess Inequality: Latin America During 1970-1995". Office of the Chief Economist, Inter-American Development Bank. Washington, D.C.

López, R. 1995. "Determinants of Rural Poverty: A Quantitative Analysis for Chile". Report prepared for the Technical Department, Rural Poverty and Natural Resources, Latin America Region, World Bank. Washington, D.C., 2 June 1995.

Peña, H., and Retamal, U., 1992. "Ventajas y limitaciones del mercado en la asignación de derechos de agua". Paper presented at "CIPMA 4° Encuentro Científico Sobre el Medio Ambiente". Santiago de Chile.

Ríos, M., and Quiroz, J., 1995. "The Market of Water Right in Chile: Major Issues". World Bank Technical Paper 285. Washington, D.C.: The World Bank.

Rosengrant, M.W., and Gazmuri, R., 1995. "Reforming Water Allocation Policy Through Markets in Tradable Water Rights: Lessons from Chile, Mexico and California". Environment and Production Technology Division Discussion Paper 6. International Food Policy Research Institute. Washington, D.C.: The World Bank.

Scott, C, 1996. "The Distributive Impact of the New Economic Model in Chile". In Bulmer-Thomas, V., (ed.). *The New Economic Model in Latin America and its Impact on Income Distribution and Poverty*. London: McMillan.

Thobani, M., 1995. Formal Water Markets: Why, When, and How to Introduce Tradable Water Right. *The World Bank Research Observer*. 12 (2): 161-79.

World Bank, 1994. "Chile - Strategy for Rural Areas: Enhancing Agricultural Competitiveness and Alleviating Rural Poverty" Grey Cover Report No. 12776-CH, Latin America and the Caribbean Region. Washington, D.C.: The World Bank.

World Bank, 1997. "Chile – Poverty and Income Distribution in a High Growth Economy: 1987-1995". Grey Cover Report 16377-CH, Latin America and the Caribbean Region. Washington, D.C.: The World Bank.